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Report and papers presented at the

SECOND WORKSHOP ON FISH TECHNOLOGY, UTILIZATION AND QUALITY ASSURANCE IN AFRICA

Agadir, Morocco, 24–28 November 2008

Rapport et documents présentés au

DEUXIÈME ATELIER SUR LA TECHNOLOGIE, L'UTILISATION ET L'ASSURANCE DE QUALITÉ DU POISSON EN AFRIQUE

Agadir, Maroc, 24-28 novembre 2008

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PREPARATION OF THIS DOCUMENT

This document contains the report and papers of the second Workshop on Fish Technology, Utilization and Quality Assurance in Africa. The workshop was held at Le Village de l'électricien COS/ONE in Agadir, Morocco, from 24 to 28 November 2008. It was attended by 24 experts who reviewed the progress in post-harvest fish utilization, with particular attention to fresh fish handling, fish processing, quality assurance, marketing and socio-economic issues. The meeting included:

- presentation by the secretariat of a report on the progress and events since the first FAO Workshop on Fish Technology, Utilization and Quality Assurance in Africa held in Bagamoyo, Tanzania, in 2005;
- presentation of 22 papers selected by the screening panel. This panel was established by the technical secretariat following a call for contributions launched a year before the meeting which recorded 31 papers of experts; and
- a field trip to the port of Agadir (fish auction and jetty) and to the Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM).

During the discussions a number of recommendations were made to FAO, its member countries and to all institutes involved in fish utilization in Africa.

The workshop was organized by the Fish Utilization and Marketing Service (FIIU) of FAO's Fish Products and Industry Division, in collaboration with the CSVTPM, under the auspices of the Institut national de recherche halieutique (INRH) in Casablanca, Morocco. The workshop was funded by the Regular Programme of FAO.

The views expressed in this publication are those of the authors and do not necessarily reflect the views of FAO. The papers do not follow the FAO editorial guidelines: they appear as presented by their authors.

PRÉPARATION DE CE DOCUMENT

Ce document contient le rapport et les contributions du deuxième Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique. L'atelier, auquel assistaient 24 experts en technologie du poisson, s'est tenu du 24 au 28 novembre 2008 aux Village de l'électricien COS/ONE (Agadir, Maroc). Il a passé en revue les progrès dans l'utilisation du poisson post-capture avec une attention particulière à la manutention du poisson frais, à la transformation du poisson, l'assurance de qualité, la commercialisation et les aspects socioéconomiques. Ces questions étaient adressées à travers:

- la présentation par le secrétariat du rapport sur les progrès et événements depuis le premier Atelier de la FAO sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique qui s'est tenu à Bagamoyo (Tanzanie) en 2005;
- la présentation de 22 communications sélectionnées par le groupe d'experts chargé de les examiner. Ce groupe d'experts a été établi par le secrétariat technique suite à l'appel à contributions lancé un an avant la réunion et qui a enregistré 31 communications d'experts; et
- une visite de terrain au port d'Agadir (halle de criée et débarcadère) et au Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM).

Lors des discussions un certain nombre de recommandations ont été faites à la FAO, à ses pays membres et aux instituts impliqués dans l'utilisation du poisson en Afrique.

Cet atelier a été organisé par le Service de la commercialisation et de l'utilisation du poisson (FIIU) de la Division des produits et de l'industrie de la pêche de la FAO, en collaboration avec le CSVTPM, sous les auspices de l'Institut national de recherche halieutique (INRH) de Casablanca, au Maroc. L'atelier a été financé par le Programme régulier de la FAO.

Les opinions exprimées dans cette publication sont celles des auteurs et ne reflètent pas nécessairement celles de la FAO. Les contributions ne suivent pas les Directives éditoriales de la FAO: elles figurent telles que présentées par leur auteurs.

FAO.
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ABSTRACT

The second Workshop on Fish Technology, Utilization and Quality Assurance in Africa was organized by the Fish Utilization and Marketing Service of FAO's Fish Products and Industry Division in collaboration with the Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), under the auspices of the Institut national de recherche halieutique (INRH) in Casablanca, Morocco. The workshop reviewed progress in post-harvest fish utilization in Africa and made recommendations to FAO, its member countries and institutes interested in fish utilization in Africa. The experts reviewed in particular fresh or live fish handling, fish processing, post-harvest loss assessment, quality and safety, and marketing and socio-economic issues. The meeting included: a presentation by the secretariat of a report on progress and events since the workshop held in 2005, presentation of 22 papers and a field trip to the port of Agadir (fish auction and jetty) and to CSVTPM. The report includes the recommendations as well as the papers that were made available to the experts.

RÉSUMÉ

Le deuxième Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique a été organisé par le Service de l'utilisation et de la commercialisation du poisson de la Division des produits et de l'industrie de la pêche de la FAO, en collaboration avec le Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), sous les auspices de l'Institut national de recherche halieutique (INRH) de Casablanca, au Maroc. L'atelier a passé en revue les progrès dans l'utilisation du poisson post-capture en Afrique et fait des recommandations à la FAO, à ses pays membres et aux instituts intéressés par l'utilisation du poisson en Afrique. Les experts ont passé en revue notamment la manutention du poisson frais ou vivant, la transformation du poisson, l'évaluation des pertes post-captures, la sécurité sanitaire et la qualité, la commercialisation et les questions socioéconomiques. Cette révision s'est effectuée à travers la présentation, par le secrétariat, du rapport sur les progrès et événements depuis l'atelier qui s'est tenu en 2005, des présentations de 22 communications et une visite de terrain au port d'Agadir (halle de criée et débarcadère) et au CSVTPM. Le rapport inclut les recommandations de même que les communications qui ont été mises à la disposition des experts.

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ORGANIZATION

1. The second Workshop on Fish Technology, Utilization and Quality Assurance in Africa was organized by the Fish Utilization and Marketing Service, Fish Products and Industry Division of the Food and Agriculture Organization (FAO), in collaboration with the Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), under the auspices of the Institut national de recherche halieutique (INRH) in Casablanca, Morocco.

OPENING

2. The workshop was held at the Village de l'électricien COS/ONE, Agadir, Morocco, from 24 to 28 November 2008.

3. Dr Naima Bou-M'Handi, Chief of the CSVTPM, expressed her honour for welcoming Mr Habib Halila, FAO Representative in Morocco, to the ceremony, as well as for hosting the meeting in Morocco. She then expressed to all the participants her cordial message of welcome to Agadir. She also highlighted her conviction that the five days of debate would help in improving and strengthening the relationships within countries to dynamize the research in the fields of fish utilization and processing technology in Africa. She finally thanked FAO for the support which enabled the organization of the meeting and wished fruitful deliberations to the participants.

4. The workshop was addressed on behalf of the Director-General of FAO by Mr Habib Halila, FAO Representative in Morocco. He recalled the importance of fisheries in the socio-economic development of Morocoo and the dynamic role of the country in the region, which can be illustrated by the number of regional events/meetings hosted each year, three of which had been held over the past two weeks before the workshop. He introduced the rationale of the workshop, namely the need for better utilization justified by the context of fish supply, consumers' awareness in the safety and quality issues fuelled by the different foodborne outbreaks, the high post-harvest losses and the need to protect the environment. He made a special appeal on behalf of small-scale fishers, a large group of marginalized stakeholders. He mentioned that, as development agents, our interventions would have more impact if solutions were found to their problems. After having recalled FAO's past and present support in post-harvest fisheries, he highlighted the important agricultural programmes which have been accomplished and the ones that are conducted by the United Nations (UN) agencies in Morocco to assist not only the producer, but also to satisfy consumers' needs.

5. The workshop was then addressed by the Director of Cooperation and Legal Affairs Division of INRH, Mr Said Taleb. He recalled the importance of technology and utilization in linking socio-economic development and sustainable resource utilization and emphasized the availability of his institution to strengthen regional cooperation in fisheries.

6. The programme is presented in Appendix A.

PARTICIPANTS

7. The workshop was attended by 24 experts from Cameroon (1), France (2), Gabon (1), Ghana (1), Italy (1), Kenya (1), Morocco (7), Nigeria (1), Senegal (3), Seychelles (1), Tanzania (1), Uganda (2) and from FAO headquarters. Eight participants were females. The list of attending experts is presented in Appendix B.

NOMINATION OF MEETING OFFICERS

8. Dr Bou-M'Handi, INRH, Ms Ndiaye, Centre national de formation des pêches (CNFP), Mr Jallow, FAO Regional Office for Africa and Mr Sérot, École nationale d'ingénieurs des techniques des industries agricoles et alimentaires (ENITIAA), were the chairpersons, respectively, of the workshop from day 1 to day 4. The names of the selected rapporteurs of the different sessions are listed in Appendix A. Mr Jallow, Mr Blaha, Mrs Diei-Ouadi and Ms Loriente, from FAO, served as the technical secretariat of the workshop.

PROGRAMME

9. The experts reviewed the progress in the area of post-harvest fish utilization, technology and quality assurance, and made a series of recommendations. Emphasis was placed on fresh or live fish handling, fish processing, post-harvest loss assessment, quality and safety, and marketing and socio-economic issues. The meeting included:

- presentation by the secretariat of a report on the progress and events since the first workshop on Fish Technology and Quality Assurance in Africa held in Bagamoyo, Tanzania, in 2005. The participants accepted the report and the changes as presented.

- presentation of 22 papers selected by the screening panel. This panel was established by the technical secretariat following a call for contributions launched a year before the meeting which recorded 31 papers of experts; and

- a field trip to the port of Agadir (fish auction and jetty) and to the CSVTPM.

10. The papers are reproduced in Appendix C.

11. On the basis of the presentations and discussions, draft recommendations were prepared by the secretariat. These were discussed, amended and adopted by the experts in the final session of the workshop.

RECOMMENDATIONS

12. The experts adopted the following recommendations to FAO, its Africa member countries and institutes involved in fish utilization in Africa:

1. The progress on the recommendations made at the first workshop held in Bagamoyo in 2005 was presented and discussed. It was noted that the Regional Fish Safety Network had still not been established. The participants recommended that it be constituted before the next session in 2011 and Dr Sylla from Senegal was nominated as a coordinator to accelerate the process.

2. The participants noted the importance of the cooperative fish technology research effort in the region and its relevance for the expert workshops held every three years and recommended that the Secretariat sustain this effort at the national and regional levels.

3. A lot of effort had been put into the research activities presented, but it would be more valuable to consider cost benefit analysis of techniques, methods and target users in future research work to be presented to the experts.

Fresh fish

*4. A presentation on the effect of holding temperatures on the microbiological spoilage of African catfish "*Clarias gariepinus*", was discussed. It was noted that information on post-harvest characteristics of common freshwater species was inadequate. In view of the information gap, the Secretariat should provide guidelines to conduct a comprehensive study on some tropical freshwater species.*

5. As a follow-up to the study on improved live fish handling using cages, it was suggested that consolidated data on the trials be further compiled for eventual dissemination in countries using the same practice.

Processing

6. The use of fish by-products for human and animal use as a way of reducing the negative environmental effect of fish processing operations was well noted and the participants were encouraged to improve the process by using locally available enzymes.

7. In the discussion on Nile perch waste around Lake Victoria, it was suggested that the technique presented on production of edible products from fish by-products be adapted to this situation.

8. Cost effective solar drying of fish should be encouraged and research should be further improved to include its adoption by the end users.

9. It was encouraging to note further work on the improvement of fish smoking techniques that reduce fuelwood consumption and levels of harmful contaminants in the products. Further research should, however, be conducted on more species, expansion of production capacity and reduction of harmful materials on the end products.

10. Interdisciplinary research and collaboration with other related institutions on improvement of fish smoking and drying techniques should be encouraged in the region.

11. Considering the numerous challenges in fish smoking and drying in the region, the alternative techniques from other regions, such as Indonesia (low technology) and France (high technology), should be taken into account in the improvement initiatives.

*12. "*Rastrineobola argentea*" (Dagaa/Mukene/Omena) offers a good source of increasing fish protein consumption in the eastern and central parts of Africa and ways should be explored to improve the availability of good quality products from it. The promotion of the consumption of good quality products should be encouraged at the national level.*

Post-harvest loss assessment

13. The participants welcomed the fish loss assessment initiative of FAO in the region and noted the valuable results that contributed to knowledge on post-harvest losses. Therefore they recommended the dissemination of the tools developed and the extension of the assessments to African countries that were not part of the current programme.

Quality and safety

14. The presentation of the isoelectric focusing (IEF) fish species identification method offered the participants an additional means of identifying processed fish (semi-cooked products, breaded fish fingers and fillets) at the competent authority and private industry levels in the countries and should be encouraged in the region.

15. The importance of microbiologically safe water in fish processing cannot be overemphasized. Chlorination is the most common method of control. Its effectiveness increases when combined with other treatments, such as UV light. However, whenever chlorination is used in water treatment, residual chlorine levels should be measured in order to ensure compliance with the regulatory requirements.

16. Participants noted the scientifically established relationship between histamine levels and the level of hygiene at the processing and storage facilities. It was therefore recommended that hygiene levels be maintained in the facilities to avoid food safety lapses and consequent economic losses in the production of semi-preserved anchovies.

17. Participants were reminded of the opportunities arising from better utilization of bycatch and by-products and they were encouraged to add value or develop new products for market promotion.

18. Further research and development at regional and national levels should focus on the production of fish oils, as in the case of Seychelles (oils extracted from tuna heads). The value-addition should be complementary and should not compete with traditional practices such as fishmeal production.

Seminar on European Union (EU) market access

19. Market access conditions continue to be an issue for exporting countries in the region and the range of difficulties faced relates to "how" official guarantees are offered, as well as "what" are the particulars of these required guarantees. Therefore, the regulatory frameworks should reflect the realities of the countries, and the true capacity of monitoring and controlling the seafood value chain with limited governmental resources.

20. Countries should take into consideration the competitiveness and livelihood of stakeholders engaged in alternative markets that do not need the same level of official controls as the EU.

21. The exploration of cost-effective regulatory strategies based on a business-like environment, with the coparticipatory involvement of the fishery stakeholders, including the separation of policy, regulatory and service delivery functions within government, should be encouraged in order to ensure the sustainability of market access and income generation for the sector.

22. While not related to seafood safety issues, it is recommended that all countries in the region exporting to the EU be aware of the critical impact of the new regulation (EC) No. 1005/2008 of 29 September 2008 establishing a community system to prevent, deter and eliminate illegal, unreported and unregulated fishing (IUU).

23. Participants were reminded that from January 2010 all fisheries products imported into the EU, whether fresh, frozen or processed, would have to receive prior certification from the flag state (country where the vessel which caught them is registered) that the products were caught legally, and that the vessel concerned held the necessary licences or permits and quotas. The validated catch certificates provided by the flag state would have to accompany the fisheries products throughout the market chain.

24. Participants were urged to sensitize their respective authorities on the new developments in EU market access.

Marketing and socio-economic issues

25. Ecocertification in artisanal fisheries should not be seen as a replacement of good fisheries management practices by fisheries stakeholders, but should only be pursued as a profit increasing means.

26. Good initiatives on livelihood improvements for women mussel collectors was noted and encouraged by the participants. It was also suggested that the approach be shared with countries having similar fisheries and harvesters.

27. The commendable effort in using a post-harvest technological platform approach in addressing technical and sociocultural problems in artisanal fisheries in Chad was acknowledged as a positive development in artisanal fisheries in the region and should be promoted.

28. The participants noted the increased trend towards fresh fish consumption and recognized the need to improve fresh fish distribution through technical interventions, such as the use of better containers and proper use of ice.

29. The reduction of the environmental impact of shrimp trawling through the introduction of the bycatch reduction devices (REBYC) project was presented to the participants and its results were acknowledged as very positive for the shrimp fisheries in the region.

CLOSURE OF THE WORKSHOP

13. The next workshop on Fish Technology, Utilization and Quality Assurance in Africa will be held in November 2011 in Seychelles. The workshop was officially closed on 28 November 2008 by Dr Naima Bou-M'Handi following some remarks from Mr Alhaji Jallow, Senior Fisheries Officer, FAO Regional Office for Africa and the vote of thanks of the participants.

ORGANISATION

1. Le deuxième Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique a été organisé par le Service de la commercialisation et de l'utilisation du poisson de la Division des industries de la pêche de la FAO, en collaboration avec le Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), sous les auspices de l'Institut national de recherche halieutique (INRH) de Casablanca (Maroc).

OUVERTURE

2. L'atelier s'est tenu aux Village de l'électricien COS/ONE (Agadir, Maroc) du 24 au 28 novembre 2008.

3. Dr Naima Bou-M'Handi, Chef du CSVTPM, a exprimé son honneur d'accueillir aussi bien M. Habib Halila, Représentant de la FAO au Maroc à la cérémonie, aussi que la réunion au Maroc. Elle a ensuite exprimé à tous les participants son message cordial de bienvenue à Agadir. Elle a également souligné sa conviction que les cinq jours de la discussion aideraient à améliorer et à renforcer les rapports entre pays pour dynamiser la recherche dans les domaines de l'utilisation et la technologie de transformation de poisson en Afrique. Elle a finalement remercié la FAO pour l'appui qui a permis l'organisation de la réunion et a souhaité des discussions fructueuses aux participants.

4. M. Habib Halila, Représentant de la FAO au Maroc, s'est adressé à l'atelier au nom du Directeur général de la FAO. Il a rappelé l'importance de la pêche dans le développement socioéconomique du Maroc et le rôle dynamique du pays dans la région, qui peut s'illustrer par le nombre d'événements régionaux/de réunions organisés tous les ans, dont trois ont été tenus pendant les deux semaines précédant l'atelier. Il a présenté l'esprit de l'atelier, notamment le besoin d'une meilleure utilisation, justifié par le contexte de l'approvisionnement de poissons, la sensibilisation des consommateurs aux questions de sécurité sanitaire et de qualité suscitées par les différentes crises alimentaires, les pertes post-capture élevées et le besoin de protéger l'environnement. Il a lancé un appel spécial pour les pêcheurs à petite échelle, un grand groupe d'acteurs marginalisés. Il a mentionné que, en tant qu'agents de développement, nos interventions auraient plus d'impact si des solutions étaient trouvées à leurs problèmes. Après avoir rappelé l'appui passé et présent de la FAO dans la pêche post-capture, il a souligné les importants programmes agricoles qui ont été accomplis et ceux qui sont conduits par les agences de l'Organisation des Nations Unies (ONU) au Maroc pour aider non seulement le producteur, mais aussi satisfaire les besoins des consommateurs.

5. Le Directeur de la coopération et de la division des affaires juridiques de l'INRH, M. Said Taleb, s'est ensuite adressé à l'atelier. Il a rappelé l'importance de la technologie et de l'utilisation à associer le développement socioéconomique et l'utilisation durable des ressources et a souligné la disponibilité de son institution à renforcer la coopération régionale en pêches.

6. Le Programme se trouve à l'Annexe A.

PARTICIPANTS

7. Ont participé à l'atelier 24 experts du Cameroun (1), de la France (2), du Gabon (1), du Ghana (1), de l'Italie (1), du Kenya (1), du Maroc (7), du Nigeria (1), du Sénégal (3), des Seychelles (1), de la Tanzanie (1), de l'Uganda (2) et du siège de la FAO. Huit des participants étaient des femmes. La liste des experts se trouve à l'Annexe B.

DÉSIGNATION DES MEMBRES DU BUREAU

8. Dr Bou-M'Handi, INRH, Mme Ndiaye, Centre national de formation des pêches (CNFP), M. Jallow, Bureau Régional de la FAO pour l'Afrique et M. Sérot, École nationale d'ingénieurs des techniques des industries agricoles et alimentaires (ENITIAA), ont présidé l'atelier, respectivement, du jour 1 au jour 4. Les noms des rapporteurs des différentes sessions figurent à l'Annexe A. M. Jallow, M. Blaha, Mme Diei-Ouadi et Mlle Loriente de la FAO ont assuré le Secrétariat technique de l'atelier.

PROGRAMME

9. Les experts ont passé en revue les progrès dans le domaine de l'utilisation, de la technologie et de l'assurance qualité du poisson, et ont fait une série de recommandations. L'accent a été mis sur la manutention du poisson frais ou vivant, la transformation du poisson, l'évaluation des pertes post-capture, la sécurité sanitaire et qualité, la commercialisation et les questions socioéconomiques. Ces aspects étaient abordés à travers:

- la présentation par le secrétariat du rapport sur les progrès depuis le premier Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique qui s'est tenu à Bagamoyo (Tanzanie) en 2005. Les participants ont accepté le rapport et les changements tels que présentés;

- la présentation de 22 communications sélectionnées par le panel d'examen. Ce panel a été établi par le secrétariat technique suite à l'appel à contributions lancé un an avant la réunion et qui a enregistré 31 communications d'experts; et

- une visite de terrain au port d'Agadir (halle de criée et débarcadère) et les bureaux du CSVTPM.

10. Les contributions sont reproduites à l'Annexe C.

11. Sur la base des présentations et des débats un projet de recommandations a été préparé par le secrétariat; celles-ci ont été discutées, amendées et adoptées par les experts lors de la session finale de l'atelier.

RECOMMANDATIONS

12. Les experts ont adopté les recommandations suivantes à l'attention de la FAO, de ses pays membres et des instituts impliqués dans l'utilisation du poisson en Afrique:

1. Les progrès sur les recommandations faites au premier atelier tenu à Bagamoyo en 2005 ont été présentés et discutés. Il a été noté que le réseau régional de sécurité sanitaire n'était toujours pas établi. Les participants ont recommandé qu'il soit constitué avant la prochaine session en 2011 et Dr Sylla du Sénégal a été nommé en tant que coordinateur pour accélérer le processus.

2. Les participants ont noté l'importance de l'effort du programme coopératif de recherche en technologie du poisson dans la région et sa pertinence pour les ateliers d'experts qui se tiennent tous les trois ans, et ont recommandé que le Secrétariat pérennise cet effort au niveau national et régional.

3. Beaucoup d'effort a été mis dans les activités de recherche présentées, mais il sera plus bénéfique dans le travail futur à présenter aux experts, de considérer l'analyse coût et bénéfice des techniques, les méthodes et groupes d'utilisateurs.

Poissons frais

*4. Une présentation de l'effet de la température de conservation sur l'altération microbiologique du poisson-chat africain «*Clarias gariepinus*», a été discutée. Il a été noté une insuffisance d'information sur les caractéristiques post-capture des principales espèces d'eau douce. Pour plus d'information dans ce domaine, le secrétariat devra fournir des lignes directrices pour entreprendre une étude complète sur certaines espèces tropicales d'eau douce.*

5. Comme suite à l'étude sur l'amélioration de la conservation du poisson vivant à l'aide de cages, il a été suggéré que des données consolidées sur les essais/expérimentations soient poursuivies pour une éventuelle diffusion dans les pays ayant la même pratique.

Transformation

6. L'utilisation des déchets de poissons pour l'usage humain et animal comme une façon de réduire l'effet néfaste sur l'environnement des opérations de transformation de poissons a été bien notée et les participants ont été encouragés à améliorer le procédé d'hydrolyse enzymatique par l'utilisation d'enzymes disponibles localement.

7. Dans la discussion sur les co-produits de la perche du Nil autour du lac Victoria, il a été suggéré que la technique présentée sur la production des produits comestibles provenant des déchets de poissons soit adaptée à cette situation.

8. Le séchoir solaire efficace et rentable de séchage du poisson devrait être encouragé et la recherche encore améliorée pour tenir compte de son adoption par les utilisateurs finaux.

9. Il a été encourageant de noter le travail sur l'amélioration des techniques de fumage de poissons qui réduisent la consommation de bois combustible et le niveau des contaminants nocifs dans les produits.

Cependant, plus de recherche devrait être conduite sur davantage d'espèces, l'expansion de la capacité de production et la réduction de contaminants sur les produits finis.

10. La recherche et la collaboration interdisciplinaires avec d'autres institutions similaires sur l'amélioration des techniques de fumage et séchage du poisson devraient être encouragées dans la région.

11. Vus les nombreux défis dans le fumage et séchage de poisson dans la région, les techniques alternatives d'autres régions, par exemple, Indonésie (basse technologie) et France (technologie de pointe) devraient être prises en considération dans les initiatives d'amélioration.

12. «Rastrineobola argentea» *(Dagaa/Mukene/Omena) offre une source croissante de protéine de poisson dans l'alimentation des zones orientales et centrales de l'Afrique et les moyens devraient être explorés sur l'amélioration de la disponibilité des produits de bonne qualité qui en sont issus. La promotion de la consommation de produits de bonne qualité de cette espèce devrait être encouragée au niveau national.*

Évaluation des pertes post-capture

13. Les participants se sont félicités de l'initiative d'évaluation des pertes post-capture de la FAO dans la région et ils ont noté les bons résultats qui ont contribué à la connaissance sur les pertes post-capture. Ils ont donc recommandé la diffusion des outils développés et l'extension des évaluations aux pays qui ne faisaient pas partie du programme précédent.

Qualité et sécurité sanitaire

14. La présentation de la méthode d'identification d'espèces de poissons de focalisation isoélectrique (IEF) a offert aux participants des moyens additionnels d'identification du poisson traité (semi cuit, bâtonnets et filet de poisson pané) par l'autorité compétente et l'industrie privée dans les pays, et cela devrait être encouragée dans la région.

15. L'importance de l'eau microbiologiquement saine dans le traitement de poissons ne peut être sous-estimée. La chloration est la méthode de contrôle la plus utilisée. Son efficacité augmente lorsqu'elle est combinée à d'autres traitements, tels que la lumière UV. Cependant, quand la chloration est employée dans le traitement de l'eau, les niveaux résiduels de chlore doivent être mesurés afin d'assurer la conformité aux normes réglementaires.

16. Les participants ont noté le rapport scientifiquement établi entre les niveaux d'histamine et le niveau de l'hygiène dans les installations de traitement et de stockage. Il a été donc recommandé que les niveaux d'hygiène soient maintenus dans ces installations pour éviter des problèmes de sécurité sanitaire et des pertes économiques conséquentes dans la production des semi-conserves d'anchois.

17. L'opportunité d'une meilleure utilisation des captures accessoires et des co-produits a été rappelée aux participants et ils ont été encouragés à ajouter de la valeur ou à développer de nouveaux produits pour la promotion du marché.

18. Plus de recherche et développement aux niveaux régional et national devrait se concentrer sur la production d'huiles de poisson comme dans le cas des Seychelles (huiles extraites des têtes de thon). La valeur ajoutée devrait être complémentaire et ne devrait pas être en compétition avec les pratiques traditionnelles telles que la production de farine de poisson.

Conférence sur l'accès au marché de l'Union européenne (UE)

19. Les conditions d'accès au marché continuent d'être un problème pour les pays exportateurs de la région et la série de difficultés rencontrées se rapportent tant à «comment» les garanties officielles sont offertes, aussi bien qu'à «ce que» sont les conditions particulières de ces garanties exigées. Par conséquent, les structures de normalisation devraient refléter les réalités du pays, et la vraie capacité de surveillance et contrôle de la chaîne de valeurs des produits de mer avec des ressources gouvernementales limitées.

20. Les pays devraient prendre en compte la compétitivité et les moyens d'existence des acteurs impliqués dans les marchés alternatifs qui n'ont pas besoin du même niveau de contrôles officiels que l'UE.

21. L'exploration des stratégies de normalisation rentables basées sur un environnement efficace, avec la participation des acteurs des pêches, y compris la séparation des fonctions de politique, de normalisation et

de prestation de service dans le gouvernement, devrait être encouragée afin d'assurer la durabilité de l'accès au marché et des revenus produits par le secteur.

22. Même s'il n'y a pas de relation avec les questions de sécurité sanitaire des produits de la mer, il a été recommandé que tous les pays dans la région qui exportent vers l'UE soient sensibilisés à l'impact critique de la nouvelle réglementation (l'EC) no. 1005/2008 du 29 septembre 2008, qui établit un système communautaire pour empêcher, décourager et éliminer la pêche illicite, non déclarée et non réglementée (INN).

23. Il a été rappelé aux participants qu'à partir de janvier 2010, tous les produits de pêche importés par l'UE, frais, congelé, ou traité, doivent recevoir au préalable une certification du pays de pavillon (pays où est enregistré le navire qui les a péchés) que les produits ont été pêchés légalement, et que le navire concerné a les licences, permis ou quotes-parts nécessaires. Les certificats de capture validés fournis par le pays de pavillon devraient accompagner les produits de la pêche dans toute la chaîne de commercialisation.

24. Les participants ont été invités à sensibiliser leurs autorités respectives sur les évolutions relatives à l'accès au marché de l'UE.

Commercialisation et questions socioéconomiques

25. L'écocertification en pêche artisanale ne devrait pas être vue comme un substitut aux bonnes pratiques de gestion des pêches par les acteurs, mais devrait être perçue comme moyen d'augmenter les profits.

26. Les bonnes initiatives sur l'amélioration des moyens d'existence des femmes collectrices de moules ont été notées et encouragées par les participants. Il a été également suggéré que l'approche soit partagée avec des pays ayant les pêcheries et pratiques de pêche similaires.

27. La bonne pratique dans l'utilisation de l'approche plateforme technologique post-capture dans la résolution des questions technologiques et socioculturelles dans la pêche artisanale au Tchad a été reconnue comme évolution positive dans la pêche artisanale de la région et doit être promue.

28. Ayant noté la tendance croissante de consommation de poisson frais, les participants ont reconnu la nécessité d'améliorer la distribution de ce produit à travers des interventions techniques telles que l'utilisation de meilleurs conteneurs et un emploi adéquat de la glace.

29. La réduction de l'impact environnemental de la pêche crevettière à travers l'introduction du dispositif de capture accessoire (projet REBYC) a été présentée aux participants et ses résultats reconnus très positifs pour la pêche crevettière dans la région.

CLÔTURE DE L'ATELIER

13. Le prochain Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique aura lieu en novembre 2011 aux Seychelles. L'atelier a été officiellement déclaré clos le 28 novembre 2008 par Dr Naima Bou-M'Handi après l'allocution de M. Alhaji Jallow, Fonctionnaire principal des pêches, Bureau régional de la FAO pour l'Afrique et la motion de remerciements des participants.

APPENDIX/ANNEXE A

PROGRAMME

Monday 24 November 2008

Opening address by Ms Naima Bou-M'Handi, Chief of the Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), Morocco

Address by Mr Habib Halila, FAO Representative in Morocco, on behalf of the Director-General of FAO

Welcoming address by Mr Said Taleb, Director of the Cooperation and Legal Affairs Division of INRH, Morocco

Election of Chairman and meeting officers

FAO report on progress made since the first FAO Workshop on Fish Technology, Utilization and Quality Assurance in Africa
Presented by Yvette Diei-Ouadi, FAO, Rome, Italy

The effect of holding temperatures on the microbiological spoilage of African catfish – *Clarias gariepinus*
Presented by Margaret Masette, FBRC, Uganda

Improved live fish preservation using cages
Presented by Kenneth Werimo, KMFRI, Kenya

Improvement of the socio-economic conditions of a female cooperative for drying and brining of mussels: training, design of the process and putting in place of the HACCP
Presented by Younes Zenati, ISTPM, Morocco

From waste to product: some examples using mild technologies
Presented by Jean-Pascal Bergé, IFREMER, France

Promoting value-addition and improved small-scale fish processing in Lake Victoria
Presented by Caroline T. Kirema-Mukasa, LVFO, Uganda

Rapporteurs:
am: Mr Mgawe/Mr El Filali
pm: Ms Ndiaye/Mr Kharroubi/Ms Salaudeen

Tuesday 25 November 2008

Improved fish drying using a polythene solar dryer
Presented by Kenneth Werimo, KMFRI, Kenya

Dissemination of a new improved concept of artisanal drying and smoking of food: application in artisanal fisheries in Gabon
Presented by Serge Ekomi Ango, DGPA, Gabon

Adapting low cost shrimp drying technology: initial trials in Nanggroe Aceh Darussalam Province (NAD), Indonesia
Presented by FAO Secretariat

Post-harvest fish loss assessment on Lake Victoria sardine fishery in Tanzania – *Rastrineobola argentea*
Presented by Yahya I. Mgawe, MFDC, Tanzania

Addressing post-harvest losses in artisanal fisheries: some key considerations
Presented by Yvette Diei-Ouadi, Rome, Italy

Assessment of the effects of the smoke generation processes and of smoking parameters on the organoleptic perception, the levels of the most odorant compounds and PAH content of smoked salmon fillets
Presented by Thierry Sérot, ENITIIA, France

Commercial fish species identification with isoelectric focusing: application to breaded fish products
Presented by Maurizio Ferri, ASL, Italy

Rapporteurs:
am: Mr Bergé/Mr Sylla/Mr Khbaya
pm: Mr Ferri/Mr Njifonjou

Wednesday 26 November 2008

Comparative study of the bacteriological quality of water used in fishing industries in Senegal according to the treatment applied
Presented by Khalifa B. Sylla, EISMV, Senegal

The influence of dagaa-based poultry feed quality on chicken egg production within Lake Victoria basin
Presented by Margaret Masette, FBRC, Uganda

Histamine and microbiological change during the storage of semi-preserved anchovies
Presented by Fayssal El Filali, CVSTPM, Morocco

Quality changes and heavy metal analysis of marine water prawn and fresh water prawn stored in ice – *Penaeus notialis* / *Macrobrachium vollenhovenii*
Presented by Mutiat M. Saludeen, NIOMR, Nigeria

Production and export of fishery products: challenges facing the industry in Seychelles
Presented by Christopher Hoareau, VETFIQCU, Seychelles

Regulatory alternatives for European Union market access
Presented by Francisco Blaha, FAO, Italy

Rapporteurs:
am: Mr Sérot/Mr Radi/Mr Hoareau
pm: Ms Masete/Ms Diouf/Ms Kirema-Mukasa

Thursday 27 November 2008

Evaluating the opportunities, constraints and implications of eco and ethical fish labelling on the octopus value chain in Senegal
Presented by Mame Betty Lette Diouf, ENDA REPAO, Senegal

Post-harvest fisheries technological platform approach: entry point to addressing technological and sociocultural issues in artisanal fisheries
Presented by Oumoulkhairy Ndiaye, CNFP, Senegal

Situation analysis of long-distance fresh fish distribution along the coast of Tanzania
Presented by Yahya I. Mgawe, MFDC, Tanzania

Trading the shrimp trawling bycatch in the Central Gulf of Guinea: a dilemma for its negative/positive impact
Presented by Oumarou Njifonjou, IRAD, Cameroon

Rapporteurs:
am: Mr Zenati/Mr Ekomy Ango/Mr Werimo

Friday 28 November 2008

Field trip (Port of Agadir and CSVTPM premises)

Resolution, discussion and adoption of the recommendations of the Workshop

Closing

Technical Secretariat

Mr A. Jallow, FAO Regional Office, Ghana
Mr F. Blaha, FAO, Rome
Ms Y. Diei-Ouadi, FAO, Rome
Ms G. Loriente, FAO, Rome

APPENDIX/ANNEXE B

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APPENDIX/ANNEXE C

PRESENTED PAPERS/DOCUMENTS PRÉSENTÉS

THE EFFECT OF HOLDING TEMPERATURES ON THE MICROBIOLOGICAL SPOILAGE OF AFRICAN CATFISH – *Clarias gariepinus*

[EFFETS DES TEMPÉRATURES DE CONSERVATION SUR L'ALTÉRATION MICROBIOLOGIQUE DU POISSON-CHAT AFRICAIN]

by/par

Margaret Masette[1] and E.E. Ssebunnya

Abstract

Since the year 2000 capture fisheries in Uganda's water bodies have been declining due to a myriad of factors. In response, the Government of Uganda (GoU) has initiated aquaculture promotional campaigns to bridge the ever increasing gap between fish supply and demand. The African catfish *(Clarias gariepinus)*, one of the three aquaculture species being promoted, contributes to about 60% of the total aquaculture production. However, there is an information gap on its post-mortem keeping qualities. In this preliminary study to determine shelf-life at designated holding temperatures, a total of twenty-four (24) fish *(Clarias)* were collected and divided into two batches. One was held at ambient temperatures (24–28 °C) and the other chilled (0–4 °C) prior to microbiological analyses which included aerobic total plate counts (TPC) and isolation of major spoilers. Results indicated that both *Pseudomonas* and *Aeromonas* species were the major spoilers at ambient temperatures. However, at chilled temperatures only *Pseudomonas* species proliferate. As expected, samples held at chilled temperatures kept longer than fish held at ambient temperatures which concurs with other studies conducted on other fish species. By linear regression extrapolation and based on maximum allowable microbiological limits of 106, the shelf-life was estimated at about 13 hours and 29 days for fish held at ambient and chilled temperatures, respectively.

Key words: African catfish, Temperature, Spoilage

Résumé

Depuis les années 2000 la pêche de capture dans les eaux ougandaises est en déclin du fait d'une myriade de facteurs. En réponse le Gouvernement de l'Ouganda (GoU) a initié des campagnes de promotion de l'aquaculture pour combler le déficit entre l'approvisionnement et la demande. Le poisson-chat africain (*Clarias gariepinus*), une des trois espèces aquacoles en cours de promotion, contribue environ 60% au total de la production aquacole. Toutefois, il y a un déficit d'information sur ses qualités de conservation post-mortem. Dans cette étude préliminaire pour déterminer la durée de conservation à des températures définies, un total de 24 poissons (*Clarias*) ont été collectés et divisés en deux lots. L'un était tenu à températures ambiantes (24-28 °C) et l'autre réfrigérée (0-4 °C) avant les analyses microbiologiques qui incluent le dénombrement de la flore aérobie totale (TPC) et l'isolation des altérateurs majeurs. Les résultats indiquent que les espèces de *Pseudomonas* et *Aeromonas* sont les germes majeurs d'altération à températures ambiantes. Toutefois à basses températures seulement les espèces de *Pseudomonas* prolifèrent. Comme attendu, les échantillons tenus a basses températures se conservent plus longtemps que ceux à températures ambiantes, ce qui rejoint d'autres études conduites sur d'autres espèces de poisson. Par l'extrapolation de la régression linéaire et sur la base des limites maximales microbiologiques admissibles de 106, la durée de conservation a été estimée à environ 13 heures et 29 jours respectivement pour les poissons à températures ambiantes et basses.

Mots clés: Poisson-chat africain, Température, Altération

1. INTRODUCTION

Due to declined wild fish stocks in major lakes of Uganda (DFR, 2008), aquaculture is being promoted in various areas of Uganda (FAO, 2005) to meet nutritional requirements, income generation and employment among other benefits. African catfish *(Clarias gariepinus)* is the most cultured fresh water fish species with a contribution of about 60% of the total aquaculture production (FAO, 2005). It has an elongated body, a large head, depressed and bony with small eyes. The gill arch has an air breathing labyrinth organ arising from gill

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arches. The mouth terminal is large with four pairs of barbels. It has a long dorsal fin and dorsal fin spine (FAO, 2000). From other studies conducted on temperate fish, spoilage begins as soon as the fish dies and the rates differ among fish species (Huss, 1998) and regions (Roberts and Skinner, 1983). There are three specific bacteria known to cause most of the microbiological spoilage and these include *Pseudomonas* species (Adams and Moss, 2000, and Atlas and Ronald, 1984) *Aeromonas* species and *Shewanella* species (Roberts and Skinner, 1983). In Nile perch (*Lates niloticus*) kept at ambient temperatures these same bacteria were identified as the principal spoilers (Gram *et al*., 1989). Generally, 25% of fresh water fish catches in developing countries are lost due to bacterial spoilage. Gram, 1998 and Huss, 1998, attributed the high spoilage rate to elevated temperatures prevailing in tropical areas. Indeed, the most influential factor in fish spoilage is temperature as it accelerates bacterial as well as enzymatic and chemical spoilage reactions.

Currently, there is one fish processing plant in Uganda that is engaged in exportation of smoked African catfish to a niche market in Europe. On several occasions, the plant has incurred financial losses due to product safety concerns. The inability to comply with international safety standards and demonstrate due diligence in a highly competitive international fish trade is partly attributed to a narrow knowledge base prevailing in most developing economies. Undoubtedly, the technological inadequacies, skewed research policies and financial constraints among other drawbacks in many of these economies, have contributed immensely to the information gap in the post-harvest fisheries sector. Owing to their international significance, Nile perch and Nile tilapia species have attracted donor funds that were used to generate the limited available data. However, comparable information on *Clarias* and other species with less international value is completely missing from the Ugandan database on post-harvest. In view of the current promotional drives by the GoU to popularize *Clarias*, there should also be concerted efforts in the other direction to generate relevant local data about the species that will supplement information from other regions. Typically, formulation and subsequent compliance with safety and quality standards require the relevant input from various stakeholders which, in the case of *Clarias* and other low-value species, need contributions from local researchers. Generally, post-mortem information on most tropical fresh water species is either lacking or scanty.

Overall objective

- To generate post-mortem relevant data on farmed African catfish.

Specific Objectives

- To determine the effect of holding temperature on microbiological spoilage;
- To isolate major bacterial spoilers in fish held at chilled and ambient temperatures; and
- To estimate shelf life at different holding temperatures.

2. MATERIALS AND METHODS

A total of 24 live fish (*Clarias*) were randomly collected from Kajjansi Fisheries Research Station and transported to a Veterinary Medicine laboratory (Makerere University) for subsequent microbiological analyses. On arrival, the fish were killed and time of death recorded. The initial microbiological load (Total Plate Count - TPC) was determined using the spreading method (Refai, 1979) prior to division into two batches. Batch (A) was kept at ambient temperatures (24–28 °C) while Batch (B) at chilled temperatures (0–4 °C). Each batch was sampled at intervals of 2 hours, for 12 hours. Plates were incubated at 27 °C for 2 days on MacConkey agar. Formed colonies were counted and expressed in colony forming units (cfu)/g-1 of fish sample. Bacteria isolation was based on colonial morphology and biochemical tests (Freeman 1979; Buller, 2004; Carter and Cole, 1990).

3. RESULTS AND DISCUSSION

The microbiological spoilage in *Clarias* (Figure 1) showed a similar trend to that of other fish species. The bacteria on Batch (A) samples kept at ambient temperatures had a lag-phase of only two hours. The first two hours of the exponential phase was steep with a growth rate of 1.39cfu/sec. On the contrary, bacteria on Batch (B) samples kept on ice remained in lag phase for 10 hours and probably the batch may have reached the 1–2 weeks mark for tropical fish (Huss, 1995) if the study had continued for at least 4 weeks. The numerous studies conducted on temperate fish species showed similar spoilage trends. Available information on microbiological fish spoilage in temperate regions indicates that several factors play pivotal roles in its exacerbation. They include the thickness of the slime on fish skin (Murray and Fletcher, 1976) initial microbial load (Clucas and Ward, 1996) temperature (Huss, 1995) and handling practices. One of the few studies (Gram *et*

al., 1989) conducted on fish species in the tropics and specifically Nile perch *(Lates niloticus)* showed similar spoilage trends.

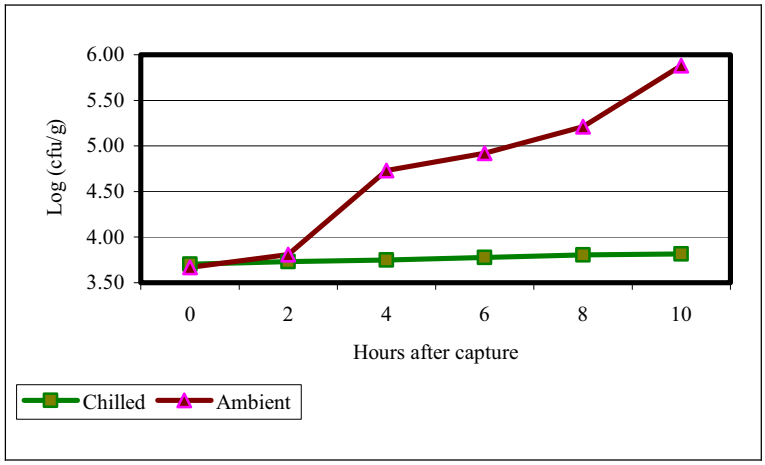

Figure 1. The spoilage of *Clarias gariepinus* kept at chilled and ambient temperatures

The initial microbial load of about 103 was a reflection of the environment at Kajjansi aquaculture farm. From the quality viewpoint, it was indicative of a commendable unpolluted farming system. At ambient temperatures, the rate of cfu/g-1 accumulation was 100–fold higher than under chilled temperatures. According to previous studies (Huss, 1995; Gram *et al*., 1989), ambient temperatures in the tropics provide ideal conditions for the existing aerobic mesophilic bacteria that naturally occur on the outer integument of the fish and in the intestinal tract (Roberts and Skinner, 1983). The increased mesophilic bacterial populations cause hydrolytic and oxidative deterioration of the fish tissue (Van Speekens, 1997). Furthermore, the by-products of the bacterial metabolism at ambient temperatures promote proliferation of more bacteria up to the threshold level that causes detectable spoilage (Adams and Moss, 2000). The presence of mesophilic bacterial population in fish muscle cause rapid spoilage (Huss, 1998). The slow spoilage rate exhibited by Batch (B) was due to inactivation of and eventual cessation of mesophilic bacterial growth attributed to change in membrane structure of the bacteria which in turn affects the uptake and supply of nutrients to enzymic systems within the bacterial cell (Adams and Moss, 2000).

Isolation of fish spoilage bacteria at different holding temperatures

At ambient temperatures, *Pseudomonas* and *Aeromonas* species were predominant in equal numbers whereas only *Pseudomonas* survived the low temperature (Table 1). This has been attributed to their short generation time (Devaraju and Setty, 1985). This concurred with previous studies (Roberts and Skinner, 1983, and Adams and Moss, 2000) which noted that *Pseudomonas* and *Aeromonas* were the major constituents of the spoilage flora of African catfish.

Table 1: Bacteria isolated at different storage temperatures

Storage temperature	Isolated bacteria
Ambient (24–28 ºC)	*Aeromonas* species and *Pseudomonas* species
Chilled (0–4 ºC)	*Pseudomonas* species

However, when chilled conditions are maintained only *Pseudomonas* species proliferate (Gram, 1989). The presence of *Pseudomonas* species at chilled temperatures confirms its psychotropic and mesophilic properties (Inglis *et al*., 1994). However, their proliferation rate is higher at chilled than ambient temperatures (Refai, 1979). On the contrary, *Aeromonas* species only proliferate at ambient temperature which demonstrates their mesophilic nature (Roberts and Skinner, 1983). However, in a mixed culture with *Pseudomonas* species at ambient temperature (Table 1), *Aeromonas* growth rate is low (Gram *et al*., 1989) and ultimately eliminated at chilled temperatures since they are specific spoilage bacteria of tropical fishes (Adams and Moss, 2000). Elimination of *Aeromonas* bacteria at chilled temperature inadvertently reduces microbiological spoilage of the respective fish species.

Shelf life of African catfish held at different temperatures

TPC on samples of African catfish under chilled and ambient temperatures follows the linear regression equation; Y = 1405.9X and Y = 73649X, respectively, where Y = Average TPC per gram of sample and

X = Time taken. According to several authors (Liston, 1980; Howgate, 1982; Connell, 1990) fish with a microbial load of ≥ 106 is regarded as spoilt and therefore if Y = 106 then X is 13 hours and 29 days at ambient and chilled temperatures, respectively, when a linear regression equation is applied.

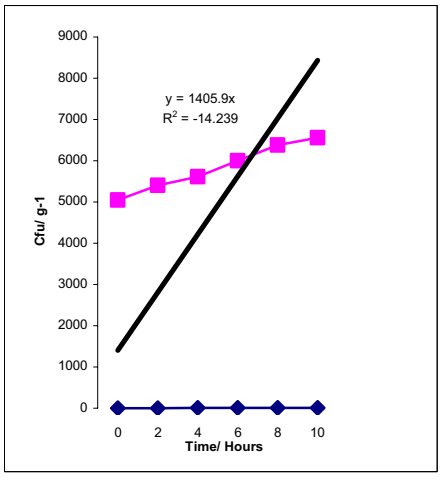

Figure 2(a). Linear regression curve for fish samples kept at chilled temperature

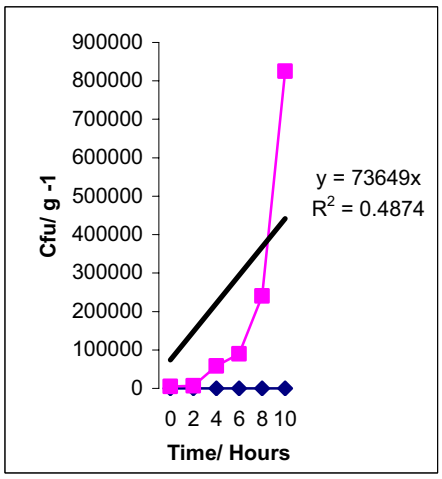

Figure 2(b). Linear regression curve for fish samples kept at ambient temperature

However, if logarithmic regression equation (Figure 3) is applied, the shelf-life reduces to 8 hours and 4 days at ambient and chilled conditions, respectively.

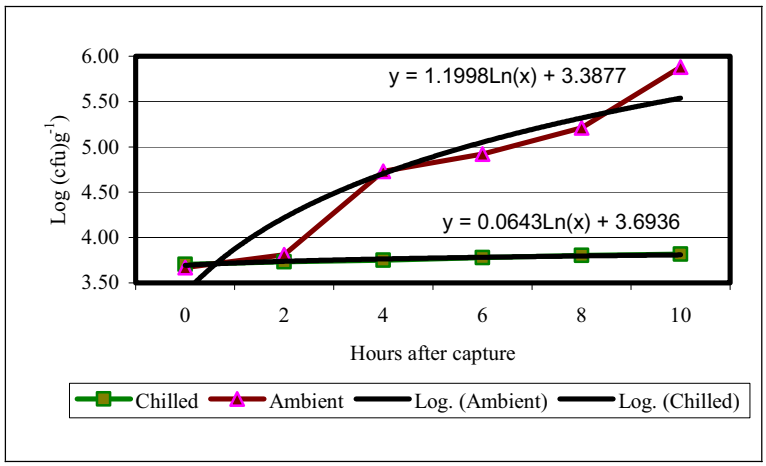

Figure 3. Logarithmic regression curve for samples held at both chilled and ambient temperatures

Evidently, the different trendlines on the spoilage curve indicate different shelf-life durations for the African catfish and, therefore, it is advisable to run the experiment until acceptable limits are naturally reached. However, according to previous studies on other tropical fish species like Nile perch *(Lates niloticus)* (Bagumire, 1998) and Nile tilapia *(Oreochromis niloticus)* (Clucas, 1981), the linear regression equation offers the most probable shelf life of catfish of 13 hours and 29 days at ambient and chilled temperatures, respectively. Although microbiological spoilage is highly influenced by temperature (Huss, 1998), it is not the sole determinant of fish spoilage. There are other influential factors like the initial microbial load at fishing ground or aquaculture system on the fish integument (Schwan, 1977), autolytic spoilage as well as oxidative rancidity (Clucas and Ward, 1996). Although these objective methods can be used to detect spoilage in fish and therefore shelf life, the ultimate judge of fish acceptability is the consumer, hence the need to conduct sensory evaluation tests concurrently.

4. CONCLUSIONS

Generally, the study demonstrated that African catfish follows a normal microbiological spoilage trend showing a faster spoilage at ambient temperatures than in chilled conditions. The major spoilage microflora consist of the renowned *Pseudomonas* and *Aeromonas* species, which proliferate faster at ambient temperatures than at chilled temperatures. However, only *Pseudomonas* species survive in chilled conditions. Based on agreed microbiological rejectable limits, the African catfish remained acceptable for human consumption for an appreciable period of time.

5. RECOMMENDATIONS

- Other aquaculture systems in the country should emulate the commendable water quality.
- For a definite determination of shelf life, sensory, microbiological and chemical tests should be conducted concurrently for prolonged periods of time: at least one month for samples kept at chilled temperatures and 20 hours for samples held at ambient temperatures.
- Funds should be made available to complete a comprehensive study.

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IMPROVED LIVE FISH PRESERVATION USING CAGES

[AMÉLIORATION DE LA CONSERVATION DU POISSON VIVANT EN UTILISANT DES CAGES]

by/par

Kenneth Werimo[1] and John Malala

Abstract

Lake Turkana fish supply chain lacks cooling facilities for fresh fish preservation. The ambient air temperatures may rise up to 46 ºC while surface water temperature may reach 32 ºC. In a bid to maintain the quality of fresh fish, fishers have been preserving live fish by tying them on a string and immersing them in the lake water. The use of the string was found to be a very inappropriate method for preserving live fish in water since it causes stress to the fish, leads to low flesh quality and high mortality, resulting in income loss.

This study's objective was to design, test and adapt an appropriate live fish storage cage to reduce stress on fish, enhance fish quality and reduce fish mortality. The study used a specially built metal cage to preserve live fish after removal from the gillnet. The cage was immersed in the water and mortality was monitored and recorded for at least 14 hours.

The mortality rate of fish preserved in the special cage under water compared to that of fish preserved on a string was reduced from 15% to less than 1%. Normally dead fish are not packed for marketing purposes but are consumed locally or processed by sun drying. The market price of sun dried fish compared to the fresh one is about 50% lower. The special cage therefore improves the income of the fisher by a margin of more than 10%.

Key words: Live fish, Preservation, Mortality, Value loss

Résumé

La chaîne d'approvisionnement du poisson du lac Turkana manque d'installations de froid pour la conservation du poisson frais. La température de l'air ambiant peut atteindre 46 ºC alors que la température de la surface de l'eau peut atteindre 32 ºC. Dans la tentative de maintenir la qualité du poisson frais, les pêcheurs conservent les poissons vivants en les fixant à une ficelle et en les immergeant dans l'eau du lac. Il a été noté que l'utilisation d'une ficelle n'est pas la méthode la plus appropriée pour préserver le poisson frais dans l'eau puisque cela cause du stress au poisson, engendre une chair de mauvaise qualité et une mortalité élevée, d'où une perte en revenus.

L'objectif de cette étude était de concevoir, tester et adapter une cage appropriée de stockage de poisson vivant pour réduire le stress du poisson, améliorer la qualité et réduire la mortalité. L'étude a utilisé une cage métallique préfabriquée pour conserver le poisson vivant après l'avoir retiré du filet maillant. La cage est immergée dans l'eau du lac et la mortalité enregistrée pendant au moins 14 heures.

Le taux de mortalité du poisson vivant conservé en cage dans l'eau comparé à celui attaché a la ficelle a été réduit de 15% à moins de 1%. Habituellement, les poissons morts ne sont pas emballés pour la commercialisation mais sont consommés localement ou traités par séchage au soleil. Le prix de vente du poisson séché au soleil en comparaison au produit frais est d'environ 50% plus bas. Par conséquent la cage améliore les revenus du pêcheur avec une marge de plus de 10%.

Mots clés: Poisson vivant, Conservation, Mortalité, Perte de valeur

1. INTRODUCTION

Studies conducted during the Lake Turkana Research Project in early 2007 showed that there is high fish mortality when fish is preserved live in water, on a string. This method of preservation is used due to lack of cooling facilities to preserve fish the normal way once harvested. The only way to maintain fish fresh is to keep it alive. Fishers use an innovative method of tying fish on a string which is then suspended in water until the

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time to take the fish to the market. This method keeps the fish restricted but free to swim around and thus reduces stress; fish held on a string tend to struggle and suffer stress leading to high mortality rates, and those that survive are of low quality. The use of the string may, therefore, not be the most appropriate method for preserving live fish in water. There is a need to reduce the stress of fish, as well as to reduce the mortality rate. The use of a cage could improve on this hence the need to investigate its effectiveness. This study aimed at designing, testing and adapting an appropriate live fish storage cage to reduce the number of fish that die from being held on a string when immersed in water. The reduction in fish mortality increases the quantity of fish offered for sale and thus increases fishers' earnings. This contributes to increased income and thus improves the socio-economic status of the fishers.

2. METHODOLOGY

The method used by fishers/traders along Lake Turkana in order to preserve live fish is by the use of a string passed through the fish mouth/gills and immersed in water (Plate 1). The study used a specially built metal cage (Plate 2) to preserve live fish. The fish, after being caught (Plate 3) by a gillnet, was removed from the net and placed in the cage that was previously immersed in lake water. The mortality rate of the life fish was monitored for at least 14 hours, i.e. from 3 pm to 5 am.

Plate 1. Fish preserved on a string immersed in water

Plate 2. Fishing activity using gillnet as a seine

Plate 3. Prefabricated live fish preservation cage

3. RESULTS AND DISCUSSION

The mortality rate of fish preserved in the cage under water compared to those preserved on a string was reduced from 15% to less than 1% (Figure 1). Normally, dead fish are not packed for marketing purposes but are processed by sun drying. The market price of sun dried fish compared to the fresh one drops from K Sh 78 to about K Sh 14, representing 83% value loss.

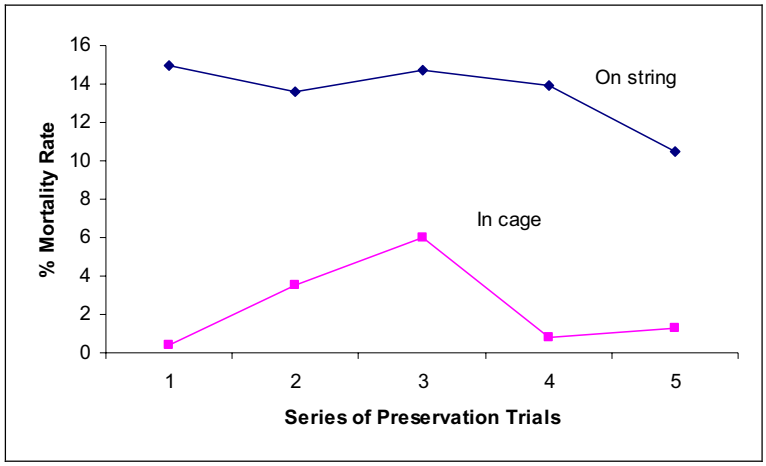

Figure 1. Mortality rate of fish kept in cage and on string

4. COST BENEFIT ANALYSIS

To evaluate the benefits of live fish preservation, a simple cost benefit analysis was conducted based on the cost inputs of the cage (see Table 1), the reduction in mortality of the fish preserved in the cage compared to the fish preserved on a string and the savings in terms of revenue. The results presented on Table 2 show that the payback period is about 13 days. The durability of the cage may be over 4 months.

Table 1. Materials and cost estimates for construction of fish cage (3ftx6.5ft)

S/No.	Item description	Quantity	Estimated cost (K Sh)
1	¾" box tube	3.5 pcs @ 650	8,640
2	Wire mesh	3.5 pcs @ 350	1,225
3	Tray wire	10m @ 350	3,500
4	Paint	1 L @ 800	800
5	Labour	3000	3,000
6		**Total**	**17,165**

Table 2. Mortality of fish preserved with and without the cage and savings in terms of revenue

Without Cage		**With cage**	
Total catch (kg)	200 kg	Total catch (kg)	200
Daily quantity loss	23 kg	Daily quantity savings (kg)	23
Expected price/kg (K Sh)	78	Expected price/kg (K Sh)	78
Actual price/kg (K Sh)	14	Actual price/kg (K Sh)	78
Daily value loss (K Sh)	1,495	Daily savings (K Sh)	1,495
		Investments cost (K Sh)	18,265
		Payback period (Days)	13

5. CONCLUSIONS AND RECOMMENDATIONS

Based on above results, the use of a specially-built fish preservation cage to preserve live fish may reduce mortality of the fish by up to 15%, resulting in higher prices for fresh fish and thus increasing the income of the fishers. The payback period of about 14 days makes investing in the usage of the cage a viable option. The live fish preservation cage concept needs to be expanded to cover parts of Lake Turkana area such as Todonyang (Nairobi area Lodwar town and Kakuma Refugee Camp. It is also recommended that Roto/Kentainers Limited (plastic containers manufacturers) be approached with a view of designing a plastic cage similar to the metal one to reduce costs and increase durability of the cage for fishers.

AMÉLIORATION DES CONDITIONS SOCIOÉCONOMIQUES D'UNE COOPÉRATIVE FÉMININE POUR LE SÉCHAGE ET MARINAGE DE MOULES: FORMATION, MISE AU POINT DU PROCÉDÉ ET MISE EN PLACE DU HACCP

[IMPROVEMENT OF THE SOCIO-ECONOMIC CONDITIONS OF A FEMALE COOPERATIVE FOR DRYING AND BRINING OF MUSSELS: TRAINING, DESIGN OF THE PROCESS AND PUTTING IN PLACE OF THE HACCP]

by/par

Younes ZENATI[1] and Farida SARF

Résumé

Dans le cadre de sa stratégie de développement du secteur artisanal et d'appui des populations de pêcheurs (village de pêche), le Département des pêches maritimes encourage les actions sociales et, en particulier, celles relatives à la parité hommes-femmes.

Dans ce contexte, plusieurs projets ont été initiés, notamment un projet d'appui aux coopératives de femmes conduit par l'Unité genre et développement (UGED) rattachée au Secrétariat général du Ministère de la pêche et financé par l'ONG italienne Centro Mondialità Sviluppo Reciproco (CMSR). Deux coopératives ont été choisies selon les critères prescrits au niveau des termes de références. Ainsi la coopérative des femmes de pêcheur Tigri, sise à Sidi Boulfdail Point de débarquement aménagé (PDA) au sud du Maroc a bénéficié d'une aide pour le développement d'activités rémunératrices.

La principale activité des femmes avant la mise en place du projet était la cueillette des moules, leur décorticage et leur vente à l'état séché. L'objectif de cet appui est la formation et l'encadrement des femmes pour développer leur capacité à l'autogestion ainsi que de leur permettre de travailler dans des conditions d'hygiène meilleures que celles dans lesquelles elles travaillaient, ce qui leur permettrait ainsi de garantir un marché plus étendu à leur produit. Dans ce contexte, deux conventions entre l'Institut spécialisé de technologie des pêches maritimes (ISTPM) et l'UGED ont été signées pour l'assistance technique au démarrage de la production dans les locaux construits au profit de la coopérative féminine Tigri. La première convention visait la formation et l'encadrement des femmes adhérentes. La deuxième convention a été signée pour l'élaboration d'un manuel d'Analyse des risques – points critiques pour leur maîtrise (HACCP).

Les objectifs de formation ont pu être atteints, puisque actuellement les femmes de la coopérative travaillent de façon autonome. La mise au point du procédé a été améliorée, mais un suivi avec une certaine fréquence, notamment pour étudier le vieillissement du produit, doit être fait.

Les changements proposés au niveau de la conception du local ainsi qu'au niveau des équipements et de la gestion devraient être pris en compte pour permettre l'adéquation de la production avec la démarche HACCP.

Mots clés: Groupement de femmes, Valorisation des moules, Environnement

Abstract

Within the development strategy of the artisanal sector and of support to fishers (fishing village), the Moroccan Department of Fisheries encourages social actions and particularly in relation to gender.

In this context several projects were initiated, in particular a project in support of women cooperatives led by the gender and development unit (UGED) within the General Secretariat of the Minister of Fisheries and funded by the Italian NGO Centro mondialita di sviluppo reciproco (CMSR). Two cooperatives were selected based on specific criteria in the terms of reference. Thus the women fishers' cooperative of Tigri in Sidi Boulfdail improved landing site in southern Morocco received assistance to develop income generating activities.

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Previously, the main activity of these women was to harvest mussels, peel and dry them, and sell them as such. The objective of this project aimed at training and supervising the women of the Tigri cooperative to build their capacity in self management, as well as enable them to work in more hygienic conditions than before, thus securing a better access to markets. In this regard, two agreements were signed between High Institute of Marine Fisheries Technology (ISTPM) and UGED in order to provide the necessary technical assistance in the inception of production in facilities constructed for the women's cooperative Tigri. The first agreement aimed at training and supervising the women members. The second was signed to develop a Hazard Analysis and Critical Control Point (HACCP) manual.

The training objectives were achieved, since the women of Tigri's cooperative are now working autonomously. The setting up of the process has been improved but there is still need for more follow-up and supervision, mainly to study the aging process of the product.

The recommended changes in the design of the facility, as well as in the equipment and management, should be taken into consideration to comply with the HACCP plan.

Key words: Grouping of women, Utilization of mussels, Environment

1. INTRODUCTION

Contexte et objectif
Les groupements de femmes exerçant l'activité de pêche au Maroc n'étaient reconnus que récemment grâce à une volonté politique visant la promotion de la femme dans le Secteur des pêches maritimes. Ces femmes apparaissent les plus pauvres sinon les plus vulnérables du secteur face à leurs conditions de travail et à la saisonnalité de leur activité.

Ainsi le Département des pêches maritimes a mis en place un programme de promotion des femmes marins pêcheurs et des femmes et filles des marins pêcheurs; ce programme a évolué par la suite vers le concept du genre et développement.

Dans la mise en oeuvre de certains projets relatifs au dit programme, le Département des pêches maritimes est appuyé par différents partenaires dont le Centro mondialitá di sviluppo reciproco (CMSR) et la Conférence épiscopale italienne (CEI) qui sont intervenus activement dans le financement d'un projet de développement local dans la région sud du Maroc, en faveur de deux coopératives de femmes et des hommes pêcheurs à Imsouane et d'une coopérative féminine à Sidi Boulfdail.

A Sidi Boulfdail, les bénéficiaires directes du projet sont les adhérentes de la coopérative féminine Tigri (20 femmes) qui collectent les moules et les transforment pour les vendre à l'état séché. Les bénéficiaires indirectes sont les autres femmes du douar Sidi Boulfdail et des douars proches qui exercent la même activité.

Le présent projet est géré et exécuté localement par l'UGED qui passe une série de conventions et de sous-traitance pour l'exécution de certaines actions avec d'autres organismes et ONG nationaux.

Dans ce contexte deux conventions entre l'ISTPM et l'UGED ont été signées pour l'assistance technique au démarrage de la production dans les locaux construits au profit de la coopérative féminine Tigri dans le cadre du même projet. La première convention visait la formation et l'encadrement des femmes adhérentes. La deuxième convention a été signée pour l'élaboration d'un manuel HACCP.

2. MÉTHODOLOGIE DE TRAVAIL

Étude socioéconomique
L'appréciation de la population cible s'est fondée sur le diagnostic participatif. Un entretien semi structuré a été administré aux groupements de femme et leur famille ainsi qu'un questionnaire individuel destiné aux femmes exerçant l'activité de ramassage des moules (rapport sur le diagnostic de l'activité de ramassage des moules à Sidi Boulfdail, UGED, 2004). Les données collectées ont été traitées par Excel et analysées dans une perspective de développement durable.

Assistance technique

Formation théorique sur l'hygiène de production (une journée)

a) Projection de diapositives
   La projection de diapositives est accompagnée de commentaires du formateur en langue arabe dialectal traduits simultanément en berbère par l'animatrice du groupe
b) Projection de l'enregistrement des femmes filmées en cours de production
   Cette technique est utile après la présentation purement théorique sur le processus de production car elle permet de montrer aux femmes de façon directe les erreurs qu'elles ont commises. Cette partie de la formation a été donc faite après la fin de la première production

Formation pratique sur le processus de production (6 jours (3+3))

Accompagnement et supervision des adhérentes en cours de production; il a été réalisé sur deux productions (deux marées). Dans la première production, les femmes ont travaillé selon leurs techniques propres tout en suivant les conseils de manipulations qui leurs sont données par le formateur. Cette phase est indispensable pour diagnostiquer les pratiques propres aux femmes et développer avec elles le processus de fabrication. La projection du film, après la fin de cette première production, a permis de synthétiser et de récapituler l'ensemble du processus en mettant aussi l'accent sur l'élément qualité.

Mise au point du procédé: Au cours de la deuxième marée, le travail des femmes a été supervisé en constatant les progrès réalisés dans l'application des prescriptions données au cours de la première visite.

Élaboration du manuel HACCP: Une troisième visite a été nécessaire où le plan de l'unité a été pris ainsi que la liste des équipements et du matériel. Une analyse des dangers et la détermination des points critiques ont été faites sur le processus de séchage et de marinage des moules en tenant compte des conditions d'une petite unité telle que celle-ci.

3. RÉSULTATS ET DISCUSSION

Diagnostic socioéconomique

La population cible est un groupe de femmes marins pêcheurs pratiquant le ramassage de moules dans le site de "Jeleb" à 36 Km au sud de Tiznit. Leur nombre est estimé à 20 femmes âgées de 18 à 35 ans appartenant au douar de Sidi Boulfdail. Ce dernier compte 163 foyers et une population totale d'environ 818 personnes dont 447 sont de sexe féminin.

La période de forte activité dure 4 mois et s'étale entre octobre et décembre quand les moules de grande taille sont disponibles. La collecte des moules se fait à marée basse à une fréquence moyenne de 2 séances par mois avec un pic de 8 pendant la période de forte activité. Les quantités de moules ramassées varient entre 25 et 50 kg par séance de ramassage et chaque séance dure environ 5 heures. Les moules sont ensuite transportées à dos d'âne, décortiquées et séchées. Le taux de conversion est de l'ordre de 1/14; c'est à dire que 14 kg de moules ramassées produisent 1 kg de moules séchées. Le prix de vente moyen ne dépasse pas 20 DH le kg et le revenu mensuel moyen par femme est de l'ordre de 300 DH par mois.

Les conditions de travail de ces femmes sont pénibles en raison de l'éloignement et de la dispersion des points de ramassage, de la difficulté d'accès à ces sites et de la baisse du rendement qui nécessite une multiplication de l'effort déployé. D'autre part le procédé de transformation des moules, effectué par ces femmes, ne respecte pas les normes d'hygiène et de qualité.

La majorité des femmes de la coopérative (18) sont analphabètes, sauf 2 entre elles qui ont un niveau de scolarisation primaire. Cependant elles montrent une motivation pour les cours d'alphabétisation accordés aux femmes du Douar.

En ce qui concerne l'écoulement du produit sur le marché, on peut dire qu'il existe un marché potentiel pour les moules séchées. En effet, dans une autre étude (Naji, 2006) commanditée par l'UGED concernant la commercialisation de moules et de poisson fumé, il ressort entre autre, que les femmes, en se groupant en coopérative, en dotant les moules d'un certificat sanitaire et en organisant mieux les opérations de commercialisation, celles-ci peuvent, en fournissant nettement moins d'efforts pour la mise en filet des moules fraîches, multiplier leur revenu par dix (le kilo de moule fraîche sera vendu au prix de la moule séchée). Cependant, toujours selon la même référence, c'est la mise au point de procédés de traitement sains et agrées,

suivie d'un important effort de communication commerciale qui pourrait différencier et démarquer clairement le produit de la Coopérative du reste de l'offre du marché traditionnel.

Formation et encadrement
Compte tenu du diagnostic et afin de développer les capacités de promotion et d'autogestion de cette population, une animatrice a été recrutée pour accompagner les femmes durant la période d'exécution du projet. Pour ce qui est de l'encadrement, le projet a proposé en plus de la formation technique des femmes de la coopérative une série de formation qui comprend les volets suivant: alphabétisation fonctionnelle (utilisation des modules adaptés à cette population); formations sur les normes de sécurité, les conditions d'hygiène et de qualité; formation sur la gestion de la coopérative; formations diverses (civique, sanitaire);

Au cours des formations techniques théoriques et pratiques bon nombre de remarques ont été faites sur la démarche à suivre lors de la production dans une optique qualité:

- Eviter de déposer les caisses, panier ou marmites à même le sol.
- Distinguer entre les seaux de lavage de matière première, des moules décortiquées et des seaux de nettoyage (eau + détergent) par des couleurs différentes.
- Respecter la marche en avant, et à ce propos un schéma simplifié de l'unité avec les principales flèches de flux a été exposé et expliqué au cours de la présentation orale.
- Information sur les objets à proscrire au cours de la production comme bagues, boucles ou bracelets.
- Information sur les gestes à proscrire au cours de la production comme manger, boire ou éternuer sur le produit, etc.
- Couvrir le produit au cours du séchage et le rentrer chaque soir.
- Il serait intéressant et judicieux que toutes ces informations soient rappelées aux femmes par des pancartes expressives à l'instar de ce qui se fait au niveau des unités industrielles.
- De plus, une notice en arabe sur les instructions de préparation a été fournie à l'animatrice du groupe.

4. FORMALISATION ET MISE AU POINT DU PROCESSUS DE PRODUCTION

La période de formation a été aussi l'occasion de mettre au point le processus de fabrication. Les étapes de ce processus sont déjà connues par les femmes cependant certaines remarques ont été faites pour que la production soit en adéquation avec les normes de qualité internationalement reconnues.

a) Lavage et nettoyage des moules
Il est conseillé que les coquilles des moules soient bien lavées au niveau du site de la cueillette pour éviter d'une part une grande consommation d'eau potable au niveau de l'usine (ce qui a deux conséquences: débordement de la fosse septique et augmentation de la facture d'eau potable).

D'autre part, le sable qui s'incruste dans les coquilles mal dégagées se retrouve dans la chair lors de l'ouverture des coquilles au cours de la cuisson. D'autant plus que dans la conception de l'unité, il n'y a pas de possibilité de dégorgement des moules (pas de bassin de dégorgement).

Par ailleurs pour bien finaliser ce lavage, il a été aussi conseillé de procéder à un brossage des moules en les plongeant dans un bassin faiblement rempli d'eau. Ce conseil a même été mis en application et il a été effectivement constaté que cette technique permet une bonne friction des coquilles entre elles et avec la brosse. La présence d'eau permet de récupérer les grains de sable.

Cette étape est particulièrement importante à maîtriser si on veut éviter de retrouver des grains de sable dans les moules séchées.

b) Décorticage des moules
Ce travail est manuel et nécessite un lavage des mains immédiatement avant le commencement de la tâche. Par ailleurs, l'organisation de l'espace tel qu'elle a été prévue selon le plan de construction doit être revue car les femmes n'utilisent pas le potager conçu au départ: elles préfèrent s'asseoir et déposer les paniers sur les tabourets pour travailler. Des tables plastiques ont été donc introduites et mises au centre de la salle. Les femmes s'installent autour de ces tables, assises sur des tabourets pour décortiquer les moules. Or dans cette nouvelle organisation, le potager, en plus des tables placées au centre de la salle obstruent complètement le passage d'une extrémité à l'autre. Il est donc préférable de réorganiser l'espace: en effet l'élimination du potager ainsi que du mur séparant la salle de décorticage de la chambre, prévue au départ pour le rangement du matériel, permettrait de mieux organiser le travail dans la salle et notamment le respect de la marche en avant.

c) Évacuation des eaux de lavage de la salle de réception et de la salle de décorticage

L'absence de canalisations au niveau de ces deux salles complique l'évacuation de l'eau. En fait, ceci oblige les femmes à récupérer ces eaux dans des seaux et les sortir par l'entrée et le déverser juste devant l'usine; à la longue cette pratique aura des conséquences néfastes, notamment en matière de respect de l'environnement qui aura nécessairement un impact sur les conditions d'hygiène dans l'environnement direct de l'unité.

En outre, le déversement de ces seaux ne se fait qu'à la fin du travail pour des questions de bonnes pratiques mais aussi de disponibilité des femmes. Ce qui a pour conséquence une accumulation des seaux à l'entrée de l'usine et cause un encombrement et une obstruction du passage au niveau du couloir central entraînant à la longue une désorganisation dans le travail.

Pour cela on conseille qu'une tuyauterie d'évacuation soit réalisée dans chacune de ces deux salles.

d) Lavage des moules décortiquées

Les femmes avaient l'habitude de laver les moules décortiquées avec l'eau de mer. Cette pratique est à proscrire car l'eau de mer aussi claire qu'elle puisse paraître, est toujours chargée de grains de sable. Cependant les femmes jusqu'alors avaient toujours refusé de laver avec l'eau potable expliquant ceci par le fait que l'eau potable ferait perdre le goût aux moules. Cette hypothèse n'est pas à écarter totalement car la différence de salinité pourrait effectivement provoquer la diffusion de certains solutés vers l'eau de lavage (parmi lesquels les composés responsables du goût).

Afin d'éviter ce problème, il a été proposé un lavage répété des moules décortiquées dans une saumure légère (pour éviter la diffusion des solutés vers l'eau par phénomène d'osmose); le lavage répété par immersion dans plusieurs seaux successifs permet un meilleur dessalement, notamment pour les pièces se trouvant au fond du seau. En effet celles-ci se trouvent trop proches du décantât, rendant ainsi la séparation quasiment impossible.

e) Séchage des moules

Surface de séchage: la surface de séchage (séchoir inox) parait ne pas être suffisante pour traiter l'ensemble de la production d'une marée. Il est donc nécessaire de réaliser d'autres prototypes ou faire une extension de la surface de séchage en utilisant la terrasse.

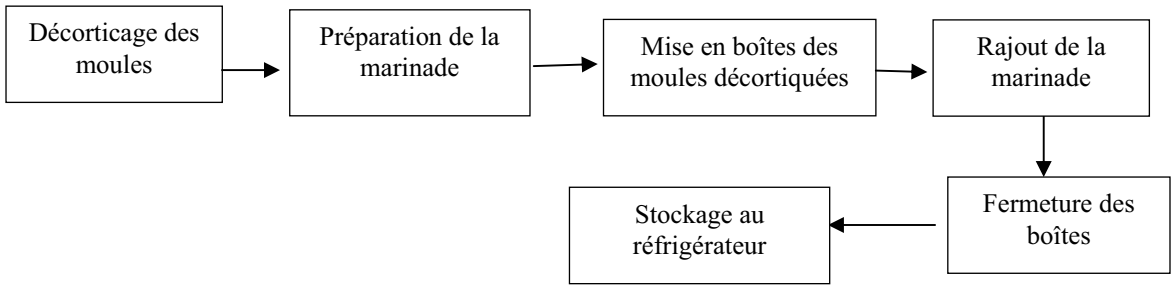
Une autre idée serait de fixer des grilles de séchage en étagère le long des murs de la cour destinée au séchage.

f) Alternative au séchage: marinage des moules

Il a été aussi donné de constater que la technique de séchage pourrait ne pas permettre une rentabilité suffisante surtout au départ où le produit n'est pas suffisamment connu dans son marché potentiel mais aussi par la capacité de production réduite de l'unité (surface de séchage réduite). Dans ce cas une transformation du même type pourrait être développée en parallèle avec la première et qui est le marinage.

En effet, le marinage des moules ne nécessite par rapport à ce qui existe déjà qu'un investissement en consommable additionnel peu coûteux. De plus la production ne sera faite que sur commande en petits lots, car la durée de validité de produit est restreinte par rapport au séchage, en effet La DLC de moules marinées existant déjà sur le marché est de six mois.

Le procédé suivant a été proposé et réalisé avec les femmes:



g) Rejet des déchets solides

Les déchets solides de même que les rejets liquides vont agresser l'environnement direct de l'usine si aucune action n'est entreprise pour organiser la gestion de ces déchets. Ainsi les coquilles des moules sont déposées en tas à trois ou quatre mètres de l'unité. Les femmes comptent s'en débarrasser par le passage des agriculteurs des environs à dos d'âne qui les prend pour en faire de la fumure après qu'ils soient séchés au soleil. Cependant, il reste qu'ils vont séjourner pendant un temps plus ou moins long avant qu'ils ne soient ramassés.

Les sacs plastiques ainsi que les cartons d'emballages sont jetés temporairement au cours de la production à peu près à la même distance, mais dans un autre endroit. En fin de production, ils sont incinérés.

L'idée d'incinération est peut être à garder puisqu' aucune autre issue ne parait être réalisable sauf qu'il faudrait aménager un foyer en brique à l'intérieur duquel seraient incinérés ces déchets, pour que ceux-ci ne restent pas exposés à la vue.

5. ÉLABORATION DU MANUEL HACCP

Sur la base de la bibliographie disponible sur les moules et leur transformation une description des produits moules marinées et moules séchées a été élaborée (Annexe I).

L'analyse des Dangers (Annexe II) et la détermination des points de contrôle critiques (Annexe III) ont donné:

- Pour le processus des moules séchées les PCC suivants: Réception des moules fraîches, séchage, Emballage et Stockage du produit fini;
- Pour les moules marinées, les étapes du procédé qui ont été retenues comme PCC sont: Réception des moules fraîches, Préparation de la marinade et Marinage et Stockage du produit fini.

Sur cette base le plan HACCP (Annexe IV) concernant la transformation des moules séchées et marinées a été dressé pour l'unité en question.

Cependant lors de l'établissement du manuel il a été relevé un certain nombre de remarques sur l'incohérence de certains points avec l'application du manuel HACCP; une série de remarques ont été faites lors de la remise du manuel au commanditaire pour que ces éléments indispensables soient pris en compte avant la validation du manuel HACCP et qui sont:

- **Équipement et installations:**
  Pédiluves, inscriptions de rappel pour le personnel, carrelage salle décorticage, évacuation déchets solides, piège à rat, matériel pour le contrôle de routine (thermomètre, pH mètre, densimètre) et l'étalonnage du matériel.
- **Gestion qualité:**
  Désigner un responsable qualité;
  Établir une convention avec la municipalité pour programme désinsectisation et dératisation;
  Établir, pour la phase de démarrage, une convention avec un laboratoire de contrôle et ce pour réaliser les analyses des produits finis vu la situation de la coopérative ne lui permettant pas de s'équiper pour faire ces propres analyses sur les produits finis.

6. IMPACT DU PROJET SUR LES CONDITIONS SOCIOÉCONOMIQUES DES FEMMES

Après la mise en place du projet en faveur des femmes de la coopérative "Tigri", les moules séchées ont une valeur nettement supérieure et leur prix de vente est passé de 20 DH le kg à 100 DH le kg ce qui a permis l'augmentation du revenu des adhérentes de plus de 200%.

L'introduction du procédé des moules marinées a permis aux femmes de diversifier leur production et garantir un travail pérenne même en période humide.

Les efforts du projet qui se sont articulés essentiellement sur les actions de formation et d'encadrement de la coopérative ont été d'un apport social positif. Les femmes, au cours du projet, ont développé progressivement les aptitudes, les compétences et la confiance en elles mêmes, qualités requises pour développer leur activité. Cette nouvelle situation leur a permis de s'ouvrir sur le monde extérieur, comme leur participation dans des ateliers ou foire en dehors du douar, voire même dans d'autres villes. Elle leur a permis aussi de développer leur

capacité de gestion de la coopérative, comme par exemple leurs actions et relations avec différentes administrations, banques ou autres.

Le projet a eu aussi un impact positif sur l'environnement:

- Grâce aux bonnes pratiques d'hygiène, l'unité de valorisation produit des moules salubres et de qualité;
- Le travail au sein de l'unité de valorisation génère une propreté du douar et la côte avoisinante, les femmes ne travaillant plus au bord de la mer ou près de leur maison.

Le projet a été conçu de telle façon à inciter les femmes à respecter la réglementation. En effet, seules les moules de taille marchande réglementaire (6 cm ou plus) sont admises à la réception de l'unité de valorisation. Cette mesure préserve les gisements naturels grâce à une diminution de la pression de ramassage des moules de petite taille.

La mise en place de l'unité de valorisation près du point de débarquement aménagé de Sidi Boulfdail a valorisé l'activité de ramassage des moules dans la région. Sa position près de la station balnéaire Mirleft et son emplacement sur la route côtière reliant la ville de Tiznit à TanTan lui permet d'être un pôle attractif pour les touristes de la région et les voyageurs de passage. D'autre part, la dimension sociale et écologique du projet facilitera à la coopérative de trouver un marché potentiel au niveau des villes du royaume où l'exploitation des moules est interdite (problème d'insalubrité du milieu) ou inexistante. De même, elle lui permettra de diversifier sa clientèle actuelle (Marchés traditionnels) en essayant de conquérir d'autres segments de marchés, plus modernes et également plus lucratifs.

7. CONCLUSIONS ET RECOMMANDATIONS

Le projet d'appui à la coopérative féminine de Sidi Boulfdail constitue une opportunité pour le Département des Pêches Maritimes qui s'ajoute aux efforts actuellement consentis dans la région pour promouvoir le développement durable et la promotion socioéconomique des marins pêcheurs et des femmes marins pêcheurs. En effet, les résultats atteints montrent bien que le projet a pu contribuer au développement souhaité:

- Les objectifs de formation ont donc pu être atteints, puisque actuellement les femmes de la coopérative travaillent de façon autonome.
- La mise au point du procédé a été améliorée, mais un suivi avec une certaine fréquence, notamment pour étudier le vieillissement du produit doit être fait.
- Les changements proposés au niveau de la conception du local ainsi qu'au niveau des équipements et de la gestion devraient être pris en compte pour permettre l'adéquation de la production avec la démarche HACCP.
- L'augmentation du revenu des femmes ainsi que leur bien être au sein de l'unité de valorisation leurs permettront de réduire le temps du travail et être plus disponibles pour participer à d'autres activités culturelles dans la région.
- La structure de l'unité de valorisation des produits de la mer étant intégrée dans le cadre organisationnel du point du débarquement aménagé de la région favorise la participation des femmes à toutes les activités relatives au secteur ce qui renforcera son rôle dans le développement économique, l'équité sociale et la protection de l'environnement.

La pérennité du projet dépendra de la capacité des femmes à poursuivre les activités du projet, une fois cessé l'appui extérieur. Plusieurs facteurs interviennent et conditionnent cette pérennité:

- Les femmes de la coopérative ont exprimé des besoins supplémentaires en appui technique et en supervision même après l'achèvement du projet. Sachant que le succès du projet dépend de la capacité technique des femmes dans leur poste à exécuter toutes les activités prévues.
- Pour assurer un circuit de commercialisation efficient pour un tel produit de terroir, il est nécessaire pour la coopérative d'avoir une stratégie commerciale et d'élaborer un plan marketing, sachant que ces volets n'ont été que partiellement prévus dans les actions du projet.

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ANNEXE I

Description des produits

1. Description des moules séchées

Nom du produit	Moules séchées
Source de la matière première	Falaise sur le site de Sidi Boulfdail et environs
Caractéristiques importantes du produit final	Humidité ≤ 16%
Ingrédients	Sel et eau
Emballage	Sachet sous vide (150 g)
Mode opératoire d'utilisation des produits finals	Mettre le produit 24h pour réhydratation avant préparation
Durée de conservation	12 mois
Endroits ou les produits sera vendu	Marché local
Instructions d'étiquetage	Nom du produit; Poids net; date de production; DLC
Contrôle spécial de la distribution	Entreposé dans une zone sèche à température ambiante

2. Description des moules marinées

Nom du produit	Moule mariné
Source de la matière première	Falaise sur site Sidi Boulfdail et environs
Caractéristiques importantes du produit final	Température <4 °C pH ≤ 4, 5
Ingrédients	Eau; vinaigre; sel; oignon; poivre blanc; piment rouge; feuille de laurier: clou de girofle; coriandre en grains; fenouillet
Emballage	Bocaux en verre ou en plastique
Mode opératoire d'utilisation des produits finals	Consommer sans besoin de cuisson
Durée de conservation	6 mois < 4 °C
Endroits ou les produits sera vendu	Marché local
Instructions d'étiquetage	Nom du produit; poids net; date de production; DLC
Contrôle spécial de la distribution	Entreposage réfrigéré à < 4 °C

Diagramme de fabrication des moules séchées

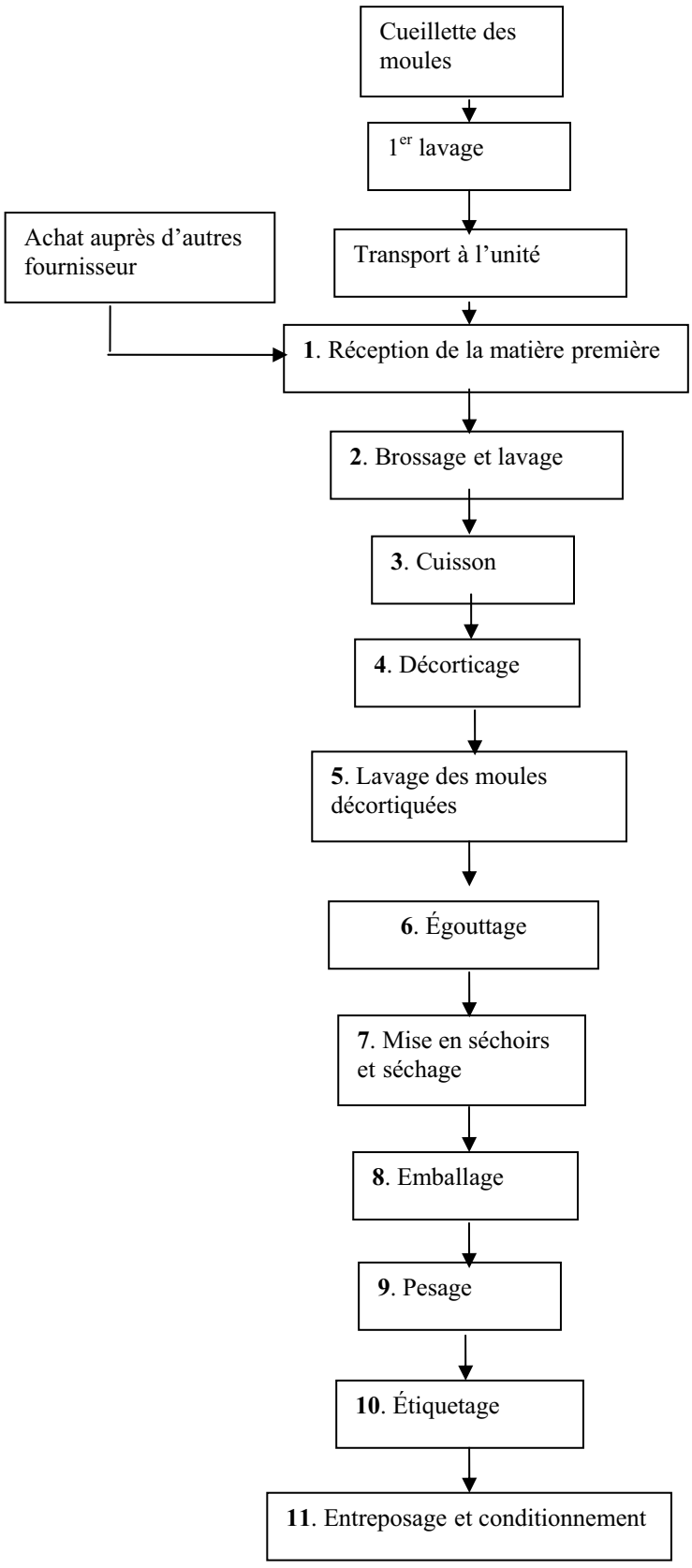
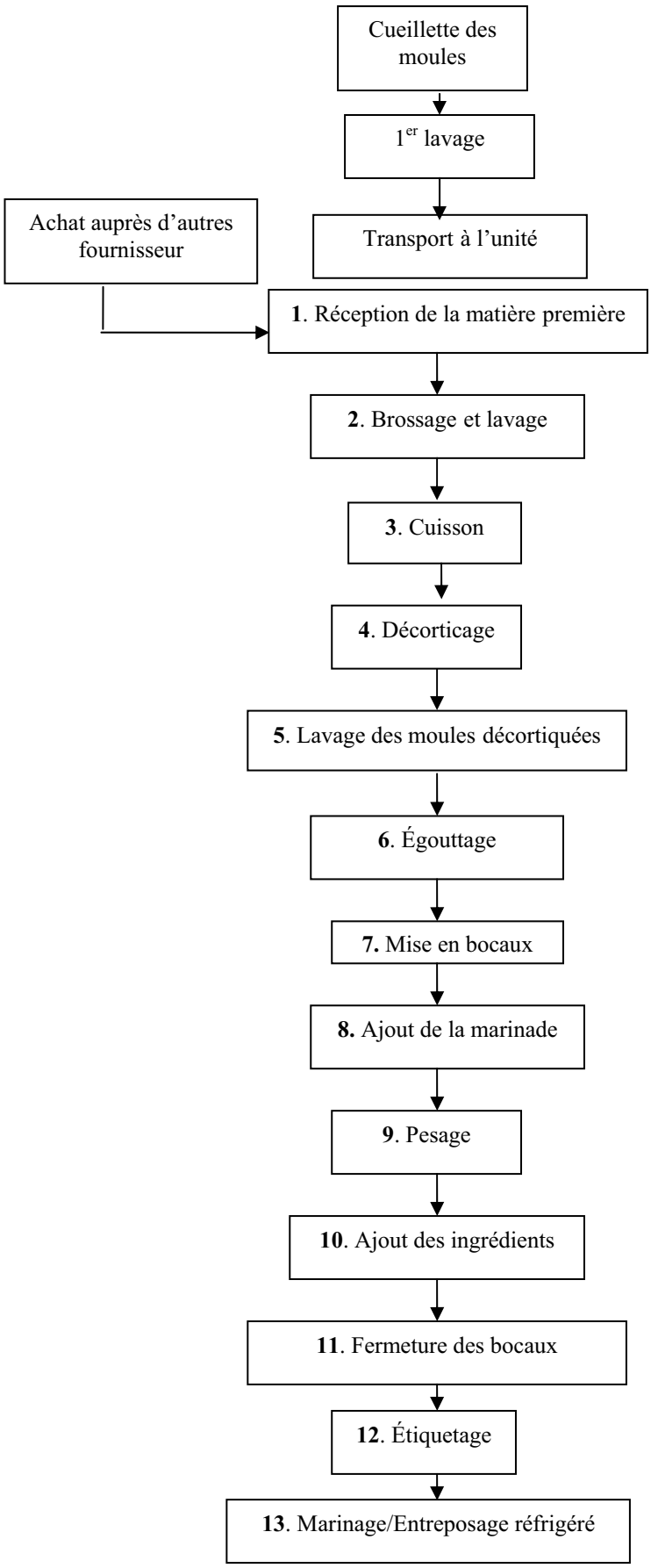


Diagramme de fabrication des moules marinées



ANNEXE II

Analyse des dangers: moules séchées

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification éventuelle de son exclusion comme danger important	Mesures préventives
Réception	Dangers biologiques	Bactéries pathogènes	Élevée	-	La prolifération des bactéries dans les mollusques récoltés concerne les animaux morts, on peut prévenir ce problème par le contrôle temps/température (voir Annexe I, FC 001)
		Virus	Élevée	-	Zone de récolte salubre, certifiée par l'INRH (RNS) (voir Annexe I, FC 001)
		Biotoxines	Élevée	-	
		Parasites	Élevée	Tués par la cuisson lors de l'ouverture des moules	Traitement thermique et salage ultérieurs
		Amines biogéniques	Faible	-	-
		Bactéries d'altération	Élevée		Contrôle temps/température
	Danger chimique	Produits chimiques: métaux lourds et hydrocarbures	Faible	Zone de récolte contrôlée	Zone de récolte salubre, certifiée par l'INRH (RNS) (voir Annexe I, FC 001)
	Danger physique	Morceaux de coquilles Corps étrangers	Faible	Le produit est lavé et brossé avant d'être ouvert, tous les débris sont donc éliminés à cette étape	Sensibilisation et motivation du personnel Respect des bonnes pratiques de fabrication (maîtrise du lavage FC 007, procédure de fabrication P 001)
Brossage/ lavage	Dangers biologiques	Prolifération des bactéries	Faible	Les moules sont lavées par lots et acheminées vers la cuisson	Contrôle de la cadence de travail (voir Annexe I, FC 019)
	Danger chimique	Aucun	S.O.[1]	-	-
	Danger physique	Fils plastiques de brosses	Faible	Les moules sont encore fermées	Respect des bonnes pratiques de fabrication (voir Procédure Fabrication P 001)
Cuisson	Dangers biologiques	Contamination croisée par bactérie lors du transvasement et récupération des moules cuites ouvertes	Élevée	Le transvasement des moules cuites ouvertes se fait dans un keskass lavé auparavant	Respect des bonnes pratiques hygiéniques Sensibilisation du personnel à la contamination croisée (voir Annexe I, FC 013)
	Danger chimique	Aucun	S.O.		

[1] S.O. = Sans Objet

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification éventuelle de son exclusion comme danger important	Mesures préventives
	Danger physique	Aucun	S.O.		
Décorticage	Dangers biologiques	Contamination croisée	Élevée	Sensibilisation du personnel à la contamination par les mains	Respect des règles hygiéniques Sensibilisation du personnel à l'hygiène. (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Reste des coquilles	Faible	Contrôle des moules par le lavage qui suit	Respect des bonnes pratiques de fabrication; (voir: Procédure Fabrication P 001)
Lavage des moules décortiquées	Dangers biologiques	Croissances des bactéries		Lavage dans l'eau salée	Respect des bonnes pratiques de fabrication Respect des règles hygiéniques (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Aucun	S.O.		
Égouttage	Dangers biologiques	Contamination croisée Croissances des bactéries	Élevée	Zone d'égouttage propre et sèche Les moules sont salées l'égouttage est rapide	Respect des règles hygiéniques Sensibilisation du personnel Contrôle du temps (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Aucun	S.O.		
Mise en séchoir/ séchage	Dangers biologiques	Contamination par bactéries de l'air	Élevée		Élimination de toute la microflore ou presque par le salage + baisse rapide de l'humidité en surface
		Produit fini altéré à cause d'un séchage insuffisant	Élevée		Séchage solaire en 3 jours au maximum H% finale entre 12 et 15%
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D, FC 012)
	Danger physique	Dépôt de corps étrangers et de poussière sur le produit	Élevée		Respect des bonnes pratiques de fabrication: couvertures des séchoirs par les moustiquaires Ne pas sécher les jours de mauvaises conditions climatiques

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification éventuelle de son exclusion comme danger important	Mesures préventives
Emballage sous-vide	Dangers biologiques	Recontamination lors du remplissage	Élevée	Mise en emballage avec gants jetables	Respect des bonnes pratiques hygiéniques, (FC 013)
	Danger chimique	Aucun	S.O.		
	Danger physique	Perforation du plastique	Élevée		Réglage du vide Plastique de bonne qualité Maîtrise du conditionnement
Pesage	Dangers biologiques	Aucun	S.O.		
	Danger chimique				
	Danger physique				
Étiquetage	Dangers biologiques	Aucun	S.O.		
	Danger chimique	Aucun	S.O.		
	Danger physique	Poussière empêchant le collage des étiquettes	Faible	Le personnel est sensibilisé au travail organisé	Emballages vides propres (FC015) Surfaces de travail nettoyées (FC013) Étiquettes rangées
Stockage	Dangers biologiques	Moules séchées altérées à cause d'une réhumidification au cours du stockage	Élevée		Emballage approprié et maîtrise des conditions de stockage (FC006)
	Danger chimique	Aucun	S.O.		
	Danger physique	Effritement des moules par pression des paquets	Élevée	Personnel sensibilisé sur la qualité marchande du produit	Maîtrise des conditions de stockage (voir Annexe II, P002: procédure de séchage des moules)

Analyse des dangers: moules marinées

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification de son exclusion comme danger important	Mesures préventives
Réception	Dangers biologiques	Bactéries pathogènes	Élevée	Si les moules sont collectées près de l'unité, la prolifération serait négligeable	La prolifération des bactéries dans les mollusques récoltés concerne les animaux morts, on peut prévenir ce problème par le contrôle temps/température (voir Annexe I, FC 001)
		Virus	Élevée		Zone de récolte salubre, certifiée par l'INRH (RNS) (voir Annexe I, FC 001)
		Biotoxines	Élevée		
		Parasites	Élevée	Tués par la cuisson lors l'ouverture des moules	Traitement thermique et salage ultérieurs
		Amines biogéniques	Faible	-	-
		Bactéries d'altération	Élevée		Contrôle temps/température
	Danger chimique	Produits chimiques: métaux lourds et hydrocarbures	Faible	Zone de récolte contrôlée	Zone de récolte salubre, certifiée par l'INRH (RNS) (voir Annexe I, FC 001)
	Danger physique	Morceaux de coquilles Corps étrangers	Faible	Le produit est lavé et brossé avant d'être ouvert, tous les débris sont donc éliminés à cette étape	Sensibilisation et motivation du personnel Respect des bonnes pratiques de fabrication (maîtrise du lavage FC 007, procédure de fabrication P 001)
Brossage/ lavage	Dangers biologiques	Prolifération des bactéries	Faible	Les moules sont lavés par lots et acheminées vers la cuisson	Contrôle de la cadence de travail (voir Annexe I, FC 019)
	Danger chimique	Aucun	S.O.	-	-
	Danger physique	Fils plastiques de brosses	Faible	Les moules sont encore fermées	Respects des bonnes pratiques de fabrication (voir Procédure Fabrication P 001)
Cuisson	Dangers biologiques	Contamination croisée par bactérie lors du transvasement et récupération des moules cuites ouvertes	Élevée	Le transvasement des moules cuites ouvertes se fait dans un keskass lavé auparavant	Respects des bonnes pratiques hygiéniques Sensibilisation du personnel à la contamination croisée (voir Annexe I, FC 013)
	Danger chimique	Aucun	S.O.		
	Danger physique	Aucun	S.O.		

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification de son exclusion comme danger important	Mesures préventives
Décorticage	Dangers biologiques	Contamination croisée	Élevée	Sensibilisation du personnel à la contamination par les mains	Respect des règles hygiéniques Sensibilisation du personnel à l'hygiène. (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Restes des coquilles	Faible	Contrôle des moules par le lavage qui suit.	Respect des bonnes pratiques de fabrication; (voir Procédure Fabrication P 001)
Lavage des moules décortiquées	Dangers biologiques	Croissances des bactéries		Lavage dans l'eau salée	Respect des bonnes pratiques de fabrication Respect des règles hygiéniques (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Aucun	S.O.		
Égouttage	Dangers biologiques	Contamination croisée Croissances des bactéries	Élevée	Zone d'égouttage propre et sèche Les moules sont salées l'égouttage est rapide	Respect des règles hygiéniques Sensibilisation du personnel Contrôle du temps (voir Annexe I, FC 013)
	Danger chimique	Contamination par reste détergent	Faible	Contrôle de l'efficacité du nettoyage et désinfection	Propreté des équipements (voir procédure N & D et FC 012)
	Danger physique	Aucun	S.O.		
Préparation de la marinade	Dangers biologiques	Contamination par des bactéries pathogènes	Élevée	Bonnes pratiques de manipulation et de la préparation Maîtrise de la recette de préparation Mesure permanente de pH de la marinade	Respect des quantités vinaigre et sel à préparer pH de la marinade $\leq 4,5$ (voir Annexe I, FC 009)
	Danger chimique	Aucun danger détecté	S.O.		
	Danger physique	Présence des corps étrangers	Faible	Contrôle de la qualité des ingrédients avant l'utilisation	Utilisation des ingrédients de bonne qualité (Annexe I, FC 004)
Remplissage de boîtes par les moules	Dangers biologiques	Recontamination lors du remplissage	Élevée	Mise en emballage avec gants jetables	Respect des bonnes pratiques hygiéniques (voir Annexe I, FC 013)
	Danger chimique	Aucun	S.O.		
	Danger physique	Introduction de corps étrangers	Faible		Respect des bonnes pratiques hygiéniques (voir Annexe I, FC 013 et FC 003)

Étape dans le processus	Types de dangers	Dangers	Criticité	Justification de son exclusion comme danger important	Mesures préventives
Pesage	Dangers biologiques	Aucun	S.O.		
	Danger chimique				
	Danger physique				
Rajout de la marinade	Dangers biologiques	Croissance des bactéries pathogènes	Faible	Maîtrise du pH du produit et de la marinade (pH ≤ 4,5)	pH du produit mariné et de la marinade doit être inférieur à 4,5 (voir Annexe I, FC 009)
	Danger chimique	Excès de sel ou de vinaigre	Faible		(Voir fiche procédure préparation marinade P 003)
	Danger physique	Présence de corps étrangers	Faible	Contrôle des additifs à la réception, à l'entreposage et avant l'expédition	
Fermeture manuelle des boîtes	Dangers biologiques	Recontamination par les staphylocoques	Faible	Respect des règles d'hygiène - bonnes conditions de manipulation - vérification de la fermeture des boîtes	Sensibilisation et formation régulière du personnel (voir Annexe I, FC 018)
	Danger chimique	Aucun danger détecté	S.O.		
	Danger physique	Présence de poussière sur les couvercles	Faible	Vérification de la propreté des couvercles avant utilisation	Contrôle des emballages avant utilisation (voir Annexe I, FC 003)
Etiquetage	Dangers biologiques	Aucun	S.O.		
	Danger chimique	Aucun	S.O.		
	Danger physique	Poussière empêchant le collage des étiquettes	Faible	Le personnel est sensibilisé au travail organisé	Emballages vides propres (FC 003) Surfaces de travail nettoyées (FC 012) Étiquettes rangées
Marinage/ stockage	Dangers biologiques	Faible acidification du produit engendrant une contamination	Élevée		Emballage approprié et maîtrise des conditions de stockage (voir Annexe I, FC 021)
	Danger chimique	Aucun	S.O.		
	Danger physique	S.O.	-	-	-

ANNEXE III

Détermination des PCC: moules séchées

Étape du procédé	Dangers	Question 1 Des mesures de maîtrise sont-elles en place pour le danger considéré? Si oui passer à la question 2. Si aucune mesure de maîtrise n'est en place et que la maîtrise à cette étape est nécessaire pour la sécurité du produit, il faut modifier l'étape, le procédé ou le produit.	Question 2 Cette étape élimine-t'elle le danger ou en réduit-elle l'occurrence à un niveau acceptable? Si le danger est éliminé l'étape est un PC. Si non on passe à la question 3.	Question 3 Une contamination peut-elle intervenir, ou le danger peut-il s'accroître, jusqu'à un niveau acceptable? Si oui on passe à la question 4, si non stop*	Question 4 Une étape ultérieure peut-elle éliminer le danger ou en réduire la probabilité d'occurrence à un niveau acceptable? S'il n'existe pas d'étape cette étape est un PC Si oui stop*	PCC
Réception des moules fraîches	- Bactéries pathogènes - Virus - Biotoxines	Oui	Oui			Oui
	- Bactéries d'altération	Oui	Oui			Oui
Séchage	Contamination par bactéries de l'air	Oui	Non	Oui	Non	Oui
	Produit fini altéré à cause d'un séchage insuffisant	Oui	Non	Oui	Non	Oui
	Dépôt de corps étrangers et de poussière sur le produit	Oui	Non	Oui	Non	Oui
Emballage	Perforation du plastique	Oui	Non	Oui	Non	Oui
Stockage du produit fini	Moules séchées altérées à cause d'une réhumidification au cours du stockage	Oui	Non	Oui	Non	Oui

Détermination des PCC: moules marinées

Étape du procédé	Dangers	Question 1 Des mesures de maîtrise sont-elles en place pour le danger considéré? Si oui, passer à la question 2. Si aucune mesure de maîtrise n'est en place et que la maîtrise à cette étape est nécessaire pour la sécurité du produit, il faut modifier l'étape, le procédé ou le produit.	Question 2 Cette étape élimine-t'elle le danger ou en réduit-elle l'occurrence à un niveau acceptable? Si le danger est éliminé l'étape est un PC. Si non on passe à la question 3.	Question 3 Une contamination peut-elle intervenir, ou le danger peut-il s'accroître, jusqu'à un niveau acceptable? Si oui passer à la question 4, si non stop*	Question 4 Une étape ultérieure peut-elle éliminer le danger ou en réduire la probabilité d'occurrence à un niveau acceptable? S'il n'existe pas d'étape cette étape est un PC Si oui stop*	PCC
Réception des moules fraîches	- Bactéries pathogènes - Virus - Biotoxines	Oui	Oui			Oui
	- Bactéries altération	Oui	Oui			Oui
Préparation de la marinade		Oui	Non	Oui	Non	Oui
Marinage (en cours de stockage)	Prolifération des germes tolérants (acidophile et halophiles) à cause d'un marinage inadéquat	Oui	Non	Oui	Non	Oui
Stockage du produit fini	Prolifération des moisissures et levures à cause d'un mauvais stockage à une température < 4 °C	Oui	Non	Oui	Non	Oui

ANNEXE IV

Plan HACCP - moules séchées

(CCP)	Danger	Seuils critiques	Procédures de surveillance				Action(s) corrective(s)	Vérification
			Quoi	Comment	Quand	Qui		
Réception	-Moules insalubres -Moules altérées	Absence de toxicité < 300 coliformes fécaux/100 g de chair de mollusque ou < 230 *E. coli*/100 g de chair de mollusque	Salubrité de la zone de cueillette État bactériologique des moules cueillies	Contact du réseau de surveillance: certificat de salubrité de la zone Prise d'échantillon et analyse au laboratoire	À chaque marée (15 jours) À chaque marée (15 jours	Responsable qualité	Rejet du lot en cas de moules insalubre ou altérées	Le responsable du contrôle qualité vérifie et examine quotidiennement la fiche de contrôle à la réception donnée par le laboratoire et le certificat de salubrité donné par l'INRH et le registre des mesures correctives (FC 001 et FC 017)
Séchage	Développement de germes xérophiles et osmophiles	H% ≤ 55% après 24 heures de séchage H%≤ 18% après 72 heures	Humidité du produit	Mesure de l'humidité à l'humidimètre	En cours et à la fin de chaque séchage	Responsable laboratoire	Écarter le lot concerné, voir son innocuité. Si non contaminé remettre à sécher	Le responsable du contrôle qualité vérifie et examine quotidiennement la fiche de contrôle et le registre des mesures correctives (FC 006 et FC 017) Étalonnage de l'humidimètre
	Survie des spores de *Clostridium botulinum* Altération	Étanchéité des sachets Sachets non conformes	Sachets non étanches	Contrôle d'étanchéité Inspection visuelle sachets propres	Chaque journée de travail	Responsable laboratoire	- Écarter les pièces contenant des parasites visibles - Sensibilisation et motivation du personnel Respect des règles d'hygiène Contrôle des équipements de séchage - Suivie de la température et de degré d'humidité à cœur du produit. Une vérification visuelle minutieuse.	Contresignature des documents dans moins de 24 heures
Stockage	Altération thermophiles et xérophiles	Température de stockage: T< 40° C Humidité < 16%	Température et humidité de stockage	Thermomètre calibré Hygromètre	Deux fois par jour	Responsable laboratoires	Test bactériologiques	Le responsable du contrôle qualité vérifie et examine quotidiennement la fiche de contrôle du produit séché et le registre des mesures correctives (FC 006 et FC 017)

Plan HACCP - moules marinées

(CCP)	Danger	Seuils critiques	Procédures de surveillance				Action(s) corrective(s)	Vérification
			Quoi	Comment	Quand	Qui		
Réception	Moules insalubres Moules altérées	Absence de toxicité < 300 coliformes fécaux/100 g de chair de mollusque ou < 230 *E. coli*/100 g de chair de mollusque	Salubrité de la zone de cueillette État bactériologique des moules cueillies	Contact du réseau de surveillance: certificat de salubrité de la zone Prise échantillon et analyse au laboratoire	À chaque marée (15 jours) À chaque marée (15 jours)	Responsable qualité	Rejet du lot en cas de moules insalubre ou altérées	- Le responsable du contrôle qualité vérifie et examine quotidiennement la fiche de contrôle à la réception donnée par le laboratoire et le certificat de salubrité donné par l'INRH et le registre des mesures correctives (FC 001 et FC 017)
Préparation de la marinade	Développement des bactéries acidophiles, des moisissures, levures et lactobacillus	Respects des pourcentages Sel Vinaigre eau	Méthodes de préparation	Suivi de la fiche d'instruction de préparation de la marinade Mesure du pH de la préparation par le pH mètre	À chaque préparation de marinade	Responsable qualité	Le responsable qualité: - isole le produit affecté et évaluation de l'innocuité - Consigne les cas de non-conformité dans le registre des mesures correctives - signe et date la mesure corrective prise Détermine la source du problème et prend les mesures qui s'imposent pour éviter toute récidive	- Le responsable qualité vérifie et examine quotidiennement la fiche de contrôle du pH du produit et de la marinade (FC 005 et 009 et le registre des mesures correctives (FC017) Étalonnage régulier du pH mètre Étalonnage régulier du thermomètre (FC 015)
Marinage (1 ère semaine de stockage)	Faible acidification du produit engendrant une contamination	pH = 5,3 au cœur du produit après 24 heures et pH ≤ 4,5 après une semaine	Bon dosage de la marinade	Mesure de l'acidité dans le produit et dans le liquide de couverture Détermination de la teneur en sel du produit	À chaque marinage Après 24 heures et après une semaine	Responsable laboratoire	- Écarter les lots concernés, et faire test bactériologique - si test négatif (pas de croissance microbienne) refaire le marinage et garder le lot - si test positif croissance microbienne: rejet du lot - Sensibilisation et motivation du personnel - Respect des règles d'hygiène	- le responsable qualité vérifie et examine quotidiennement la fiche de contrôle du pH du produit et de la marinade (FC 005 et 009 et le registre des mesures correctives (FC017) Étalonnage régulier du pH mètre Étalonnage régulier du thermomètre (FC 015)
Stockage	Altération psychrophile et acidophile	Présence des bêtas bactéries, levure et moisissures pH ≤ 4, 5 T°≤ 6 °C	Contamination pH de la marinade	Analyse visuelle Présence de trouble dans la boîte Analyse microbiologique pH mètre calibré	À partir de la deuxième semaine de stockage du produit fini	Responsable laboratoire	- Séparer le lot concerné + Test bactériologiques + décision de garder les lots ou leur rejet selon le résultat du test bactériologique	- Vérification de la fiche d'enregistrement du réfrigérateur (FC 010 et FC 021) - et du registre des actions correctives (FC 017) Étalonnage thermomètre (FC 015)

FROM WASTE TO PRODUCT: SOME EXAMPLES USING MILD TECHNOLOGIES

[DU DÉCHET AU PRODUIT: DES EXEMPLES UTILISANT DES TECHNOLOGIES MODÉRÉES]

by/par

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Abstract

Due to rarefaction of fish products, environmental problems and an increase of the population, there is an urgent need to upgrade wastes into useful products, notably for food and feed applications. This presentation will expose how enzymatic hydrolysis can be useful for such purposes and can be easily applied into developing countries. Examples from Viet Nam, Tunisia, Madagascar and Senegal will be given.

Key words: Isoelectric focusing (IEF), Breaded fish products, Commercial fraud, Traceability

Résumé

Du fait de la raréfaction des produits de la pêche, des problèmes environnementaux et de la croissance de la population, il y a un besoin urgent d'améliorer l'utilisation des déchets en des produits utiles, notamment pour les applications alimentaires humaines et animales. Cette présentation exposera comment l'hydrolyse enzymatique peut être utile pour ces objectifs et peut être utilisée dans les pays en voie de développement. Des exemples du Viet Nam, de la Tunisie, de Madagascar et du Sénégal seront donnés.

Mots clés: Focalisation isoélectrique (IEF), Produits des pêches panés, Fraude commerciale, Traçabilité

1. INTRODUCTION

The raw materials that come from traditional fisheries and aquaculture can be regarded as a great and valuable source of proteins, both for animal and human consumption. However, a direct consequence of traditional fisheries practices is the large amount of wastes and by-products that they generate. They represent an economic and environmental problem since these biomasses are often underutilized creating disposal problems and environmental concerns (Folador *et al*., 2006). The marine by-products in general can be classified into three main groups:

- discards (portion of the total organic material of animal origin in the catch, which is thrown away, or dumped at sea for whatever reason; they comprise small-sized and non-targeted species with low commercial value);
- wastage on board (wastes generated by fish processing inside the vessels); and
- by-products and wastage on shore, due to fish processing and trade industry (Blanco *et al*., 2007). Out of the estimated 141.6 million tonnes of fish and shellfish landed each year worldwide (FAO, 2006), only one part is used for direct human consumption. Estimates of this direct use vary from 50–70% according to the type of species and the possibilities of processing.

Until recently, these by-products were commonly recognized as low value resources with negligible market value (Klompong *et al.,* 2007), thus they have often been dumped or used without treatment for animal feed or as fertilizer, even though the waste material was often high in protein and mineral sources. However, due to the worldwide decline of marine living resources' stocks, a better use of bycatch and by-products is deemed necessary.

Hopefully, there are promising opportunities in the upgrading of marine by-products by using mild processing techniques to convert them into products for many application fields. Mild techniques like pH shift, fermentation, enzymatic hydrolysis, filtration, centrifugation and compression are used in the processing and production of valuable products. This presentation will expose some examples of marine wastes upgrading (two

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fishes, one mollusc and one crustacean) by using mild technologies. All the work presented here is conducted by PhD students, to an unspecified extent, in relation to industries that generate these by-products. These are preliminary studies and a lot of work remains to be done, but the preliminary results are promising.

2. MATERIAL AND METHODS

Whatever biomass is studied, some common techniques are employed. They are first presented and then followed by more specific techniques. The general strategy adopted for all the cases is presented in Annex I.

Proximal composition

All the following analyses were carried out both on the starting biomass (marine wastes or by-products) and the resulting fractions after mild processing.

Dry matter and ash
The percentage of dry matter was estimated gravimetrically. Ash content was calculated by weighing the samples after overnight heating of the dried samples at 600 °C.

Protein
Total nitrogen content was determined in the raw material and the aqueous phase generated by hydrolysis using the Kjeldahl method. Crude protein was estimated by multiplying the total nitrogen content (%N) by factor 6.25.

Lipid
Lipids were extracted according to the Folch procedure (Folch *et al.,* 1957). Total lipid content was determined gravimetrically after solvent extraction and evaporation.

Mild technologies (bioprocessing)

Enzymatic hydrolysis
Two large-spectrum proteases (Protamex and pepsine) were used as they were non GMO, food accredited, industrial and not expensive. Moreover they could work in a large range of temperatures and pH.

Raw materials were mixed and homogenized with (or without) water before enzyme addition and hydrolysis were conduced into controlled temperature tanks (temperature is maintained toward the range of the activity of the selected enzyme) and the pH was monitored and sometimes controlled.

Fraction recovery
At the end of the hydrolysis, enzymes were inactivated (by increasing temperature or pH change), the solutions were filtered in order to remove the solid particles (such as bones). Liquid fractions were then centrifuged leading to an insoluble phase (sludge) and a soluble one (supernatant). In the case of fatty biomass, an oily phase can sometimes be recovered at this stage.

Biological samples

Tuna head
Yellowfin tuna *(Thunnus albacares)* was caught in the Pacific Ocean, stored in ice and brought to the seafood processing company “Hai Vuong” in Nha Trang, Viet Nam. Raw fish was filleted less than 36 hours after catch. Heads were collected, frozen and transported to IFREMER (Nantes, France). The heads were then thawed and ground and the minced materials were packed into plastic bags (0.5 kg per unit), frozen and stored at -20 °C, until they were used for the hydrolysis experiment.

Cuttlefish viscera
Cuttlefish (*Sepia officinalis*) was provided by the seafood processing company “Calembo” (Sfax, Tunisia). Mature individuals were caught in the Gabes Gulf by trawling during November 2005. The cephalopods were then immediately stored in ice and transported to the laboratory where they were eviscerated. The collected viscera were homogenized for one minute and then frozen at -80 °C until used. Endogenous enzymes were not inactivated. The cuttlefish viscera fraction included all the organs usually found in the abdomen of mature cuttlefish, and only the ink gland was removed.

Shrimp head
Heads of frozen cultivated shrimp (*Penaeus monodon*) and wild shrimp (mixture of *Penaeus indicus*, *Penaeus japonicus*, *Penaeus monoceros* and *Penaeus semisulcatus*) were collected from a processing factory (UNIMA Madagascar). They were sent to IFREMER (France) in frozen form and stored at -20 °C before use.

Backbones of tropical sole
Backbones from tropical sole (*Cynoglossus senegalensis)* were collected from a processing factory (Sénégal Pêche, Senegal) and sent to IFREMER in frozen form. They were kept at -20 °C before use.

3. RESULTS AND DISCUSSIONS

All these experiments were based on the same procedure, i.e. the bioconversion of biomasses by using industrial enzymes, in order to generate useful products (or fractions). All the preliminary trials were done in France at IFREMER's laboratory but, as the objective was the sharing of know-how and technology, all the procedures were adapted to local context (Viet Nam, Tunisia, Madagascar and Senegal).

As a first step, quantitative (tonnage, seasonality, availability, etc.) and qualitative (food grade or not) data regarding the raw material (wastes mainly from fish processing industries) were collected in order to define potential application fields (feed, food, etc.). At the same time, a biochemical characterization was conducted in order to identify potentialities (protein, lipid, other, etc.) and to identify the strategy to be adopted (protection of lipid, protein or peptide, etc.). Of course, the global strategy further adopted took into account the specific context (equipment, field of application, etc.).

This presentation will expose 4 examples of wastes upgrading for different purposes.

Tuna head
Regarding the different fish factories in Viet Nam, tuna factories are among the most important. Nowadays, tuna heads are generally considered as waste and are thrown away but, in some cases, are used in fishmeal factories.

After analysis, the proximal composition of the tuna heads was established: 61% of moisture, 16% of proteins, 11% of lipids and 11% of ashes. It appeared that this biomass had a relatively high content of protein and in a lesser extent of lipids. Moreover, the big quantities available and their quality (food grade) allowed the development of a strategy for producing food and feed products.

Initial experiments using different hydrolysis conditions (time length, nature of enzyme, temperature) were conducted in order to define the level of proteolysis and the protein solubility. As this was a fatty biomass, the lipid localization (sludge or supernatant) was also studied. This screening procedure lead to the selection of the enzyme Protamex, a ratio enzyme/substrate of 0.5, a temperature of 45 °C and a maximum time length of hydrolysis of 6 hours.

Regarding local considerations, two upgrading strategies were retained: feed pellet for shrimp and protein enrichment of fermented sauce (Nuoc Mam).

Viet Nam is one of the big producers of cultivated shrimp and thus a big consumer of raw materials for feeding (fish meal, fish oil, etc.). As the price of these materials has increased considerably, alternative strategies are welcomed. Different trials of substitution (partial or complete) of fishmeal (and also some proportion of fish oil) into the pellet have been done using fractions after tuna head hydrolysis (sludge, supernatant, mix, etc.).

The processing of fermented sauce is a traditional way of preserving fish in South-East Asia. Heavily salted fish with 2 to 3 parts water in closed tanks is used for fermentation over 6 to 12 months. Biochemically, fish sauce is a salt-soluble protein in the form of amino acids and peptides. The idea of this work was to determine if the enrichment of a fish sauce by a hydrolysate could improve its quality, thus different trials were done: different hydrolysates (after 2, 3 and 6 hours of proteolysis) were added to a fish sauce at different stages of maturation.

Therefore, such processes appear useful for converting waste (tuna head) into valuable products (pellets and fermented sauce). At this stage, different kinds of operators were associated: the producers who want to eliminate their wastes at a lower price and the final users who are pleased to find "new" raw materials. In case of success, an economic evaluation of this strategy will be conducted, implying new trials on a bigger scale.

Cuttlefish viscera

The cuttlefish (*Sepia officinalis)* is among the most exploited marine species in Mediterranean waters and particularly in the Gulf of Gabes (south-east of Tunisia) and the landings occur essentially in the fishing port of Sfax. The waste loads generated from the processing plants of marine species, in addition to the concentration of the conditioning activity on the shores, are becoming a major problem. Indeed, during transformation steps, large quantities of waste, including viscera, are generated and discarded. However, the proximal composition has revealed that viscera contain at least 15% of proteins and 5% of lipids, thus a processing strategy has been developed to reduce the polluting impact and to find some useful applications for them. As this material is not food accredited, only feed applications have been screened.

Due to local context, we chose to look for large-spectrum protease that can work in extreme pH conditions (out of the range of bacterial growth to avoid microbial development) but with middle temperature (to limit the processing cost). This screening procedure lead to the selection of the pepsin due to the high yield of protein solubility, its low cost and its working range (pH=2, temperature = 55 °C, maximum time length = 6 hours). For the application fields we decided to focus on aquaculture feed but with some extension compared to classical feed. Indeed, some antibacterial activities were screened notably against aquaculture pathogens. Some hydrolysates with both nutritional interest (amino acid composition) and biological activities (antipathogenic ones) were then produced. Preliminary trials for optimising the yield and the activity were also carried out.

This study was initially focused on environmental problems but as some valuable products were identified the project changed. Indeed, the wastes could now be converted into products for feed purposes, but a lot of additional work has to be done, such as *in vivo* trials for antipathogenic screening, upscaling of membrane process, etc. However, even without such data, fisheries that generate those polluting materials are interested and are following these studies.

Shrimp head

Shrimp production has developed well in Madagascar, with an increase of 7.3% of production per year. The average production is currently 16000t with 25% coming from aquaculture. In 2002, the shrimp wastes (due to local processing) were estimated at 4800t; most of time they are thrown away but sometimes they are turned into fertilizer or used in animal feed. However, shrimp wastes (head and shell) still contain useful components such as protein, lipid, astaxanthin pigment and chitin, the extraction of which is interesting for generating more marketable, valuable and acceptable products in a number of applications.

A bibliographic analysis has revealed that the crude shrimp head constitute a valuable biomass for biotechnological upgrading. Therefore, we decided to focus only on this raw material. For practical considerations and for PhD work purposes, only one species of shrimp (*Penaeus monodon*) coming from aquaculture has been studied. Heads are rich in proteins (49%)[1] and to a lesser extent in fat (17%) while chitin represents around 17%. Thus, enzymatic proteolysis would be able to generate fractions enriched in proteins and devoid in minerals and with a lower content of fat and such fractions could be useful for food or feed applications. Preliminary trials have demonstrated that pepsin is the more adapted enzyme due to the high proteolysis yield and the absence of bacterial contaminations. Moreover, in some conditions, interesting fractions were obtained i.e. hydrolysates with high nutritional value and with an inhibition of the angiotensin converting enzyme (link to hypertension). Such products are currently in evaluation with *in vitro* and *in vivo* (poultry) trials. A simplification of the whole process (hydrolysis + concentration) has been done in order to be transferred to local partners (laboratory and industry from Madagascar).

This approach is quite new in Madagascar and at the beginning we encountered some difficulties. However, as the preliminary results were satisfactory (poultry feed), shrimp producers are now interested. Indeed, one of them is now associated to the PhD work and is currently studying the implementation of such procedure. Nevertheless, a lot of work remains to be done, such as to study the effectiveness of such feeding supplementation compared to a classical feed, the cost of this transformation at big scale and the optimisation of this procedure for obtaining different products (feed for poultry, valuable hydrolysates, chitin, etc.).

Backbones of tropical sole

Among all the by-products studied here, backbones from *Cynoglossus senegalensis* are of the highest quality in terms of freshness and they possess a high nutritional value. Indeed, in some cases they are used for pulp production. The aim of this study was to put forward an alternative to this pulp which has very few market

[1] As chitin is rich in nitrogen that is also quantified by the Kjedhal method we have an overestimation of the total protein content into raw material but some corrections have been applied by using also colorimetric trials such as the method of Lowry and/or Biuret.

demands in spite of its quality. Enzymatic hydrolysis can constitute an interesting procedure for food purposes by generating nutritive products that can be used in food industries. However, on the other hand, bitterness has to be lowered and palatability has to be increased.

Due to these considerations, the enzymatic complex Protamex was chosen as this complex is used for different food/feed applications and its cost is not too high (€/15 kg). Interaction process/products have been studied, such as temperature and time of hydrolysis, ratio of enzyme, quantity of water and inactivation procedure. The purpose was to determine the effects of different processing parameters (quantity of enzyme, time, temperature, etc.) on the aromatic properties of tropical sole hydrolysates. Thus, volatile compounds are extracted, identified and quantified while the sensory properties of the final products are described by sensory analysis. In addition, *in vivo* trials on poultry are in progress in order to evaluate the nutritive effects (growth rate, palatability, yield of conversion, etc.).

As the raw materials used here are of very high quality, a process leading to "new" food products has been retained. Indeed, the first trials have revealed the very good sensory properties of the resulting hydrolysates. However, it is too early to estimate if this technology can be transferred to the industry, as those products are quite new and imply a new marketing strategy.

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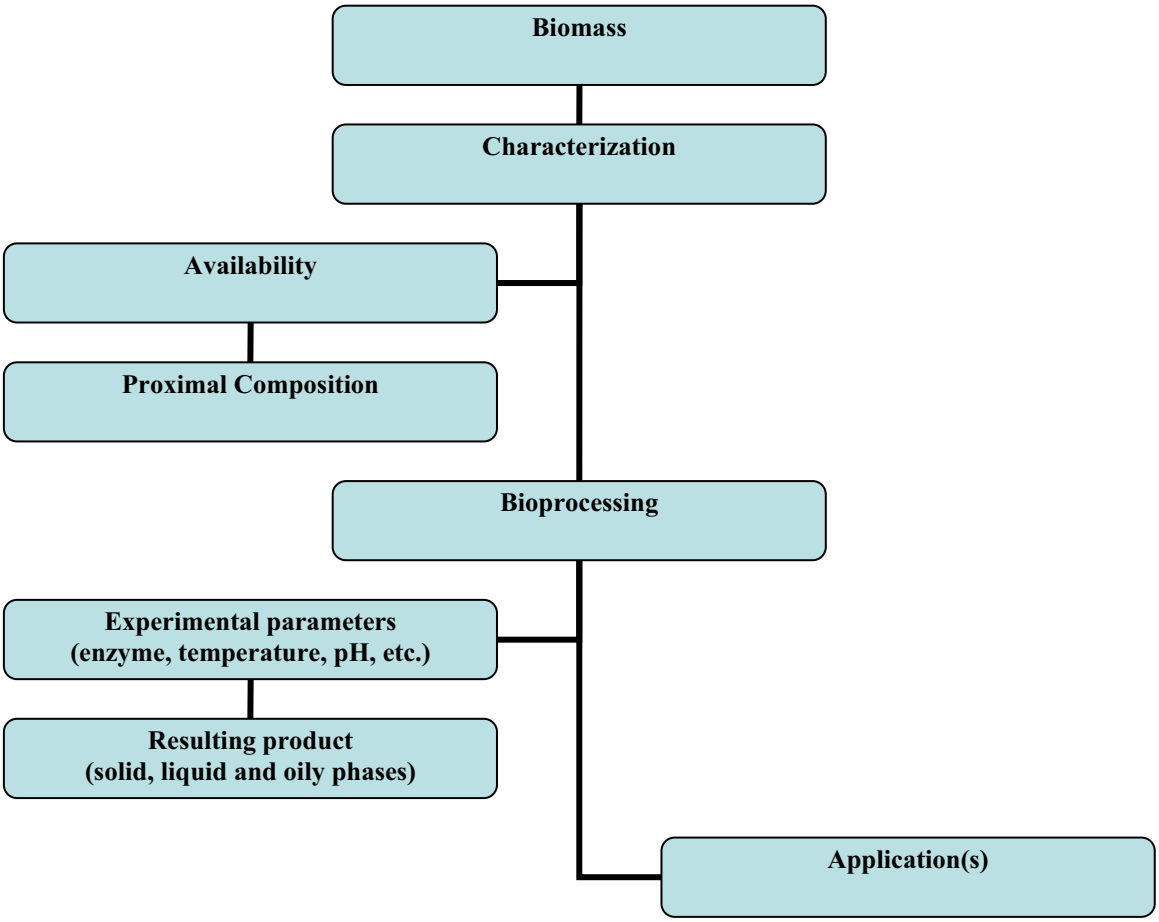
ANNEX I

General Strategy



PROMOTING VALUE-ADDITION AND IMPROVED SMALL-SCALE FISH PROCESSING IN LAKE VICTORIA

[PROMOUVOIR LA VALEUR AJOUTÉE ET LA TRANSFORMATION AMÉLIORÉE À PETITE ÉCHELLE AU LAC VICTORIA]

by/par

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Abstract

Fish is an important commodity for the three East African Countries sharing Lake Victoria. This lake is the major source of fish exports contributing over US$300 million from international markets. Substantial amount of fish is also exported to regional markets in Central and Southern African Countries. New markets have also opened up in Southern Sudan. The challenge facing Lake Victoria fisheries is to meet the growing demand without compromising its sustainability. Fish quality standards were developed and harmonized under the EAC Sanitary and Phytosanitary Standards for capture, marine and aquaculture Volume 3. Improved methods of processing and adding value to fish and fishery products have been initiated, tested and demonstrated to the fish processors. Ecolabelling and fair trade aspects are viewed as possibilities of maintaining and guaranteeing market for the fishery products from Lake Victoria. The overall focus is to increase availability of fish to local consumption, regional trade and international markets with the intent of maintaining long-term sustainability of the fisheries resources of Lake Victoria.

Key words: Artisanal fisheries, Lake Victoria, Value addition

Résumé

Le poisson est une importante denrée alimentaire pour les trois pays d'Afrique de l'Est partageant le lac Victoria. Ce lac est la source majeure de poisson d'exportation contribuant pour plus de 300 millions de dollars EU provenant des marchés internationaux. Une quantité substantielle de poisson est aussi exportée sur les marchés régionaux dans les pays d'Afrique centrale et australe. De nouveaux marchés se sont aussi ouverts au Sud Soudan. Le défi auquel sont confrontées les pêcheries du lac Victoria est celui de répondre à la demande croissante sans compromettre sa durabilité. Les normes de qualité du poisson ont été développées et harmonisées dans le Volume 3 des Normes sanitaires et phytosanitaires de poisson de capture marine et d'aquaculture des pays d'Afrique de l'Est. Les méthodes améliorées de transformation et de valeur ajoutée du poisson et des produits de la pêche ont été initiées, testées et démontrées aux transformateurs de poisson. Les aspects de l'écoétiquetage et du commerce éthique sont vus comme des possibilités de maintenir et garantir le marché pour les produits de la pêche du lac Victoria. L'objectif global est d'augmenter la disponibilité du poisson pour la consommation locale, le commerce régional et les marchés internationaux tout en maintenant la durabilité à long terme des ressources halieutiques du lac Victoria.

Mots clés: Pêche artisanale, lac Victoria, Valeur ajoutée

1. BACKGROUND

Fish is an important commodity to the three East African Countries sharing Lake Victoria, namely, Kenya (6%), Tanzania (51%) and Uganda (43%). Lake Victoria covers approximately 68,800 km² and is the largest freshwater lake in Africa and second to Lake Superior in the world. The lake has a shoreline of 3,450 km with a catchment area of 194200 km² extending into Rwanda and Burundi. Lake Victoria's basin supports a population of 34 million people who derive their livelihood directly or indirectly from the resources within the basin (LVBC, 2007). Lake Victoria fisheries contribute 0.5% in Kenya, 2.5% in Tanzania and 2.6% in Uganda to the respective GDP, in terms of food, income, employment and foreign exchange earnings. Per capita, fish consumption is 5 kg in Kenya, 10 kg in Tanzania and 10 kg in Uganda, which are below the world average of 16.5 kg/person/annum. Lake Victoria's total fish production is estimated at one million tonnes, worth US$650m of which US$340 is generated at the shore and US$310 is generated from fish exports estimated at 86,000

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tonnes (LVFO, 2007). The Lake Victoria fisheries sub-sector provides employment to over three million people of which about 200,000 are fishers (LVFO, 2008).

Lake Victoria Fisheries Organization

Lake Victoria Fisheries Organization (LVFO) is a specialized and autonomous regional institution of the East African Community (EAC) responsible for coordinating and managing the fisheries resources of Lake Victoria. (EAC, 2000, 2003, 2004), The Partner States of Kenya, Tanzania and Uganda, with support of FAO, formed Lake Victoria Fisheries Organization through a Convention signed in 1994 to jointly manage the fisheries of Lake Victoria. The Organization started its operations in 1997. The objective of the LVFO is to foster cooperation among the Partner States by harmonizing national measures, developing and adopting conservation and management measures for the sustainable utilization of living resources of Lake Victoria for maximum socio-economic benefits. The main functions of the LVFO are to:

- Promote the proper management and optimum utilization of fisheries and other resources of the lake;
- Enhance the capacity of existing fisheries institutions;
- Provide a forum for discussion on the impact the initiatives have on the lake;
- Provide for the conduct of research on the living resources of the lake and its environment;
- Coordinate and undertake training and extension in all aspects of fisheries;
- Consider and advise on the impact of introduction of non-indigenous organisms into Lake Victoria;
- Serve as a clearinghouse and a data bank for information on the fisheries of the lake; and
- Promote the dissemination of information (LVFO, 1996, 1999, 2005).

Fish processing sector

There are two distinct fish processing subsectors on Lake Victoria, that is, the small-scale artisanal fish processing and large-scale industrial fish processing. Small-scale artisanal fish processing uses old traditional preservation methods which dates back to past centuries and now are the base of vibrant commercial enterprises. Artisanal fish processing contributes significantly to domestic and regional trade and is dominated by women who constitute 23% of the people directly involved in fisheries' activities at the beaches (LVFO, 2007). The main traditional methods are hot smoking, sundrying and salting, a combination of two or more of these methods and the recently introduced deep-frying. The sardine-like pelagic species are usually sundried and the bigger species are either smoked or salted/sundried. The processed products include the smoked, dried or salted Nile perch, smoked, dried or salted tilapia, sundried *Rastrineobola argentea* (dagaa/omena/mukene), sundried Haplochromines, smoked *Bagrus* sp. Smoked *Clarias* sp., smoked Barbus sp. and smoked *Synodontis* sp.

Industrial fish processing started in late 1980s and focused on the abundant Nile perch and there are 35 fish factories established along the shores of Lake Victoria. The major products include fillets and dried fish maws which are exported to international markets; and the by-products which are sold fresh or reprocessed into smoked, salted, sundried or deep-fried products by artisanal processors for the domestic and regional markets. Filleting of tilapia is limited as a precautionary measure for domestic consumption. It is mainly sold whole in fresh form or as smoked or salted/sundried products in the domestic or regional markets.

2. ISSUES IMPACTING ON FISH PROCESSING

The major concern in the Lake Victoria fisheries is the decline of the Nile perch fishery, the increasing regional illegal trade in undersized fish, particularly for the Nile perch and tilapia and the high post-harvest losses especially for dagaa/omena/mukene. These concerns further intensify the issues affecting fish processing, such as fish supply, market access and maintenance, source of fuel power and fish processing facilities with significant differences with regard to the nature of fish processing.

Fish supply

The fish stock of Lake Victoria is estimated at over 1,160,000 tonnes with insignificant changes over the years. Significant changes are shown in the species composition where the dagaa/omena/mukene has increased tremendously making it the dominant species. The Nile perch biomass has decreased and the haplochromines, which had almost disappeared, are recovering. In 2005 the Nile perch biomass was 543,736 tonnes, dagaa was 495,362 tonnes and that of haplochromines and other species was 438,663 tonnes. By 2008 the biomass for Nile perch had reduced to 298,644 tonnes, that of dagaa had risen to 1,110,145 and that of haplochomines and other

species rose to 625,180 tonnes. Similarly, the dagaa constitutes about 60%, Nile perch constitutes 23%, tilapia 5%, Haplochromines 10% and other species 1% of the fish catches (LVFO, 2008).

The decline of the Nile perch fisheries has reduced fish supply to the fish factories and the small scale fish processors of Nile perch by-products with serious consequences. Over 10 fish factories on Lake Victoria have closed and the remaining 25 are operating under capacity (Pollard, 2008). The small scale, artisanal fish processors dependent on the Nile perch by-products are getting less raw materials as factories refined the filleting skills. The recovery rate of fillet has risen over the years from 30% (1988/2001) at the beginning of industrial fish processing to 43–49% in 2007 (Boeri, 2007).

The decline of the Nile perch fishery calls for value-addition to the limited catches and emphasize the urgent need to implement a recovery plan for the Nile perch fishery.

The increase in the dagaa fishery and other native species, which now constitutes over 70% of the catch, has increased fish supply to small scale artisanal fish processors. The challenge is to ensure that the fish is properly preserved, processed and basically used for human consumption.

Market aspects

Fish exports to international markets have declined from 91,200 tonnes valued at US$319.4m in 2005 to 86,000 tonnes valued at US$310m in 2007. Dagaa and the haplochromines, which now constitute over 70% of the biomass have low market value and fetch less income compared to Nile perch (LVFO, 2008). In 2007 the catches remained close to one million tonnes but the beach value dropped by 22% due to the decrease of high value Nile perch and dominance of low value dagaa and other pelagic species. The Nile perch catches dropped by 18% and the value decreased by 34%, whereas the dagaa catches went up by 33% the value increased by 19% (Muhoozi *et al*., 2008).

It is estimated that 80% of the fish catch is undersized (Johnson, 2008) and this represents an economic loss to the Partner States for it fetches less money than that at maturity size. Mugabira (2008) established that Uganda has a potential of earning US$500m in fish exports but loses over US$360m annually by earning an average of US$140 m due to harvesting of undersized Nile perch. The Nile perch fishery has continued to attract investments due to lucrative earnings, prompt cash payments and assured ready market. The increasing demand has precipitated the increase in fishing effort (in terms of fishers, boats, fishing gear, engines and fishing time) and the use of illegal gear. The total number of fishers rose from 129,305 in 2000 to 175,890 in 2006 and to 199,242 in 2008. The use of illegal gear, such as the monofilament nets, has increased by eight-fold from 2,293 in 2006 to 20,194 in 2008 (LVFO, 2008). The reduction in fish supply to fish factories and the stiff competition posed by the suppliers of small-sized farmed fish fillets (Bassa and Pangasius) from Asia has prompted the Industrial fish processors on Lake Victoria to implement self policing to eliminate the processing and marketing of undersized fish and to consider value-addition as an option (Borel, 2008).

The increasing regional illegal trade in undersized Nile perch and tilapia products is a major concern to the Partner States as it contributes to depletion of fish stocks in Lake Victoria (LVFO, 2007). Regional fish trade has expanded from Central and Southern African Countries to include new markets in Southern Sudan. Fish exports to regional markets are dominated by traditionally processed products of sundried dagaa, salted/sundried and smoked tilapia and Nile perch. Tanzania and Uganda are the main fish exporters, while Kenya is an importer. In 2005 Tanzania recorded exports to regional markets were about 3,000 tonnes of which dagaa comprised 1,700 tonnes (Odongkara, 2006.). In Uganda, fish exports to regional markets in 2007 were estimated at 21,000 tonnes valued at US$33m (Borel, 2008). Regular data collection on domestic and regional markets is hindered by logistical constraints including the permeable national borders, where fish can be taken across without passing through the customs border posts.

Domestic trade is dominated by fresh and smoked products of tilapia, sundried dagaa and Nile perch by-products as well as various products of native fish species. In 2007, the Nile perch by-products from factories were estimated at 98,748 tonnes with a value of US$74m (Pollard, 2008). The major concern is the lack of appropriate fish handling, preservation and processing facilities in local markets and artisanal processing areas. Nile perch by-products in transit from the fish factories and in the markets or artisanal processing areas are poorly handled. Fish quality and safety measures are mainly enforced to fish destined for international markets.

Energy source

Artisanal fish processing is still viable among local communities with very limited access to refrigeration (Kayiso, 2007) and other preservation facilities. Less than 1% of the 1433 fish landing beaches on Lake Victoria have cold rooms (Yongo *et al*., 2008). The majority of fishing villages lack constant supply of power such as electricity, solar or biogas. Only 4% of the fish landing beaches on Lake Victoria have electricity. The traditional fish processing methods of sundrying and hot smoking highly depend on sunlight and firewood as the main source of energy and these are greatly affected by the vagaries of nature. Post harvest losses are high (60–80%), particularly during the rainy season. Only 3% of the fish landing beaches have fish stores for dried products. An entire catch of dagaa may be lost due to rain.

Deforestation in the lake basin has been severe in the last few decades due to agricultural encroachment and increasing demands for fuelwood, charcoal, timber, and other purposes (LVBC, 2007). Many of the fish landing sites are established near the gazetted forest reserves, where collection of fuelwood is prohibited and nearby woodlands depleted. Artisanal processing can be sustainably carried out if processors living on lake shores are encouraged to plant and own woodlots (Kayiso, 2007). The challenge is to introduce small-scale fish processing methods that can reduce the post-harvest losses and reduce the effect of nature on the artisanal fish processing.

Facilities for artisanal fish processing

The lack of social facilities puts the artisanal fish processors in a vulnerable position. Lack financial services and lack of a saving and investment culture amongst the fisher communities hinder adoption and investment in improved processing methods. Less than 1% of the fish landing beaches have drying racks or driers and only 30% of the artisanal fishers, fish traders and processors have bank accounts (Yongo, 2008), in banks located in distant towns.

3. REGIONAL EFFORTS TO ADDRESSING CHALLENGES

Resource sustainability

The LVFO Partner States are signatory to the FAO Code of Practice for Responsible Fisheries and implement the Strategic Vision and the Fisheries Management Plan (FMP) for Lake Victoria. The Partner implement the Regional Plan of Action to prevent, deter and eliminate Illegal, Unreported and Unregulated (RPOA-IUU) fishing on Lake Victoria to eliminate illegal fishing and illegal trade in undersized fish. Similarly, the LVFO Partner States implement the Regional Plan of Action for Management of Fishing Capacity (RPOA-Capacity) on Lake Victoria to control fishing effort and reduce fishing pressure on the declining stocks (LVFO, 2004; 2007). Fishery specific management plans for the major commercial species including a Nile perch recovery plan have been adopted and incorporated in the revised FMP2 for implementation. The Industrial fish processors in partnership with the Competent Authorities are implementing self monitoring and control (self policing) to curb the processing and export of undersized fish. The fisher communities have been mobilized into 1069 Beach Management Units (BMUs) and members trained and strengthened to work in a co-management partnership with government to manage the fisheries of Lake Victoria. All these efforts aim at recovery of the fish stocks and increase fish supply for domestic human consumption, processing industry and fish exports.

Measures to maintain the market

Fish quality and safety

The LVFO Partner States implement the EAC harmonized Sanitary and Phytosanitary Standards, Measures and Procedures, Volume III (fish and fishery products), which were endorsed by the EAC Summit of the Heads of States in 2006 to ensure compliance with international fish quality and safety standards and enhance consumer confidence. The LVFO collaborated with the EU Project on Strengthening of Fishery Products Health Conditions (SFP) in ACP/OCT to develop a Field Manual for beach inspectors, which comprises a checklist and guidelines for sanitary inspection in small-scale fisheries. The manual has been used to develop a training module for fish handlers on-vessel and at the beach. Under the EU-funded IFMP, the LVFO is supporting the improvement of fish handling and preservation facilities at 18 fish landing beaches and another 15 beaches are being provided with social infrastructure of their choice, such as water and sanitation facilities, dispensaries and schools (LVFO, 2008).

Ecolabelling of Lake Victoria fishery
The LVFO conducted an ecolabelling pre-assessment with support of the German Technical Cooperation (GTZ) to get preliminary information and establish whether the fishery meet the requirement to apply for Marine Stewardship Council (MSC) ecolabel. The study identified a number of gaps in the information but also noted the good recruitment in the Nile perch fishery and recommended for implementation of a fisheries recovery program (LVFO, 2008). Aspects of fair trade for the Naturland label are also being piloted in Bukoba, Tanzania with GTZ support (Naturland Project, 2008). The efforts toward ecolabelling aim at maintaining and enhancing the position of Lake Victoria fish in the global market.

Promoting value-addition production

Value addition for Nile perch
The LVFO, through the CFC/FAO/COMESA/LVFO Fishery Project on Value-addition, contracted a processing consultant to assist the Industrial Fish Processors to produce value-added fishery products (VAP). The consultant noted that there was little incentive for adding value on the fillets. The chilled fish fillets which comprised 75% of the fillet exports were attracting good prices and the frozen fillets also had specialized markets. The by-products offered more opportunities for adding value to products destined for export and domestic markets. The industrial fish processors had problems disposing of the by-products safely, although some were being sold to feed manufactures and local traders. A lot of wastage was also observed at the artisanal fish processing areas for by-products. Trial productions were conducted at selected fish factory premises in Uganda, Tanzania and Kenya. An 'open day' exhibition was held in each country at the end of the exercise to view and share information on the products. Most of the VAP can be produced in mass factory production or by small scale fish processors. Boeri (2007) noted that over the years the filleting skills of the workers had improved with recovery rates in fillets rising from 30% in 1999/2000 to 43 – 49% in 2007. The average yields from the experiments on Nile perch show that 43% is fillets, 55% is by-products and 2% is waste. Further breakdown on the yields is shown in the table below:

Table 1: Average yields of different products from Nile perch

	Yield
Fillet	43%
Skins	7%
Trimmings	2%
Fats	2%
Cheeks	1%
Frames	41%
Maws	2%
Waste	2%

Source: *Boeri, 2007*

A manual on VAP was prepared (Boeri, 2007) and has been available to the Industrial Fish Processors.

The VAP from fillets include:
- Chilled weight controlled portions;
- Frozen fillets or portions,
- Batter and breaded fillets or portions; and
- Retail products. All these have potential in the export market.

The major issues identified in VAP from fillets include:
- The stiff competition posed by large and tough companies owning production facilities in Europe;
- The producers in Lake Victoria face long distance logistics, transport delays and the need for bigger stocks for sea containers (economies of scale);
- The VAP producing companies have to offer a variety of products to the retailers (supermarkets), which is not possible at present for the tilapia from Lake Victoria cannot compete with similar cheaper products from Asia in the international market. Aquaculture in East Africa has not yet developed to provide substantial amounts of tilapia in the market and capture fisheries may not be adequate to enable a VAP Company to meet its obligations regularly;
- The issues of traceability and verification of other ingredients other than fish in VAP with regard to consumer health requirements may be a hindrance;

- The need to invest in automotive lines of processing and packaging;
- The lack of skills and need to train workers in automated lines;
- The importation of materials for value-addition may outweigh the benefits accruing to VAP;
- The need for increased working capital compared for what is required for the simpler operations of chilling and freezing; and
- The lack of developed market for VAPs within the Lake Victoria region to provide for an alternative market.

The VAP from by-products include:
- Battered and breaded products from Trimmings and recovered meat; These can be exported in bulk for production and packaging in importing countries or for production of surimi, fish sausages, bologna and hams or sold in local supermarkets, schools and hospitals and restaurants;
- Dried bladders are exported to Asian oriental markets;
- Polyunsaturated concentrated oil can be recovered over low temperatures and the technology is simple for use by small-scale producers;
- Cheeks can be exported to international markets as mini-fillets and Cocochas have a good market in Spain. Collars, wings and chests can be sold in the regional and domestic markets;
- Eggs, sacks and stomachs can be exported to Eastern European Countries but volume restrictions with freight costs are the major obstacles;
- Leather and other skins and scales: Skins with scales removed are prepared into rolled hot smoked products for regional markets. Skins can be used to produce leather goods, clean fish skins without scales, muscles and fat layers can used in the manufacturing of gelatines and glues; and the scales can be used in production of ornamental products;
- Fish meal can be produced from the remains of the recovery process of the by-products from the fish heads and rest of the frames; and
- Fish silage can be produced from the remains of the filleting operations and value-added production.

The major issues to consider in VAP from by-products include:
- The need to carry out research to identify potential markets for the VAP by-products;
- The need to undertake an aggressive marketing strategy to promote consumer acceptance within the Lake Victoria region, such as schools, hospitals, supermarkets and restaurants; and
- The need to encourage small-scale producers to adopt the simplified appropriate technologies to improve the quality of the by-products and reduce wastage.

Value addition in artisanal fish processing

It is estimated that 80% of the dagaa caught is processed into animal feeds and only 20% is available for human consumption. The LVFO supported the promotion of improved dagaa processing in order to add value, improve the quality and quantity of dagaa for human consumption and reduce post-harvest losses. The LVFO Fish Quality, Safety and Product Development Regional Working Group (FIQA RWG) conducted demonstrations on improved processing methods, with the participation of over 140 artisanal fish processors, at selected beaches in the three Partner States. Kenya and Tanzania focused on sundrying, dry-salting and brining. Uganda undertook smoking, frying and fermentation. In Kenya, the products were sold to local traders. In Tanzania, dried and salted-dried products were packed separately in 400 g and 800 g packets and retailed locally. In Uganda, both the deep-fried and smoked dagaa products were tested locally and in major towns.

The results showed that it takes 4 hours to dry and get quality dagaa using raised racks, whereas it would take six hours on nets placed on the ground. Both fried and smoked dagaa products had a shelf life of more than one month and had market potential. The low price for dagaa and the lack of information on better paying markets hinder the adoption of improved technologies. The LVFO plans to replicate the lessons learned from an USAID/Promasidor Project in Mbita, Suba District, Kenya, which supports women groups of dagaa processors with provision of drying racks, storage facilities and a regular regional market. The public will also be sensitized on the nutritional value of dagaa to increase its intake. The FIQA RWG prepared a manual on the improved fish processing methods for use by the artisanal fish processors. The LVFO plans to activate the dagaa component of the CFC/FAO/COMESA/LVFO Project to provide for training and micro-financing of dagaa fish processors.

Regional plans for post-harvest fisheries

The LVFO Fisheries Management Plan (FMP) was updated in May 2008 and a special program for FIQA was included. The focus is to improve fish handling, processing and marketing to guarantee safety and quality of fish products and increase value at all levels. The activities planned include:

- Encourage innovative public/private partnerships for product and market development for all commercial species (Nile perch, tilapia and dagaa);
- Promote an improved role for BMUs in fish safety, quality and marketing chain (including traceability and the support to cooperatives in the marketing chain);
- Sensitize stakeholders and collaborate with partners to improve fish handling and preservation at landing sites, during transport (e.g. design and construction of fishing and transport boats) and in markets (e.g. use of ice);
- Improve processing, packaging, marketing and storage of dagaa to enhance product quality and marketability;
- Develop and maintain the capacity of fish quality and safety laboratories in the partner states;
- Promote the use of environmentally friendly and low cost fishing and fish processing technologies in line with reducing the carbon footprint of the fisheries sector;
- Assist BMUs and other stakeholders to access market information;
- Achieve certification to an eco-labelling standard for the Nile perch fishery and promote partnerships for full utilization.

5. RECOMMENDATIONS

The Partner States' Governments should consider undertaking the following:

- Improve fish processing facilities and sensitize the fish processors and traders to adhere to fish quality and safety standards in the domestic market;
- Extend rural electrification programs to fisher communities to provide for alternative source of energy for household and small-scale processing;
- Support the fisher communities to plant woodlots for fuelwood and environmental conservation;
- Support market research within and outside the region for the value-added products of the Nile perch and dagaa to increase human consumption, improve prices for the VAP and encourage adoption of improved processing technologies;
- Support the Fish Quality WGs to follow-up on the dagaa demonstrations to address the bottlenecks hindering adoption;
- Encourage small-scale processors to invest in recovering species such as Haplochromis to increase utilization for human consumption;
- Support FIQA RWG to simplify and disseminate the VAP Manuals for Nile perch and dagaa into popular versions and local languages to the local fish processors;
- Provide micro-financing to promote investment and adoption of improved technologies for value-addition production by small-scale processors;
- Support programs for recovery of the fisheries, ecolabelling, and aquaculture development; and
- FAO to consider supporting a program to popularize the adoption of improved fish processing technologies and increased human consumption of value-added products.

6. CONCLUSIONS

Promoting value-addition will increase the fish available for human consumption, reduce post-harvest losses and increase earnings of the fish processors. Reduction in post-harvest losses would be possible if the fisher communities are provided with stable supply of power at reasonable rates. The fish processors should be encouraged to invest in alternative and cheaper energy sources, such as solar and biogas, and to plant trees for fuelwood. Improvement of artisanal fish processors livelihood requires financial support in adopting improved technologies and identification of a reliable market for the improved products. The Fisheries Competent Authorities should make deliberate efforts to sensitize the public and enforce quality and safety standards in the domestic market. Government should endeavour to provide social facilities to enable the fisher communities to access services, save and invest to enable them make the right choices and wise use of their earnings.

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IMPROVED FISH DRYING USING A POLYTHENE SOLAR DRYER

[AMÉLIORATION DU POISSON SÉCHÉ EN UTILISANT UN SÉCHOIR SOLAIRE EN POLYÉTHYLÈNE]

by/par

Kenneth Werimo[1] and John Malala

Abstract

Post-harvest fish losses along Lake Turkana beaches were estimated to be about 60%. One of the main causes of loss was the low technology used in sun drying, resulting in high contamination of fish with sand. Further, the drying process is slow, resulting in a product that is of low quality with a short shelf life, consequently loss of income to fishers. It was therefore essential to identify, test and adapt appropriate technology to shorten drying time, improve product quality and increase shelf life of fishery products.

This study assessed the effectiveness and efficiency of drying fish using solar dryer made of polythene (PE) sheets compared to the traditional open drying. Five drying systems consisting of a bamboo solar dryer on the ground, a raised solar dryer, a plywood solar dryer with black and another with white polythene sheet, were tested. Fish was harvested, split, washed and dried using the different systems.

The temperature inside the drying chamber increased from 33 ºC to 56 ºC, representing an increase by factor of 69.6%. The temperature inside the fish increased from ambient temperature to a maximum of 62.9 ºC, indicating an increase factor of 90.6%. Comparatively, the maximum temperature attained under open drying was 42.5 ºC, which indicates an increase factor of 28.8%. The enhanced temperature during solar drying reduced drying time from 48 hours to 30 hours. The drying ratio in solar dryer was about 0.28–0.30 compared to 0.29 under open drying. The water activity attained within 30 hours under solar dryer was 0.39–0.41 compared to 0.39–0.55 under open drying.

The results demonstrate that solar drying is more effective and efficient than open drying. In addition, solar dried fish products are of higher quality, with significantly less sand, have a firm texture, fresh fish odour and an extended shelf life of over six months. Solar dryers also have lower operating costs than mechanized dryers. In conclusion, solar dryers shorten drying time, improve product quality, extend the shelf life of the products, reduce costs and thus improve income to fishers.

Key words: Polyethylene, Solar dryer, Drying time, Drying ratio, Product quality, Insect infestation

Résumé

Les pertes post capture du poisson le long des plages du lac Turkana ont été estimées à environ 60%. Une des principales causes de perte était la faible technologie utilisée pour le séchage au soleil, d'où un poisson hautement contaminé en sable. Par ailleurs, le procédé de séchage est lent, engendrant un produit de faible qualité avec une courte durée de conservation, par conséquent une perte en revenus pour les pêcheurs. Il était donc essentiel d'identifier, tester et adapter une technologie appropriée pour réduire le temps de séchage, améliorer la qualité du produit et augmenter la durée de conservation des produits de la pêche.

Cette étude a évalué l'efficacité de sécher le poisson en utilisant des séchoirs solaires construits avec des feuilles de polyéthylène (PE) comparés aux séchoirs traditionnels ouverts. Cinq systèmes de séchoirs comprenant un séchoir solaire en bambou sur le sol, un séchoir solaire surélevé, un séchoir en contreplaqué avec une feuille en polyéthylène noire et un autre avec une feuille en polyéthylène blanc, ont aussi été testés. Le poisson a été capturé, séparé, lavé et séché par les différents systèmes.

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La température à l'intérieur de la chambre de séchage augmentait de 33 ºC à 56 ºC, représentant une augmentation d'un facteur de 69,6%. La température à l'intérieur du poisson augmentait d'une température ambiante jusqu'à un maximum de 62,9 ºC indiquant une augmentation d'un facteur de 90,6%. Comparativement, la température maximale atteinte sous un séchoir ouvert était de 42,5 ºC, ce qui indiquait une augmentation par un facteur de 28,8%. La température améliorée pendant le séchage solaire réduisait le temps de 48 heures à 30 heures. Le ratio de séchage avec un séchoir solaire était environ 0,28-0,30 en comparaison à 0,29 sous séchoir ouvert. L'activité de l'eau atteinte en 30 heures sous séchoir solaire était 0,39-0,41 en comparaison à 0,39-0,55 sous séchoir ouvert.

Les résultats démontrent que le séchage solaire est plus efficace que le séchage ouvert. En plus, les produits de pêche séchés sont de qualité supérieure, ont significativement moins de sable, une texture ferme, une odeur de poisson frais et une durée de conservation prolongée de plus de 6 mois. Les séchoirs solaires ont aussi des coûts opérationnels plus bas que les séchoirs mécaniques. En conclusion, les séchoirs solaires raccourcissent la durée de séchage, améliorent la qualité du produit, augmentent la durée de conservation, réduisent les coûts et ainsi améliorent les revenus des pêcheurs.

Mots clés: Polyéthylène, Séchoirs solaires, Temps de séchage, Ratio de séchage, Qualité du produit, Infestation par les insectes

1. INTRODUCTION

Studies conducted by KMFRI in Lake Turkana in early 2007 indicated that fish post-harvest losses were about 60% (LTRP, 2007).One of the main causes of this loss was the low technology used in sun drying .The fish is simply split and spread on the ground to dry. This leads to long drying time, low product quality and hence short life of the product. The market value of the product is significantly reduced with subsequent low income to fishers. It is therefore vital to identify, test and adapt appropriate technology to shorten drying time, improve product quality and increase shelf life of fishery products. One option is the use of solar dryer technology. 'Solar drying' is the method of using sun's energy for drying but excludes open air drying. The justification for solar dryers is that they may be more effective than direct sun drying, but have lower operating costs than mechanized dryers. Solar dryers can be more effective than direct sun drying and have lower operating costs than mechanized dryers. This will shorten drying time; improve product quality, long shelf life, reduce post-harvest losses and thus improve income to fishers.

This study was one of the components of the Lake Turkana Research Project whose broad objective was to generate information for sustainable development and management of Lake Turkana fisheries for enhanced food security through reduction of post-harvest fish losses, provision of high quality fish and fishery products, increased income and improved socio-economic status of the fisher community. The specific objective of the study was to identify, test and adapt an appropriate solar dryer for fish along Lake Turkana, so as to produce high quality sun-dried fish products. One of the activities was to evaluate the quality of sun-dried fish products from solar dryer compared to the traditional drying methods.

2. METHODOLOGY

Experimental design

The experimental design included five sets of drying regimes, namely:

- Bamboo trays with white polythene on the ground;
- Plywood trays with white polythene on the ground;
- Plywood trays with black polythene on the ground;
- Raised trays with white polythene; and
- Artisanal drying method on the ground.

Tray construction

The bamboo trays were constructed from bamboo as shown in Plate 1. Bamboo slats comprising the arcs are attached to the horizontal frame by cutting a slit just large enough to insert the slats. UV-protected polyethylene

(PE) sheets are used for the cover. PE sheets accumulate less dust and can remain serviceable even after 31 months of use (Rouweler, 1995).

The plywood tray is constructed using plywood, mosquito mesh and PE sheets, Plate 2. The raised tray was built with timber and cedar poles fixed on the ground with ballast Plate 3. The PE sheets are fixed on open doors on the sides to allow for turning of the fish during drying. Plate 4 shows the artisanal raised drying rack that will still not prevent contamination of fish from sand. Materials and cost estimates for construction of bamboo and raised rack dryers are given in Annexes I and II.

Plate 1. Improved bamboo solar dryer

Plate 2. Plywood solar dryer

Plate 3. Improved raised fish solar dryer

Plate 4. Traditional raised fish dryer

3. FISH SAMPLE PREPARATION

All the trial fish samples were fished using gillnets. Immediately after landing, the fish were scaled, split and washed using lake water. The samples were allowed to drain and were placed in the individual trays to dry. The unit operations are shown in Figure 1.

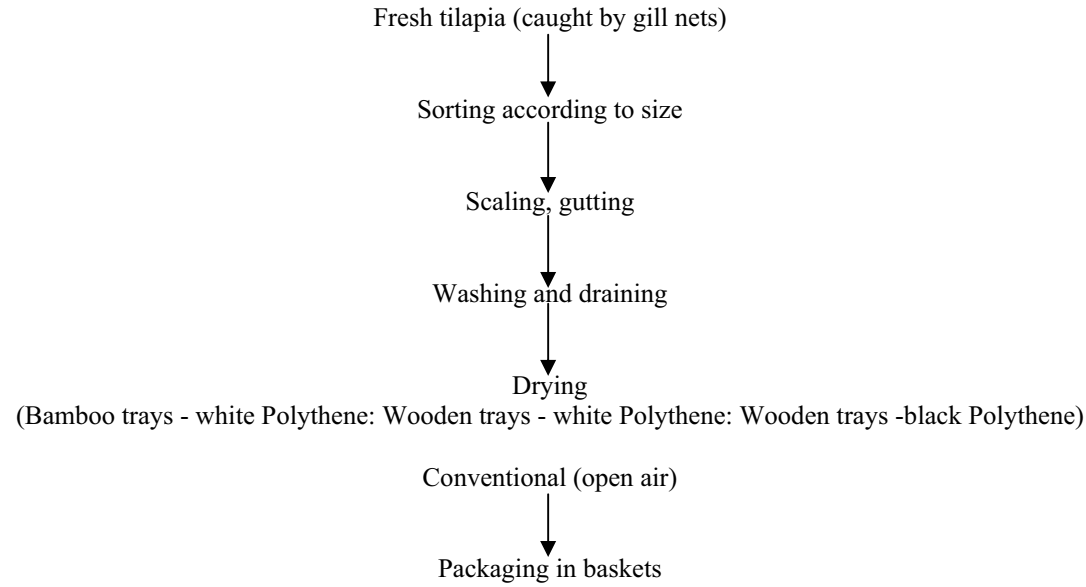

Figure 1. Process flow of improved drying of tilapia along Lake Turkana

During the drying process the parameters monitored were, weight changes, ambient temperature, temperature inside the drying chamber and in fish flesh. Temperature changes were monitored by a hand held thermometer. To compare the efficiency and effectiveness of the different drying systems, the drying ratio and product output were computed. The drying ratio is important in identifying a drying phase which does not correspond to the dryer's performance for a given product, and can assist in improving the drying system to improve the drying process. It is also useful for the end-user to check how advanced the drying process is, and the extent to which the dryer's characteristics change with time.

4. RESULTS

The white polythene solar dryer (Plates 1 and 2) gave better drying regimes than black polythene which generated a lot of humidity inside the chamber and thus affected the drying of the product.

The drying process took a minimum period of 24 hours and maximum of 30 hours in the solar dryers compared to the traditional drying method which takes up to 48 hours. The temperature inside the solar drying chamber increased from ambient temperature of 33 ºC to 39 ºC to reach a maximum of 62.6 ºC. Temperature inside fish during drying increased to a maximum of 62.9 ºC in the solar dryer, representing 90.6% increase from ambient temperature. Comparatively, the increase of temperature in fish under open drying rose to a maximum of 42.5 ºC i.e. 28.8% from ambient temperature. Product temperature profiles during the drying process indicate the relationship between temperatures at ambient, inside drying chamber and inside fish muscle. Drying rhythms indicate that the system is efficient and effective using raised rack as exemplified by the gradient of the weight loss versus time of drying. The time required to reach constant drying for both systems is approximately 24 hours.

The measured drying ratio in raised solar dryer was 3.01, bamboo 2.63 and artisanal (open) 2.93. The reciprocal of drying ratio in solar dryer was about 0.28–0.30 compared to 0.26 under artisanal drying, conforming to the values in the product datasheet of 0.25–0.33 (Rozis, 1997). Product output showed that raised solar dryer was more effective and efficient than the bamboo dryer and open drying. The water activity attained within 30 hours under solar dryer was 0.39–0.41 compared to 0.39–0.55 under open drying. This indicates that solar drying is actually more effective and efficient than open drying, as demonstrated by the narrow range of water activity. The solar dried fish product is of higher quality, since it has significantly less sand, has a firm texture, brown colour and fresh fish odour. Table 1 shows the drying parameters and organoleptic characteristics of the solar and artisanal dried products. The colour of the products was dark brown. After storage trials of up to six months there was no evidence of insect infestation.

Table 1. Drying parameters in different drying systems

	Drying Systems			
Drying Parameter	**Raised Solar Dryer**	**Bamboo solar dryer on ground**	**Tray solar dryer on ground**	**Conventional drying(Open Control)**
Ambient Temp (ºC)	32.0–37.0	32.1–39.3	32.1–39.3	32.1–39.3
Maximum T(ºC) in dryer	47.3	50	nd	38.1
Maximum T(ºC) in Fish	39.6*	50.0	48.4	42.5
Reciprocal of drying ratio	0.28–0.72	0.30–0.76	nd	0.26–0.72
Product output	1.6–31.5	1.5–28.3	nd	1.4–28.5
Water activity(aw)	0.39–0.41	0.39	0.39	0.39–0.55
Texture of product	Firm	Firm	Firm	Soft
Odour	Neutral	Neutral	Neutral	Fishy
Drying time	30 maximum	30	30	48
Insect infestation	absent	absent	absent	Evident within first week of drying

5. DISCUSSION

Foods are usually very well preserved if their water activity (a_w) has a value 0.2–0.4. At that a_w level bacterial growth and toxin production is zero, browning and enzyme activity are rather low, and food oxidation reactions have a minimum rate (Rouweler, 1995). Drying sometimes considerably changes the texture, colour, flavour, aroma and nutritive value of foods (Fellows, 1988).

The white polythene solar dryer gives better drying regimes than black polythene which generates a lot of humidity inside the chamber and thus affects the drying of the product. The drying process take a minimum period of 24 hours and maximum of 30 hours in the solar dryers compared to the artisanal drying method which takes up to 48 hours, and thus shortens the drying time by 37.5%. The enhanced temperature in the drying chamber and inside fish muscle hastens the evaporation of water from the fish, causing faster drying. In general, rapid drying and high temperatures cause greater changes to the texture than do moderate rates of drying and lower temperatures. High air temperatures, particularly with fish, cause formation of a hard impermeable skin. Flavours are lost at high drying temperatures. Longer drying times and higher drying temperatures cause greater pigment losses. The tested solar dryer attained maximum temperature of 62.9 ºC and drying time of 30 hours. From the drying rhythms observed the system is efficient and effective .The observed drying ratios are in agreement with data from the product data sheet described by (Rozis, 1997). The water activity attained within 30 hours under solar dryer was 0.39–0.41 compared to 0.39–0.55 under open drying. The narrow range of water activity indicated that solar drying is actually more effective and efficient than open drying. The solar dried fish product is of higher quality, since it has significantly less sand, has firm texture, brown colour and fresh fish odour.

Drying parameters and organoleptic characteristics of the solar and artisanal dried products indicated that drying process occurred within the recommended conditions as described by Rouweler (1995). The colour of the products was dark brown indicating that the drying process was slow. After storage trials of up to six months there was no evidence of insect infestation.

The improved quality and extended shelf life of the fishery products dried in solar dryer may be attributed to two factors:

- Drying under solar, hence higher internal temperatures, ensures that the adult *Demestes maculatus is* kept off from the wet, drying fish and hence no deposition of eggs in the fish occurs; and
- Attainment of lower water activity of 0.39–0.41 after 30 hours. The lower water activity inhibits the hatching of insect eggs that could have been laid.

Cost benefit analysis

To evaluate the benefits of the live polyethylene solar dryer a simple cost benefit analysis was conducted based on the cost inputs of the dryer, the increase in selling price of the dried fish product and period of replacing the polyethylene paper and, therefore, savings in terms of revenue. The results presented in Table 3 show that the payback period is about 6 days for dryer whose capacity is 50 kg of fish. The durability of the polyethylene paper may be up to 2 months.

Table 3. Investment analysis for polyethylene solar dryer

Without solar dryer		**With solar dryer**	
Total fish (kg) processed	50	Total fish (kg) processed	50
Expected Price/kg (K Sh)	80	Expected Price/kg (K Sh)	120
Daily value loss/kg	40	Daily savings (kg)	40
Daily value loss/50 kg	2,000	Daily savings/50 kg	2,000
		Investments cost (K Sh)	12,000
		Payback period (days)	6

6. CONCLUSIONS AND RECOMMENDATIONS

Solar dryers are therefore more efficient and effective than direct sun drying and have lower operating costs than mechanized dryers. Solar dryers shorten drying time; improve product quality, long shelf life for products, reduce post-harvest losses and thus improved income to fishers.

Due to the limited time dedicated to the studies on insect infestation, further investigation is required to ascertain the exact stage of the supply chain when the infestation occurs and thus mitigate preventative measures.

It is recommended that this technology should be available to the end users through selected pilot sites along the Lake Turkana shores to assess acceptability and effectiveness. There are at least five ideal sites for pilot study, namely: Longech, Namkuse, Nachukui (Northern Island), Todonyang, Ile Springs, Loiyangalani, Moite and Illeret.

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ANNEX I

Materials and cost estimates for the construction of a bamboo solar dryer

S/No.	Item description	Quantity	Estimated cost
1	Bamboo pole – 10’ long, 3" diam.	8 pcs @ 50	400
2	Bamboo pole - 6' long, 2" diam.	4 @ 50	200
3	0.125 mm X 240 cm UV-protected PE sheet	10m @ 350	3,500
4	1" common wood nails	1 kg @ 100	100
5	2" common wood nails	2 kg @ 100	200
6	Matt-1 pc	1 pc @ 120	120
7	Indirect costs		2,480
		Total	**7,000**

ANNEX II

Materials and cost estimates for the construction of a raised solar dryer

S/No.	Item description	Quantity	Estimated cost
1	Timber 2 x 2	100 ft @ 15	1,500
2	Cedar posts-9 ft	5 pcs @ 200	1,000
3	Timber 11/2 x 1 ft	60 ft @ 12	720
4	2" common wood nails	2 kg @ 100	200
5	1" common wood nails	1 kg @ 100	100
6	0.125 mm x 240 cm UV- protected PE sheet)	10 m @ 30	300
7	Wire gauze	10 m @ 350	3,500
8	Indirect costs		4,700
		Total	**12,000**

VULGARISATION D'UN NOUVEAU CONCEPT AMÉLIORÉ DE SÉCHAGE ET DE FUMAGE ARTISANAL DES ALIMENTS: APPLICATION EN MILIEU PÊCHE ARTISANALE AU GABON

[DISSEMINATION OF A NEW IMPROVED CONCEPT OF ARTISANAL DRYING AND SMOKING OF FOOD: APPLICATION IN ARTISANAL FISHERIES IN GABON]

by/par

Serge Ekomy Ango[1], Jean-Daniel Mbega and Essono Huguette Biloho

Résumé

L'activité de transformation des produits halieutiques, quoique fortement exercée au Gabon, est restée archaïque du fait de l'usage des fumoirs traditionnels et des conditions de travail pénibles. Le nouveau concept de transformation mis au point par l'Institut de recherche technologique a pour objectif d'améliorer les conditions de travail et la qualité des produits.

L'expérimentation sur site a conduit à l'analyse des paramètres de la nouvelle technologie à travers des applications concrètes et comparatives avec le système traditionnel existant. Les paramètres évalués concernent la durée du temps de travail, la qualité des produits (la teneur en HAP, l'apparence et le goût), la consommation en combustible (ratio bois/poisson), l'analyse des coûts des investissements, la valeur ajoutée, les capacités organisationnelles des acteurs. Il en ressort les résultats ci-après:

- la durée de fumage et de séchage du poisson est de sept heures et de huit heures pour le salage au maximum par rapport à deux à trois jours pour le fumoir traditionnel;
- la teneur en HAP des échantillons des fumoirs traditionnels donne 57 et 26 microg/kg de poids frais et ceux des prototypes 16 et 14 microg/kg de poids frais;
- la qualité sensorielle des produits des fumoirs traditionnels d'une même campagne de transformation est hétérogène mais homogènes pour le fumoir Bidul;
- la moyenne des ratios des différents essais en kg de bois consommé/kg de poissons donne pour les fumoirs traditionnels 3,12 et 4,66 et pour le fumoir Bidul 1,28 et 1,38.

Le fumoir Bidul peut faire l'objet de vulgarisation dans les communautés de pêche. Toutefois, des investigations sur l'amélioration du système de production des fumées froides doivent être poursuivies.

Mots clés: Transformation du poisson, Pêche artisanale, Gabon

Abstract

Fish processing is an important activity in Gabon but suffers from the use of traditional and outdated fish smoking kilns with severe effects on working conditions. The new concept of processing developed by the Technological Research Institute aims to improve the working conditions and quality of the products.

Onsite testing led to the analysis of the parameters of the new technology through specific and comparative applications with the existing traditional system. The evaluated parameters were the length of working time, the quality of products (content of PAH, appearance and taste), fuel consumption (ratio wood/fish), the cost analysis of the investments, the added-value and the organizational capacities of the stakeholders. The results were as follows:

- the duration of fish smoking and drying is seven hours and eight hours maximum for salting compared to two to three days in traditional smoking-rooms;
- the content of PAH of traditional smoking kilns is 57 and 26 microg/kg of fresh weight and those of the prototypes 16 and 14 microg/kg of fresh weight;
- the sensory quality of traditional smoking kilns' products of the same processing campaign is heterogeneous and homogeneous for the Bidul smoking kiln; and
- the average ratios of the various tests in kg of wood consumed/kg of fish is 3.12 and 4.66 for traditional smoking kilns and 1.28 and 1,38 for Bidul smoking kilns.

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The Bidul smoking kiln can be disseminated in fishing communities. However, research on the improvement of production of cold smoke systems must be continued.

Key words: Fish processing, Artisanal fisheries, Gabon

1. INTRODUCTION

Le poisson transformé (séché/fumé) est une ressource alimentaire importante au Gabon. Il permet aux populations à faibles revenus d'avoir accès aux protéines animales à moindre coût. Cette activité constitue la principale source de revenus pour les acteurs de ce secteur (producteurs) et d'autres ménages non directement impliqués dans les activités.

Malgré cette importance, le processus de production est resté archaïque et les conditions de travail sont très pénibles pour les transformatrices (en général des femmes, qui transforment le poisson frais en poisson fumé et salé). Elles manient les produits brûlants à mains nues dans les épaisses couches de fumées chaudes. Ce qui les expose/prédispose aux problèmes respiratoires et oculaires.

De plus, ces unités de production traditionnelles sont rudimentaires et ont un rendement énergétique faible ce qui entraîne une consommation importante de bois et de ses dérivés. Elles ne permettent pas d'obtenir de produits finis de qualité régulière et ces derniers renferment un taux élevé d'hydrocarbures aromatiques polycycliques (HAP), notamment le benzo(a) pyrène.

Dans le cadre de ses activités, l'Institut de recherche technologique (IRT) du CENAREST du Gabon a mis au point un nouveau concept de séchage et fumage des aliments (Figure 3) qui permet d'améliorer les conditions de travail des producteurs et la qualité des aliments.

Un site d'expérimentation a été installé au cap Estérias à Libreville au Gabon, dans l'Association des pêcheurs du cap Esterias (APCE). Ce site a pour objectif d'amener les futurs utilisateurs à prendre connaissance de la technologie et maîtriser son fonctionnement.

L'objectif de ce travail est, dans un premier temps, de comparer la consommation de bois et la teneur en benzo(a)pyrènes des produits finis du fumoir traditionnel et du fumoir Bidul; d'étudier les qualités sensorielles/visuelles et d'analyser l'impact du nouvel équipement au sein d'une communauté de pêcheurs artisanaux.

2. MATÉRIELS

Sites d'études
Les travaux ont été réalisés sur trois sites:

- site de production habituel des producteurs de poissons séchés et fumés situé au Pont Nomba;
- site d'essais situé à l'IRT;
- site pilote situé au Cap Estérias auprès de l'APCE.

Matériels de terrain
- Pour l'étude sur la consommation de bois, nous avons utilisé une balance de précision de pesée;
- Pour l'étude sur la teneur en benzo(a)pyrènes, les échantillons collectés en sachets ont été identifiés à l'aide d'étiquettes.

Matériel de laboratoire
Les analyses des échantillons pour l'obtention des teneurs en benzo(a)pyrènes ont été réalisées par l'Institut européen de l'environnement de Bordeaux en France (IEEB). IEEB est un laboratoire d'hygiène et de santé du groupe Institut Pasteur de Lille.

3. MÉTHODOLOGIE

Pour l'étude sur la consommation de bois, la méthode suivante a été utilisée:

- Pour obtenir le poids moyen des sardines à fumer, nous avons estimé que trois sardines font en moyenne un kg. A chaque campagne, nous comptons le nombre de sardinelles dans une rangée et le nombre de rangée sur le fumoir. Nous avons ensuite multiplié ces deux valeurs. Puis, nous avons divisé la valeur obtenue par 3 pour avoir le poids en kg de sardinelles à fumer.

Exemple lors de la première campagne de séchage et fumage sur le fumoir longitudinal:

- Il y avait 28 rangées de sardinelles, à chaque rangée il y avait en moyenne 25 sardines soit 28 x 25 = 700 sardines sur le fumoir; nous avons don c: 700/3 = 233, 33 kg soit à peu près 234 kg de sardinelles;
- Pour le bois, les différentes formes de morceaux de bois utilisé étaient pesées et le nombre de morceaux de bois utilisés pour chaque forme était compté et multiplié par le kg du morceau de bois de cette forme. Ensuite on additionnait le poids en kg de toutes les formes de bois utilisés.

Exemple lors de la première campagne de séchage et fumage sur le fumoir longitudinal, un morceau de bois d'une longueur de 12 cm, et large de 5 cm, avec une hauteur de 2 cm, pèse 2 kg et les 30 morceaux de cette forme ont été utilisés Nous avons estimé donc que 30 x 2 = 60 kg de morceaux de bois de cette forme ont été utilisés.

Pour déterminer la teneur en benzo(a)pyrènes, nous avons procédé de la manière suivante:

- Dans chaque fumoir, afin d'avoir une valeur moyenne de la teneur en benzo(a) pyrènes en fonction du nombre de fumoirs utilisés, nous avons pris trois sardines séchées et fumées, l'une de chaque côté du fumoir et une au milieu du fumoir. Nous avons réalisé trois campagnes de mesures et nous avions obtenu neuf échantillons pour le fumoir longitudinal qui est le plus utilisé. Nous avons réalisé deux campagnes de mesures et nous avons quatre échantillons pour le fumoir rond, le moins utilisé. Nous avons réalisé deux campagnes de mesures et nous avons obtenus quatre échantillons pour le fumoir Bidul. Tous les échantillons ont été mis chacun dans un sachet portant chacune une étiquette. Ce sont ces échantillons qui ont été envoyés au laboratoire IEEB à Bordeaux en France.

Pour l'intégration du fumoir dans l'environnement des producteurs et son appropriation par ces derniers, deux ateliers ont été organisés:

- un atelier de formation des formateurs sur l'appropriation de la technologie du nouveau fumoir. A cet effet, des explications sur le fonctionnement de l'équipement et sensibilisation les séminaristes sur le bon usage de cet équipement ont été faites;
- un atelier sur les techniques de fumage et de salage qui sont utilisés sur ce nouveau concept. Des explications ont été données sur le processus de séchage notamment le rôle de l'eau dans les aliments et le fumage du poisson et de la viande, avec insistance sur les rôles de la température, la vitesse du flux et la densité de la fumée. Ces paramètres qui sont très importants pour la fabrication des séchoirs et le bon déroulement du séchage/fumage des produits.

Ces ateliers étaient accompagnés de séances d'essais sur le prototype.

Une étude comparative des paramètres économiques des produits frais et transformés de l'activité de pêche a été réalisée. Les paramètres économiques de l'investissement et l'appréciation par le marché des produits transformés ont été étudiés. L'APCE disposant d'une grille évolutive des revenus pour une période donnée, une étude sur l'organisation des acteurs face au nouveau concept de transformation a été réalisée. Cette étude avait pour but d'analyser le processus organisationnel des acteurs par rapport à la nouvelle technologie et d'apprécier le temps mis, les aléas, la quantité et la qualité des produits obtenus pour une séance de transformation afin de les aider à mieux organiser leurs activités.

Par ailleurs, un système de suivi/évaluation participatif a été mis en place pour mieux apprécier les changements attendus de ce projet dans la communauté de pêche du Cap Estérias.

4. RÉSULTATS ET DISCUSSION

Consommation de bois

Figure 1: Fumoir longitudinal du pont Nomba

Figure 2: Fumoir circulaire du pont Nomba

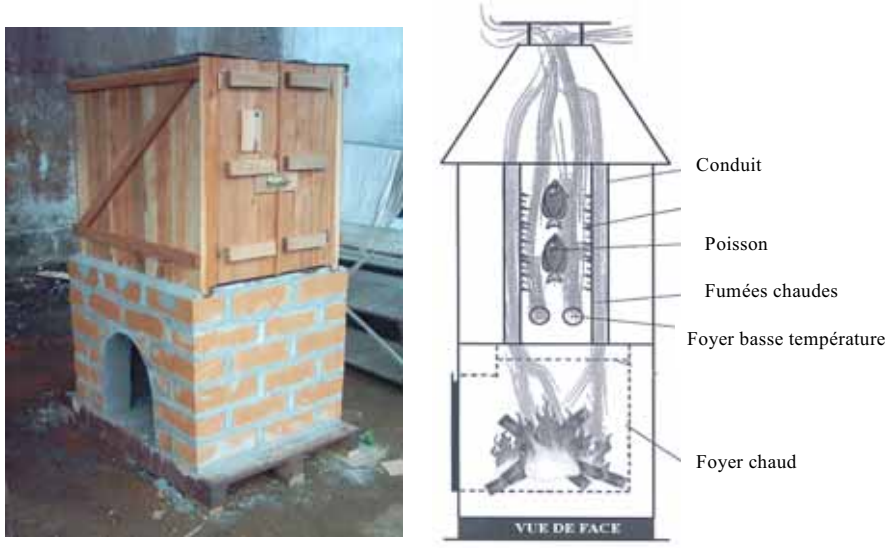

Figure 3: Fumoir Bidul et son principe de fonctionnement

Il faut noter conformément au Tableau 1 qu'il faut 4,17 kg de bois pour fumer un 1 kg de poisson pour le fumoir longitudinal alors que pour le fumoir Bidul il faut 1, 29 kg de bois pour sécher et fumer 1 kg de poisson. Ceci est dû principalement au fait que le fumoir Bidul a un foyer de combustion fermé et ses parois conservent la chaleur (briques en ciment ou terre battues) alors que le fumoir longitudinal a un foyer ouvert donc une bonne partie de la chaleur produite par la combustion de bois s'échappe et n'intervient pas dans le processus du séchage des poissons. La chaleur qui sert réellement au séchage des poissons dépend en fait de l'orientation du vent. Ce qui entraîne une qualité très variable de poissons séchés et fumés dans un même fumoir pendant la même campagne de séchage et fumage.

Tableau 1: Ratio moyen bois/poissons des différents fumoirs étudiés

Fumoirs	Longitudinal du pont Nomba	Circulaire du pont Nomba	Bidul du Cap Estérias	Bidul de l'IRT
Ratio moyen *	4,17	3,09	1,37	1,29

* Ratio moyen (kg de bois/kg de poissons)

On constate aussi que le fumoir circulaire consomme plus de combustible que les deux prototypes de fumoirs Bidul, car il faut 3, 09 kg de bois pour fumer et sécher 1 kg de poisson pour le fumoir circulaire. Ceci est dû au fait que les parois du fumoir Bidul sont en briques (standard fait à partir du ciment ou en terre battue), alors que celles du fumoir circulaire sont en tôle. Ce dernier n'est pas un bon conservateur de chaleur et cela se ressent lorsqu'on le touche pendant le fonctionnement. Il est tout brûlant et cela est dû tout simplement au fait que la tôle est un bon conducteur de chaleur.

Le même constat est fait entre le prototype Bidul construit à partir des briques standard à l'intérieur du foyer de combustion (fumoir Bidul de l'IRT) et celui construit avec les briques en terre battue (fumoir du Cap Estérias). En effet, les briques en terre battue conservent mieux la chaleur que les briques standard.

Dans le fumoir traditionnel les poissons sont posés verticalement sur le fumoir et sont maintenues dans cette position grâce aux cales qui sont interposés entre les rangées de poissons. À chaque phase du séchage ou du fumage, il faut repositionner les poissons ce qui rend le procédé très long car on doit trier des centaines de poissons. Dans le fumoir Bidul, les poissons sont accrochés sur des supports qui sont installés sur les claies. De ce fait, l'installation des produits dans le fumoir met un peu plus de temps. Mais cette opération se fait une seule fois alors que dans le fumoir traditionnel la disposition des poissons se fera plusieurs fois pendant la production.

Teneur en benzo(a)pyrènes

Tableau 2: Les teneurs en benzo (a)pyrènes des sardines séchées et fumées

Fumoirs	**Fumoir circulaire du pont Nomba**	**Fumoir longitudinal du pont Nomba**	**Fumoir Bidul du Cap Estérias**		**Fumoir Bidul de l'IRT**
Teneur en benzo(a)pyrènes (microg/kg de produit fini)	57	26	17	16	14

Le tableau ci-dessus montre que:

- Le fumoir circulaire utilisé au pont Nomba a une teneur en benzo(a)pyrène plus élevée. L'une des raisons est que les sardines sont en contact avec les fumées chaudes les plus élevées de tous les quatre autres fumoirs sur lesquels l'étude a été menée;
- Les teneurs en benzo(a)pyrènes du fumoir Bidul sont moins élevées que les fumoirs du Pont Nomba, cela confirme bien les données bibliographiques; et
- Les variations des teneurs en benzo(a)pyrènes entre les fumoirs Bidul du Cap Estérias et celui de l'IRT sont dues à la présence des fuites au niveau du système de production de fumées froides.

On remarque que plus le système de production de fumées permet d'obtenir les fumées moins chaudes, moins élevé est le taux de benzo (a)pyrènes des produits obtenus.

Qualité sensorielle, durée de conservation

L'obtention des produits de bonne texture (homogène) et de très bon goût; les séances de dégustation ont été organisées sur le site pilote, à IRT et à l'assemblée nationale. Il a été noté une appréciation toute particulière des produits issus de ce fumoir notamment la couleur, la réduction de l'odeur de la fumée et le cadre travail approprié aux mesures d'hygiènes.

Analyse coût- bénéfice du fumoir

Le fumoir Bidul offre la possibilité de transformer les espèces nobles, de produire du poisson salé et de transformer la volaille (nature et assaisonnée). Les matériaux utilisés pour la construction du fumoir Bidul sont durables et moins coûteux. Le coût de construction d'un fumoir Bidul est plus élevé au départ, mais devient moins coûteux du faite de sa durabilité (exemple celui de IRT) par rapport au fumoir traditionnel où on assiste à un renouvellement des matériaux à chaque campagne de transformation (données chiffrées en cours).

Une forte valeur ajoutée des produits transformés: Les produits issus du fumoir Bidul ont une valeur ajoutée plus élevée que ceux du fumoir traditionnel du fait de la qualité des produits. La majorité des ventes sont faites sur commandes et concernent uniquement les gros poissons.

Intégration du fumoir Bidul dans l'environnement et son appropriation par les producteurs

La capacité de transformation du fumoir Bidul dépend des dimensions de celui-ci. Malgré la rapidité de transformation et la qualité des produits observées, il convient de dire que le fumoir traditionnel, a une plus grande capacité de transformation (500 à 2000 sardinelles pour une campagne de transformation). Toutefois, il existe des possibilités de mettre en place des fumoirs Bidul de grande capacité; afin d'avoir un outil plus performant.

Pendant les consultations, et les ateliers ainsi que les différents essais, les membres de l'APCE étaient très attentifs et participatifs.

Des échanges fructueux ont eu lieu entre les séminaristes, les membres de l'association et les techniciens sur le fonctionnement du prototype et son impact.

Les résultats des enquêtes menées dans la localité et dans les marchés révèlent:

- Une forte demande en produits transformés (fumés et salés);
- Un marché potentiel d'écoulement avec établissement de partenariats, des contrats sont signés entre l'association et les différents établissements de la localité (restaurants et l'école nationale des Eaux et Forêts);
- Possibilités d'étendre le marché d'écoulement sur Libreville.

Pour ce qui est de l'analyse organisationnelle, on note:

- Une certaine dynamique dans la répartition du travail en équipe;
- Une réduction du temps de travail;
- Une amélioration des conditions de travail;
- Le respect des normes d'hygiène lors de la manipulation des produits.

En matière de suivi/évaluation, les quatre domaines de changement retenus donnent les résultats suivants:

Pour l'augmentation des revenus à travers la valeur ajoutée des produits transformés: actuellement on ne peut pas mesurer les indicateurs d'augmentation de revenus. Les productions actuelles de l'association ont servi à faire de la promotion. Toutefois, l'étude a déjà identifié les opportunités de commercialisation formelles qui seront exploitées par l'association et elle se prépare en conséquence.

Pour l'amélioration de la nouvelle technologie par la forte contribution des communautés en vue d'une meilleure adaptation en milieu réel: Les pêcheurs ont énormément contribué à l'amélioration de la technologie par des propositions concrètes qui ont été acceptées et exécutées pour certaines par les techniciens sur la qualité des supports la hauteur du fumoir, le placement d'une cheminée pour la fumée, etc.

Les populations se sont bien appropriées la nouvelle technologie. Elles manipulent actuellement le fumoir sans l'aide des techniciens. On note une grande motivation de leur part.

Pour la protection de l'environnement: l'association n'utilise pas le bois de mangrove, le bois utilisé est récolté dans la forêt à des quantités moins importantes par rapport au fumoir traditionnel. On note l'absence d'épaisse couche de fumée et le respect des normes hygiéniques. Le travail s'effectue dans un environnement propre.

Pour le renforcement des capacités organisationnelles des communautés en matière de gestion d'une infrastructure communautaire: on note une répartition des tâches et des équipes de travail. Des équipes de quatre personnes ont été mises en place et travaillent sur la base d'un calendrier établi par l'association.

Les acteurs manifestent un intérêt tout particulier envers le nouveau concept, ce qui suscite de la motivation au sein de l'association.

5. CONCLUSIONS

Le fumoir Bidul est une innovation importante pour les activités de transformation qui occupent une place importante dans la sous région en général et au Gabon en particulier. Ce fumoir offre plusieurs opportunités aux acteurs et répond à certaines préoccupations de l'administration des pêches. Cette étude a montré qu'il existe des

possibilités d'amélioration du système actuel de transformation des produits halieutiques. Cet nouveau concept présente un double avantage aux acteurs; à savoir: celui de fumer et de saler le poisson de manière efficace à l'aide d'un même outil.

Contrairement au fumoir traditionnel dont la consommation en bois et ses dérivés (sciure et copeaux) est importante, pour un rendement énergétique faible; les produis finis sont d'une qualité irrégulière et les teneurs en hydrocarbures aromatiques polycycliques (HAP) sont importantes, notamment le benzo(a)pyrène.

Le fumoir Bidul permet d'avoir un rendement énergique très élevé, la teneur en HAP très réduite, bien qu'au dessus des normes fixées. Il permet d'obtenir des produits homogènes et une organisation de travail en équipe.

6. RECOMMANDATIONS

Pour la consommation de bois

Pour avoir un bon rendement énergétique, il faut que le foyer de combustion du fumoir soit fermé. De ce fait, une amélioration de l'isolation des parois et une réduction des fuites sont obligatoires. Pour cela, il faudra chercher des matériaux locaux que l'on trouve facilement dans le pays qui puissent remplir ce rôle. Ces derniers doivent intégrer l'environnement des producteurs. Cela permettrait une meilleure adaptation de l'outil.

Pour la détermination de la teneur en benzo(a)pyrènes

Au cours de ces travaux, il a été confirmé, que lorsque les fumées chaudes produites sont en contact direct avec les produits, les poissons séchés et fumés ont un taux élevé en benzo(a)pyrènes. Le nouveau système mis en place permet de réduire considérablement cette teneur. On se rapproche un peu plus de la norme européenne (5 microgrammes/kg de poids frais).

Pour avoir le meilleur taux en benzo(a)pyrènes, il faudra améliorer le système de production des fumées de pyrolyse afin de refroidir au maximum les fumées avant qu'elles arrivent sur les produits. L'idéal serait de fumer les poissons avec les fumées froides. Malheureusement. Le système de production de fumées froides adapté à l'environnement des producteurs artisanaux du Gabon n'existe pas.

Pour l'intégration de l'environnement et l'appropriation du fumoir Bidul par ces producteurs

Actuellement, les membres de l'association APCE sont très intéressés par cet équipement. Il serait mieux de poursuivre l'accompagnement de l'appropriation et mesurer l'ensemble des indicateurs retenus auprès de cette association.

Mettre en place des fumoirs Bidul de grande capacité dans les communautés de pêche à intense activité de transformation.

De vulgariser ce fumoir dans les autres communautés de pêche ayant des bases organisationnelles et dans les communautés de pêche continentale.

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ADAPTING LOW COST SHRIMP DRYING TECHNOLOGY: INITIAL TRIALS IN NANGGROE ACEH DARUSSALAM PROVINCE (NAD), INDONESIA

[ADAPTER UNE TECHNOLOGIE DE SÉCHAGE DE CREVETTES À COÛT FAIBLE: ESSAIS INITIAUX DANS LA PROVINCE NANGGROE ACEH DARUSSALAM (NAD), INDONÉSIE]

by/par

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(presented by Yvette Diei-Ouadi)

Abstract

Small-scale fish drying is practiced in many tropical countries in Africa, Asia and Latin America. It is an important livelihood activity for many low-income earners and women in fishing communities. Traditional sun drying is less effective during rainy seasons and cloudy conditions, when drying becomes difficult or impossible.

A simple low-cost, improved dryer that may also be appropriate for small-scale processors in parts of Africa was tested using a participatory process that involved processors, local government as well as fisheries training school staff.

Using ideas from the dryers seen being used by processors in coastal Cambodia, a prototype dryer was built using zinc sheeting (1 mm) riveted on a metal bracket frame. Air is blown into the chamber using a standard "table top" electric fan (45W, 220V). Charcoal burnt in stoves is used inside the chamber to generate heat for drying. The fish are dried on wooden framed drying racks (dimensions) placed over the chamber. Anchovy (*Stolephorus commersonnii)* were used for the initial drying trials.

Results from initial tests indicate that processors can see that the dryer will enable them to continue processing fish in the rainy season. It also reduces processing time and produces good quality boiled (cooked) and then dried product. It can also be used to produce a purely dried product, but the latter is not of as good quality as the traditional sun dried product.

Work is continuing to test the appropriateness of the technology and whether processors find it convenient to use and financially beneficial.

The work is an activity of the American Red Cross funded FAO project OSRO/INS/601/ARC: "*Rehabilitation and sustainable development of fisheries and aquaculture affected by the tsunami in Aceh Province, Indonesia which is implemented in partnership with the Dinas Kellautan dan Perikanan (DKP), the Fisheries Department of Indonesia*".

Key words: Drying, Small-scale, Charcoal oven, Indonesia

Résumé

Le séchage du poisson à petite échelle est pratiqué dans plusieurs pays en Afrique, Asie et Amérique Latine. Cette activité est une source importante de moyens d'existence pour de nombreux petits salariés et femmes dans les communautés de pêche. Le séchage traditionnel au soleil est moins efficace pendant les saisons de pluie et les conditions nuageuses, quand le séchage devient difficile ou impossible.

Un séchoir amélioré, à faible coût, et qui peut aussi être approprié pour les transformateurs à petite échelle dans des parties de l'Afrique a été testé en utilisant un processus participatif qui implique les transformateurs, le Gouvernement local de même que les employés de l'école de formation en pêche.

En utilisant les idées d'un séchoir en cours d'utilisation sur la cote du Cambodge, un prototype de séchoir a été construit en utilisant des feuilles de zinc (1 mm) rivées sur un cadre en support métallique. L'air est soufflé dans

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la chambre en utilisant un ventilateur électrique normal de table (45W, 220V). Le charbon brûlé dans les foyers est utilisé dans la chambre pour générer la chaleur pour le séchage. Les anchois (*Stolephorus commersonnii)* étaient utilisés pour les essais initiaux de séchage.

Les résultats des tests initiaux indiquent que les transformateurs peuvent s'apercevoir que le séchoir leur permettra de continuer de transformer du poisson pendant la saison de pluie. Il réduit aussi le temps de transformation et donne un produit bouilli (cuit) puis séché de bonne qualité. Il peut aussi être utilisé pour produire un produit purement séché, mais ce dernier n'est pas d'aussi bonne qualité que le produit traditionnel séché au soleil.

Le travail est en cours pour tester l'adéquation de la technologie et si les transformateurs trouvent commode de l'utiliser et financièrement bénéfique.

Le travail est une activité du projet de la FAO financé par la Croix Rouge Américaine OSRO/INS/601/ARC: "*Réhabilitation et développement durable des pêches et de l'aquaculture affectées par le tsunami dans la Province de Aceh, Indonésie*" *qui est mis en œuvre en partenariat avec le Dinas Kellautan dan Perikanan (DKP), le Département des Pêches de l'Indonésie.*

Mots clés: Séchage, Petite échelle, Séchoir de charbon, Indonésie

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This work is an activity of the American Red Cross funded FAO project OSRO/INS/601/ARC: Rehabilitation and sustainable development of fisheries and aquaculture affected by the tsunami in Aceh Province, Indonesia which is implemented in partnership with the Dinas Kellautan dan Perikanan (DKP), the Fisheries Department of Indonesia. The Sekolah Usaha Perikanan Menengah (SUPM) Fisheries Training School in Ladong provided facilities and mechanical engineers for the initial trials and the small-scale women fish processors from Kreung Raya village provided advice on the dryer design and processing method.

1. INTRODUCTION

Small-scale fish drying is practiced in many tropical countries in Africa, Asia and Latin America. It is an important livelihood activity for many low-income earners and women in fishing communities. Traditional sun drying, whilst an effective and low-cost method of preservation, is less effective during rainy seasons and cloudy conditions when drying becomes difficult or impossible, thus putting a stop to an important livelihood activity. When drying takes place during these difficult periods, losses can result from poor quality final products and insect infestation.

Traditional sun drying of salted and un-salted fish is practiced in some coastal areas of Nangroee Aceh Darussalam (NAD) Province, northern Indonesia. Anchovies, shrimp, reef fish and octopus are dried by women processors mainly on racks. The final product is destined for the local market as well as export to neighbouring countries such as Malaysia. Rain from October to January hampers processing activity when losses are frequent and processing activity has to be abandoned.

A simple drying technology using charcoal as the heat source, rather than the sun, is used by some small-scale fish processors in coastal areas of Cambodia to dry shrimp. A small electric fan is used to blow heat from the charcoal through the brick or metal sheet drying chamber and over the shrimp. The shrimp are boiled first, drying is rapid and can be practiced inside a shed or building and thus during times of rain. See Annex I.

This report describes initial trials to see whether the charcoal shrimp drying technology can be adapted for use in NAD province, Indonesia, to dry anchovies, a particularly high value product. If successful, then the drying activity of mainly women processors could be extended into the rainy season when catches are also high, giving the women more income earning opportunity. The work is an activity of the American Red Cross funded FAO project OSRO/INS/601/ARC: *Rehabilitation and sustainable development of fisheries and aquaculture affected by the tsunami in Aceh Province, Indonesia* which is implemented in partnership with the Dinas Kellautan dan Perikanan (DKP), the Fisheries Department of Indonesia.

As similar dried products are produced in Africa and similar challenges are faced by small-scale processors there, the results of these trials are likely to be of interest to African extension agents, researchers, development agencies and small-scale fish processors.

2. INITIAL TRIALS: THE APPROACH

Whilst the technology itself is an important aspect of the intervention, it is widely recognized that the approach and socio-economic context of introducing new technology is as important as technical issues. The approach taken has tried to recognize this, keeping the technology low cost and simple as well as engaging with all stakeholders and involving them in the decision making process from the start. Initial discussions introduced the improved dryer idea and led to a consensus on trying to adapt and test the improved drying technology. By means of video and photographs, the charcoal drying technology was introduced to key stakeholders from a fisheries training school, the Provincial and District Fisheries Department and a small-scale women fish processors group. It was generally thought that the drying idea had potential and should be tested. The fisheries training school agreed to provide a testing area on their campus and engineering staff to help build a prototype dryer. District fisheries staff would be involved in the trials and the women fish processors would provide the fish and act as advisers regarding the design ad operation of the dryer and in the assessment of the final products.

The process has tried to be participatory and inclusive and involve key stakeholders, both outside and inside the project, in the decision making process. This has taken time and patience, but it is hoped that in the long run this will prove to have been worthwhile in setting a firm base on which to work.

3. DRYER DESIGN AND CONSTRUCTION

Using ideas from the dryers used in Cambodia a prototype dryer was built using zinc sheeting (1 mm) riveted on a metal bracket frame. Two sizes of drier were built: First with a chamber of 2m x 1m x 1m high, and then a larger version measuring 3m x 1.2m x 1.5m high. In both cases, an opening was cut in one end of the chamber so that air could be blown in using a standard “table top” electric fan (45W, 220V). Charcoal stoves were placed on the floor in a line down the centre of the chamber. The fish are dried on wooden framed drying racks (dimensions) which are placed on the chamber. These racks are exactly the same as those normally used by processors to sun dry fish. Only the nylon/plastic mesh normally used was replaced with fine iron wire mesh gauze as it was assumed that the nylon mesh would be affected by the heat generated from the charcoal stoves. Annex 1 shows the dryer and racks. The cost of constructing the larger drier used in the trials was approximately US$210 and a breakdown of the costs is shown in Annex II.

4. INITIAL TRIALS

Anchovy (*Stolephorus commersonnii)* and other species of anchovy are commonly sun dried by women processors in NAD. In good sunny conditions it takes about 6 hours to dry fresh anchovy to a 75% weight loss preferred by the market. Anchovy is also traditionally boiled in seawater before sun drying. It is estimated that 50% of anchovy landed is processed in this way. *Stolephorus commersonnii* was used in the initial drying trials. The first trial focussed on drying fresh anchovy and used the smaller dryer. The results from this suggested the technology maybe better suited to drying boiled anchovy rather than fresh. A second trial was conducted using a larger dryer. This involved drying boiled anchovy and then also fresh anchovy. The approximate operating costs based on the trials are shown in Annex 3 along with indicative market prices for the final products. However, the main running costs are seen as charcoal, kerosene, electricity and labour. The latter is difficult to calculate, but with three charcoal stoves burning the larger dryer uses approximately 2.5 kg of charcoal per hour equivalent to US$0.9 per hour and electricity costs for the fan are US$0.002 per hour. Not including labour, the largest operating cost is that of the raw material (fish) estimated at 88%. Other costs need to be factored in for the boiling process, as here we are concentrating on the cost of drying only.

Annex III shows the cost of drying 15 kg of fresh anchovy (1 tray) is US$35.7. Assuming a 2nd grade product is produced with a 50% weight loss, then the net income is estimated to be US$31.6 to US$39.5. The same annex shows the operating costs for a similar quantity of boiled anchovy. These are US$33. For boiled anchovy the drier can produce a high value 1st grade product. The net income, assuming a 50% weight loss, is US$39.5 to US$55. This equates to a net profit of US$6.5 to US$22, which represents between 16% to 40% margin and assumes no marketing costs. On paper the cost of producing 2nd grade dried product does not look financially viable, whereas producing 1st grade boiled product is, providing the market price is 2.5 to 3 times that of the

price of fresh fish. Please note that these calculations do not take into consideration the cost of replacing the dryer and it is not known at this stage its lifespan.

Key findings from the work so far are:

- The larger dryer was used to produce a 1st grade boiled and dried product in approximately 1 hour with an overall 45% weight loss. This is a much shorter time than the traditional process. The larger drier can produce a 2nd grade dried (non-boiled) product in 3 to 4 hours, with a weight loss of 50%. A margin of 16% to 40% is estimated if boiled products are dried and this assumes that the cost of boiling is minimal.
- It does not appear to be economically viable to produce un-boiled products based on the cost of raw material and market prices for 2nd grade product.
- The greatest cost is that of the fresh fish, which constitutes up to 88% of the costs of production.
- Capacity of fresh fish drying racks for anchovy is estimated to be 15 kg. Drying capacity could be increased by stacking the trays on the dryer. With four trays then approximately 60 kg of fresh fish could be dried. Fuel efficiency could be improved by building a more insulated chamber e.g. using bricks.
- Drying fresh fish which are still wet results in the fish sticking to the mesh of the rack and removal causes physical damage and a low (3rd) grade product.
- Sun drying or allowing the fish to drain on the rack for approximately 2 hours prior to drying helps to reduce the stickiness of the fish and enables a 2nd grade product to be produced.
- Dried fresh anchovy tends to look like it has been boiled first, especially with the smaller drier. The larger drier enabled less intense high temperature drying and is likely to be the most appropriate size.
- The product produced by the smaller drier had a smoky flavour. It was undecided whether this was a positive or negative attribute. There was no smoky taste detected in the product produced by the larger drier.
- Not surprisingly, the highest drying temperatures and most effective area for drying were at the back of the drier. On the larger drier the fish on this area of the tray dried more quickly and temperatures of between 50 °C and 90 °C were recorded. To even out the drying process, the trays were periodically rotated.
- Raising the drier chamber from 1m to 1.5m reduced the intensity of heat reaching the product and the risk of over cooking the product. It also reduced the risk of colour change and smoky taste of the final product. An informal tasting assessment of final products showed that the final products are acceptable. Nevertheless, the higher drier was more difficult to operate as to light the charcoal it was necessary for someone to climb into and out of the chamber, which was not easy due to the 1.5m height. This problem is not seen as a major constraint since it can be overcome by using steps on either side of the drier.

5. CONCLUSIONS

Processors can see that the dryer will enable them to continue processing fish in the rainy season and suggest the dryer is better for boiled product, but can also be used to produce a 2nd grade un-boiled product. The advantages of processing in the rainy season are that this is a time of large anchovy catches, yet as processing is risky and fewer products are produced, the final product selling price can also be high during this period. Furthermore, the dryer reduces the time taken to dry boiled anchovy by 3 hours, thus saving time and enabling the processors to do other activities.

So far the trials have been conducted by the project team in conjunction with the processors who have assisted with the construction of the wooden drying trays, procurement and preparation of the raw material and assessing the quality of final products. The next step is for processors to have the opportunity to use the dryer themselves, initially with support from the project. Field testing of the dryer is now planned to take place in the village during the current rainy season. It remains to be demonstrated whether the drier is acceptable and if it will be used independently by the processors, although from initial trials it can be seen to be technically beneficial during the rainy season and economically viable for drying boiled anchovy. Meanwhile, questions that remain to be answered include:

- How will the processors cope with operating the dryer, bearing in mind that it is a different process from the one normally used?
- If the dryer is only used during the rainy season, what will happen to it during the rest of the year?
- Is it justifiable to just use the dryer during the rainy season?
- What is the lifespan of a drier?

ANNEX I

Photos of dryer and processing

Figure 1. Dryer used for shrimp in Cambodia

Figure 2. Dryer adapted for anchovy, Indonesia

Figure 3. Setting the charcoal stoves before drying

Figure 4. Dryer designed for drying racks normally used by processors

ANNEX II

Cost of dryer

Item	Price (Rp)	Quantity	Total (Rp)	US$
Metal elbow	32,000	14	448,000	
zinc plate sheets	54,500	8	436,000	
Wire net for drying rack	25,000	11 m	275,000	
charcoal stoves	75,000	3	225,000	
Mini standing fan	150,000	1	150,000	
Spike/rivets	60,000	1 box	60,000	
Labour(total payment)	100,000	4 persons	400,000	
TOTAL			**1,994,000**	**210**

US$1 = Rp 9,500

ANNEX III

Operating costs

Drying 1 tray of un-boiled anchovy for 4 hours

Item	Unit Price	Quantity	Total	US$
Fresh anchovy	20,000	15 kg	300,000	31.6
Charcoal	3,500	10 kg	35,000	3.7
Kerosene	4,000	1 litre	4,000	0.4
Electricity	15	4 hour	60	0.006
			339,060	**35.7**

Drying 1 tray of boiled anchovy for 1 hour

Item	Unit Price	Quantity	Total	US$
Fresh anchovy	20,000	15 kg	300,000	31.6
Charcoal	3,500	2.5 kg	35,000	0.9
Kerosene	4,000	1 litre	4,000	0.4
Electricity	15	1 hour	15	0.002
			339,060	**32.9**

Indicative market selling price of final products to processor

Grades	Price/kg (Rp)
1	50,000–60,000
2	40,000–50,000
3	30,000–40,000

POST-HARVEST FISH LOSS ASSESSMENT ON LAKE VICTORIA SARDINE FISHERY IN TANZANIA – *Rastrineobola argentea*

[EVALUATION DES PERTES POST-CAPTURE DU POISSON DANS LA PÊCHERIE DE LA SARDINE DU LAC VICTORIA EN TANZANIE]

by/par

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Abstract

The Lake Victoria sardine *(Rastrineobola argentea),* locally known as *dagaa*, is a very important species in supporting sustainable livelihood in the country and the region. Dagaa is produced and processed in villages increasing the net income benefits to rural areas. It contains a combination of proteins, fatty acids, vitamins and micronutrients that provide a high level nutritious diet for good health. This fish, which can be purchased at T Sh 100 per 100 grams, is affordable to the majority of people all over the country.

However, the dagaa fishery is associated with high level of post-harvest fish loss. The loss assessment study conducted between 2006 and 2008 revealed that total production of fresh dagaa in Tanzania stands at about 197,200 tonnes per annum. More than 95% of the catch is sun-dried before being distributed in local and regional markets. The output doing drying is about 35% giving a total of about 70,000 tonnes of dried weight equivalent. It implies that this fishery could by itself contribute to at least 4 kg per caput fish supply or generate about T Sh 140 billion given a local price of T Sh[2] 2,000 per kg for best quality dagaa.

Based on the study, physical and quality losses in this fishery are extremely high standing at about 5% and 27% of the total value, respectively, and in terms of weight about 3,660 tonnes or 5% of dried dagaa is lost as physical loss, whereas quality degradation occurs to about 36,190 tonnes or 52% of total dried dagaa. In addition, the study identified the type and causes of the loss and generated other Indicative Quantitative Fish Loss Data (IQFLD) along the supply chain, as determined by field-tested fish loss assessment methods: Informal Fish Loss Assessment Method (IFLAM), Load Tracking (LT) and Questionnaire Loss Assessment Method (QLAM).

Key words: Post-harvest, Physical loss, Quality loss, Financial loss

Résumé

La sardine du lac Victoria *(Rastrineobola argentea)*, connue localement sous le nom de dagaa, est une espèce très importante pour assurer des moyens d'existence durables dans le pays et la région. Dagaa est produit et transformé dans les villages et augmente les gains de revenu net des zones rurales. Dagaa contient une combinaison de protéines, d'acides gras, de vitamines et de micronutrients qui fournissent un régime nutritif d'un niveau élevé pour une bonne santé. Ces poissons, qui pourraient être achetés en 100 T Sh pour 100 grammes, sont accessibles à la majorité des personnes dans tout le pays.

Cependant, la pêche du dagaa est associée à un niveau élevé de perte post-capture du poisson. L'étude d'évaluation de perte conduite entre 2006-2008 a révélé que la production totale du dagaa frais en Tanzanie est d'environ 197.200 tonnes par an. Plus de 95% de la prise est séchée au soleil avant d'être distribuée sur les marchés locaux et régionaux. Le rendement du séchage est environ de 35%, ce qui donne un total d'environ 70.000 en tonnes équivalent poids sec. Ceci implique que cette pêche pourrait par elle-même contribuer au moins à 4 kg par personne en approvisionnement de poissons ou générer environ 140 milliard T Sh si on considère un prix local de 2.000 T Sh par kg pour la meilleure qualité de dagaa.

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[2] US$1 = T Sh 1,100

Sur la base de l'étude, les pertes physiques et de qualité de cette pêche sont extrêmement élevées, environ 5% et 27%, respectivement, de la valeur totale et, en termes de poids, environ 3.660 tonnes ou 5% de dagaa sec sont perdus en tant que pertes physiques tandis que la dégradation de qualité se produit à environ 36.190 tonnes ou 52% du dagaa sec total. En outre, l'étude a identifié le type et les causes de la perte et a produit d'autres données Quantitatives Indicatives de Pertes du Poisson le long de la chaîne d'approvisionnement, comme déterminé par les méthodes d'évaluation de perte de poissons testées sur le terrain: IFLAM, LT et QLAM.

Mots clés: Post-capture, Perte physique, Perte de qualité, Perte financière

1. INTRODUCTION

The post-harvest fisheries could make a contribution to realization of Millennium Development Goals (MDGs) especially those targeting; food security, poverty reduction and improved health. The sector begins immediately after the fish has been caught. Hence, it includes all people's activities at all stages from capture to consumption. It involves a number of groups of stakeholders playing different roles in handling fish on board, unloading, processing, storing and in distribution.

In addition, post-harvest fisheries is inter-linked with other socio-economic services taking place in fishing communities to include education, health and other undertakings. The linkages make it important to work on ways that can secure greater post-harvest benefits to include areas such as reduction of high Post-Harvest Fish Losses (PHFL) occurring in small-scale fisheries all over the world.

Regarding post-harvest fish losses, the FAO Code of Conduct for Responsible Fisheries (CCRF) urges states to achieve full utilization of aquatic resources particularly those suitable for direct human consumption, by improving practices through out the production and supply chain in fisheries and eliminating wastage (FAO, 1995).

This assertion has been adopted by a number of countries including Tanzania, where a fisheries policy (URT 1997), recognizes existence of several constraints in the fisheries sector to include poor fish handling practices and inadequate processing methods. The policy statement number 7 states the aim of the country on improving fisheries product utilization and their marketability.

But getting beyond declarations has been problematic, partly owing to lack of data and concrete information regarding type, causes of fish losses and indicative quantitative loss levels. Indeed, such data and information are crucial in understanding the magnitude of losses before deciding appropriate and cost-effective intervention, given limited resources available especially in developing countries.

Collection of PHFL data and information on small-scale fisheries, however, is considered to be a difficult undertaking given a dispersed nature of many small-scale and less developed fishing operations. Also, lack of simple and cost-effective fish loss assessment methods has been a stumbling block to conducting regular assessment of the losses.

Of late, however, FAO and the Natural Research Institute (NRI) have come up with three methods: Informal Fish Loss Assessment Method (IFLAM), Load Tracking (LT) and Questionnaire Loss Assessment Method (QLAM). These are considered to be simple, user friendly and cost-effective fish loss assessment methods in small-scale fisheries.

The methods have been field tested in Tanzania through a study conducted in 2006–2008. The study focused on Lake Victoria and the marine waters focusing dagaa fishery, which constitutes about 46% of fish landing from Lake Victoria fisheries.

The importance of this fishery on food security and sustainable livelihood can not be over-emphasized. The survey on poverty and nutrition conducted in 2000 (URT 2002), where the nutritive value of different food stuff was analysed according to cost, nutritional value and economic efficiency, found out that the dagaa from Lake Victoria purchased at T Sh 100 had the highest score (200) followed by soy beans (172). This shows that dagaa is an extremely economical food item. And can contribute in Tanzania's endeavour to eradicate poverty and to improve nutritional intake through securing an inexpensive, nutritionally rich food item.

Hence, understanding losses in the dagaa fishery and ultimately reducing it has a great potential to provide all Tanzanians and others in the region, physical and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life.

2. OBJECTIVES

The objectives of the Post-Harvest Fish Loss Assessment (PHFLA) study in Tanzania were:

- To field-test three loss assessment methods: IFLAM, LT and QLAM;
- To use the three loss-assessment methods in identifying type and causes of PHFL occurring in Lake Victoria sardine fishery and generate Indicative and/or Quantitative Fish Loss Data (IQFLD); and
- To collate interventions that are being made in reducing post-harvest fish losses.

3. METHODS

The PHFLAstudy was conducted by using three loss assessment methods as indicated above:

The Informal Fish Loss Assessment Method (IFLAM)

This method is basically a qualitative method relying on Participatory Rural Appraisal (PRA) principles. Literature review, Semi-Structured Interviews (SSI) and field observation were conducted guided by properly designed check-lists. Key informants were interviewed to verify information collected from large groups' interviews.

Again, the information generated from the SSI was used in drawing up a flow diagram, which made it easier to collect Indicative and/or Quantitative Fish Loss Data (IQFLD) along the supply chain. Historical and frame-survey data were used as raising factor in extrapolation with area and season variations considered when analyzing the qualitative data.

The Load Tracking (LT)

In conducting LT, samples of Lake Victoria sardine were tracked for over 1000 km, right from the fishing ground on Lake Victoria to Dar es Salaam, which happens to be the largest wholesale market for the dagaa in Tanzania. The exercise was repeated by using the same handling, processing and distribution procedures as applied by local operators.

Weight measurements on losses were taken at each critical stage along the supply chain to include; fishing, processing, storage, packing and transportation to wholesale market. Other important parameters such as output doing sun drying of dagaa, number of days taken for dagaa to change colour from silvery to brownish and mean quantity of broken portions or fragments were also collated. Similarly, moisture content of dagaa getting to the wholesale market in Dar es Salaam was determined by a moisture metre in laboratory.

The Questionnaire Loss Assessment Method (QLAM)

QLAM was conducted through administration of questionnaires. The exercise involved: development of questionnaire, piloting phase, review of questions and administration of questionnaires at a full scale. It involved 125 respondents including fishermen, processors, traders and key informants. QLAM was used in validating data and information generated by IFLAM. Also to fill-in information gaps that were not captured during the IFLAM study.

Study sites

Figure 1. Map of Tanzania showing Study sites and LT route

Site selection for the initial phase, IFLAM study, was based on analysis of historical data on Tanzanian fisheries' profile. The data suggest that Lake Victoria fishery is the most important in the country. It produces over half of total fish landing, employing more than 60% of fishers in the country and sustains fish export trade. Hence anything happening on this lake has high impact on the country. Four different study sites were selected on Lake Victoria fishery (Figure 1). These were:

- Kibuyi village in Mara region (Eastern side of the lake);
- Kirumba Mwaloni in Mwanza - the largest fish market for cured products in East and Central Africa;
- Yozu-a small island in Sengerema district (about 120 km from Mwanza);
- Bukoba custom in Kagera region (Western side of the lake).

On marine waters, Dar es Salaam and Mafia Island were selected as study sites. The former is the largest consumer market of fish in the country with Dar es Salaam Fish Market Complex and Kariakoo market receiving huge amount of fish on a daily basis whereas the latter is the most productive marine fishing area.

Whereas the IFLAM study report provided an opportunity to rank and prioritize the losses from different fisheries, which led to the decision to follow up the study by conducting a thorough LT and QLAM assessment on Lake Victoria dagaa fishery.

Operational definition

The operational definitions of important terms were adopted from Ward and Jeffries (2000). They have defined post-harvest as the period of time from when a fish is separated from its growing medium including the time a fish enters a net. On the other hand, physical loss refers to fish that is not used, which is either thrown away or consumed by animals/insects, while quality loss is the fish that has undergone changes (due to spoilage or physical damage) and is sold for a lower price than if no/minimal deterioration in quality had taken place.

4. RESULTS AND DISCUSSION

Fisheries profile

Fishing on Lake Victoria is carried out by more than 98,000 small-scale fishers using about 29,000 small canoes with an average crew size of 3–4 fishers per canoe. Heavy investment on Lake Victoria fishery has been directed on Nile perch, which is a high value export-oriented fishery. This development has resulted in an over capacity of Nile perch fishery as depicted by the high number of gill nets, long lines and beach seines targeting the perch (Table 1).

Table 1. Lake Victoria fishing effort statistics for 2007

Item	Kagera	Mara	Mwanza	Total
Total number of landing sites	168	151	315	634
Total number of fishermen	18,953	22,741	56,321	98,015
Total number of fishing vessels	6,799	6,022	16,911	29,732
Number and type of fishing gears				
Number of gillnets	107,243	99,850	208,079	415,172
Number of traps	0	5	87	92
Number of hand lines	6,570	4,869	24,040	35,479
Number of long lines	716,754	1,177,882	2,240,752	4,135,388
Number of beach seines	288	333	1,054	1,675
Number of scoop nets for dagaa	880	108	6	994
Number of cast nets for dagaa	8	18	4	30
Number of lift nets for dagaa	12	52	306	370
Number purse seine nets for dagaa	448	1,252	3,143	4,843
Others (unspecified)	0	1	37	38
Engines				
Number of Outboard engines	1,211	1,037	4,168	6,416
Number of Inboard engines	0	0	0	0

Source: *United Republic of Tanzania (URT) 2008*

Dagaa fishing is done mostly by purse seining method (Table 1) with light attraction mechanism. Fishers use an average of 4–5 pressure lamps and dagaa nets ranging between 6–8 mm mesh-size. Fishing is usually done during dark moon period, which is about 15–20 days per month. Good harvest is experienced between November and April, when a fishing unit of 4 people catches about 1–2 tonnes of fresh dagaa per night. Production of dagaa declines to an average of 400–700 kg per night during the lean season (May-October).

Most of the catch is processed by sun drying on sandy beaches, rock areas and on grass locally known as *kinshwi*. The method has little control over contamination by sand, dirty and attacks from insects and pests. As a result the end product tends to contain a lot of sand, the quality suffers and the product fetches low price adding to quality loss. And during the rainy season the method becomes just ineffective in handling increased volume.

Generally, data and information on Lake Victoria fish landing have always been scant; however, the Tanzania Fisheries Research Institute (TAFIRI) conducted a Catch Assessment Survey (CAS) between July 2005 and August 2006, which generated reasonably acceptable data (Table 2).

Table 2. Total fish landing on Lake Victoria fishery (July 2005–August 2006)

No.	District	Nile perch	Lake sardine	Tilapia	Others	TOTAL
1	Biharamulo	2,679.40	964.3	1,487.60	1,075.10	6,206.40
2	Bukoba	3,795.40	1,425.60	728.60	273	6,222.60
3	Bunda	5,254.70	8,716.30	2,643.60	923.90	17,538.50
4	Geita	5,279.30	360	2,465.30	2,173.70	10,278.30
5	Magu	5,383.20	6,160.80	1,549.20	4,231.50	17,324.70
6	Misungwi	697.90	473.50	430.30	823.70	2,425.40
7	Muleba	13,156.10	37,860.30	4,498.50	3,128.60	58,643.50
8	Musoma	14,864.10	17,997.90	6,697.80	1,968.30	41,528.10
9	Mwanza	4,271.70	8,134.00	2,962.40	521.20	15,889.30
10	Sengerema	24,224.10	25,883.30	27,800.90	1,630.30	79,538.60
11	Tarime	11,141.20	15,480.20	5,816.70	22,929.50	55,367.60
12	Ukerewe	19,295.70	73,746.00	23,836.10	3,215.10	120,092.90
	TOTAL	110,042.80	197,202.2	80,917.00	42,893.90	431,055.90
	% of Total	**25.5%**	**45.7%**	**18.8%**	**10.0%**	**100.00**

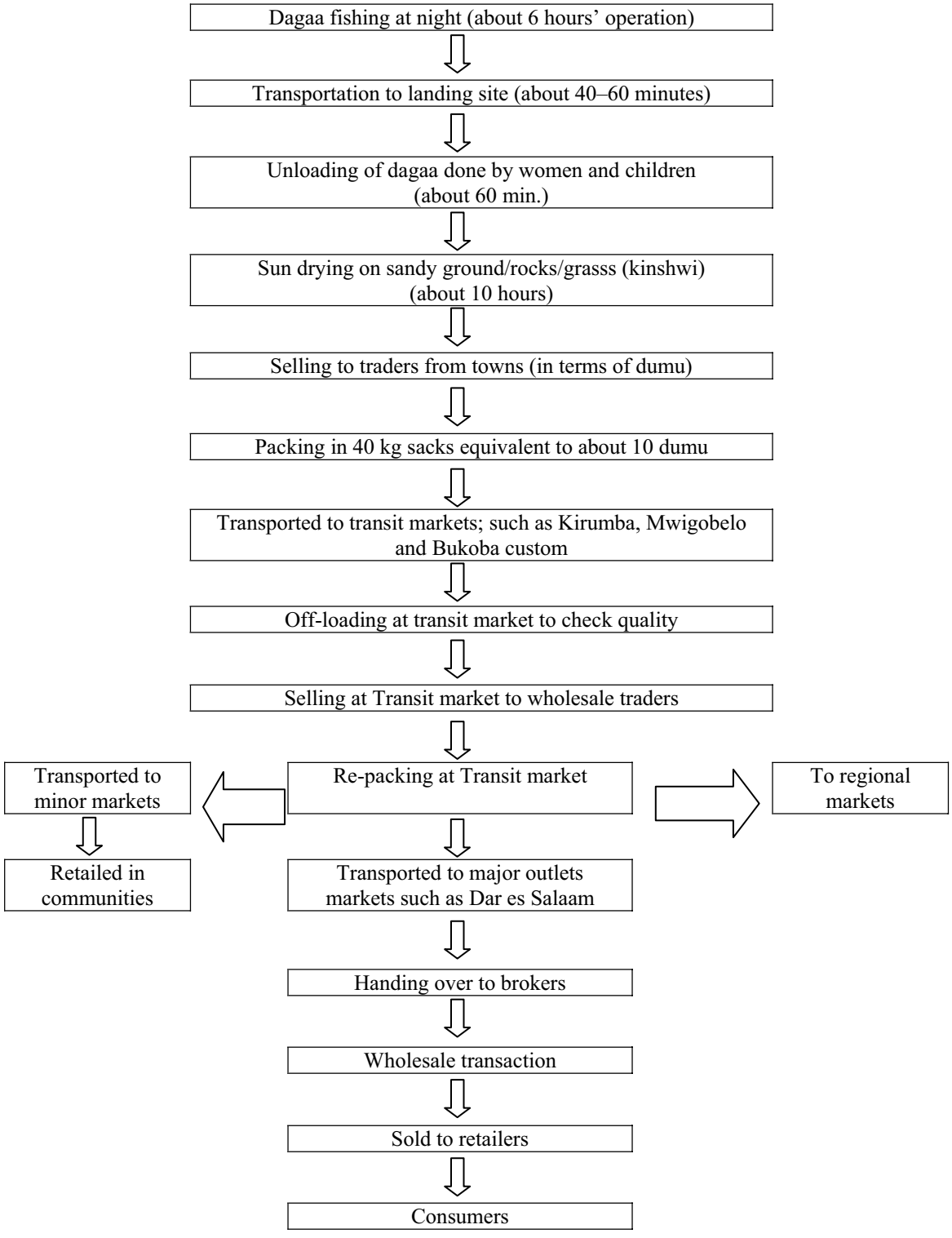
Source: *TAFIRI: Takwimu za mapato ya uvuvi Ziwa Victoria*

The data on Table 2 suggest that dagaa constitutes about 46% of total fish landing on Lake Victoria fisheries followed by Nile perch and tilapia in that order. However, when it comes to value dagaa has the lowest value of all fish species caught on the lake.

Most of the Nile perch, over 70–80%, caught on Lake Victoria is being exported to the European market, while the remaining amount is dry-salted or fried for the domestic and regional markets. On the other hand, the tilapia *(Oreochromis niloticus)* is the most popular fresh-water fish species in the domestic market fetching relatively high price, which tend to exclude large segment of local consumers. As a matter of fact, increased price of Nile perch and tilapia has made the dagaa to remain the cheapest source of animal protein for the great majority of people in the country and within the East and Central African regions.

The flow diagram

The dagaa is widely distributed in local and regional markets, as presented below:



Post-harvest fish losses

The benchmark data for assessment of post-harvest fish loss in dagaa fishery was determined by using the three PHFLA methods mentioned above. The results are shown in Table 3.

Table 3. Benchmark for PHFL assessment on dagaa fishery

No.	Benchmark	Measure
1	Estimated Fresh dagaa landing (tonnes)	197,200
2	output doing sun drying	35%
3	Estimated weight of dried product (tonnes)	70,000
4	Estimated production during dry days	60%
5	Estimated production during wet days	40%
6	Average price/kg of best quality (T Sh)	2,000
7	Average price/kg for changed colour product (T Sh)	1,500
8	Average price/kg for animal feed quality (T Sh)	200
9	Difference between best and animal feed quality (T Sh)	1,800
10	Moisture content	10%

US$1 = T Sh 1,100

The study identified different types of losses that exist in the dagaa fishery right from capture to wholesale markets, as presented in Table 4.

Table 4. Types of assessed fish losses

Physical loss	Quality loss	Other losses
Physical damage during fishing	Presence of bycatch	Unfair marketing practices
Animal predation	Quality degradation through rain	Levy evasion
Discarded after prolonged rain (rotten)	Change in colour before being sold	
Theft	Fragments/breakages	
Sinking during transportation		

Based on results obtained (Table 5), it implies that losses in terms of value is about 32% with physical loss representing about 5% and quality loss about 27%. Also, about 3,660 tonnes or 5% of dried dagaa is lost as physical loss each year, while the quality of about 36%, 190 tonnes or 52% of dried dagaa is degraded. Obviously, these figures could go up when other losses, not captured in this study, such as the one caused by insect infestation are taken aboard.

Table 5. Indicative quantitative PHFL in dagaa fishery (Tanzania)

No	Reasons for loss	%	Fresh wt. (tonnes) Equivalent	Dry wt. (tonnes) Equivalent	Loss in billion T Sh
ESTIMATED DAGAA LANDING			197,200		
1	Physical damage during fishing	0.9%	1,775	621	1,242.40
2	Animal predation	2.0%	3,944	1,380	2,760.80
3	Discarded after prolonged rain (nyambore)	4.0%	3,155	1,104	2,208.60
4	Theft	0.1%		35	70.00
5	Sinking sacks during transportation	0.7%		520	1,040.00
6	Presence of bycatch	2.5%		1,750	3,500.00
7	Quality degradation through rain	11.0%	22,400	7,840	14,112.00
8	Change in colour before being sold	30.0%		21,000	10,500.00
9	Fragments/drying grass (chekencha)	8.0%		5,600	10,080.00
TOTAL PHYSICAL AND QUALITY LOSS					45,513.80
1	Unfair marketing practices	11.0%		7,700	15,400.00
2	Loss due to insect infestation	Not quantified			
3	Loss in terms of levy evasion	Not quantified			

Source: *Mgawe and Mondoka 2007, 2008 (US$1= T Sh 1,100)*

Fishing stage
PHFL during fishing is mainly associated with stepping on fish done by crew onboard the canoe due to the lack of separating boards. The weight measurements taken during the study suggest that about 0.9% of dagaa, equivalent to over 621 tonnes, is thrown over board due to physical damage caused by this practice. This loss is estimated to cause physical loss of over T Sh 1.2 billion. Similarly, lack of Good Hygienic Practice (GHP) to include: dirty canoe and fishing gears, lack of drainage system and poor personal hygiene of fishers on board could be sources of contamination at the fishing stage causing spoilage and quality loss of the raw material.

Unloading of the catch
The unloading of fish at the beach is done immediately after getting back to the landing site, about 03.00–05.00 am, before dawn. The catch is taken to the drying ground straight away minimizing chances for loss at this stage. Although a portion is given away to relatives, this is considered to be a livelihood support to strengthen social networks in fishing communities.

Animal predation
The traditional method of drying dagaa in the sun on sandy beaches, rocks or on drying grass locally known as Kinshwi has little control over attacks from insects, birds and domestic animals. Fishers employ different tactics to deal with the problem including placing watch-keepers and butchered birds as scaring mechanism for the growing flock of birds roaming around drying places. These coping strategies notwithstanding, about 2% of dagaa is lost through animal predation. The loss is equivalent to about T Sh 2.8 billion, a loss to crew, canoe owners and watch-keepers.

Discarded after prolonged rain (nyambore)
Dagaa takes about ten hours to dry-up and get sold in the evening if the weather is favourable. However, the situation is very challenging during the rainy season. The quality of dagaa is heavily degraded if it rains before completion of the drying process. The grade of the product is lowered from that for human consumption to that for animal feed. When there is prolonged rain on two consecutive days, the whole lot rots and gets discarded as nyambore (unsuitable for human consumption and animal feed). In addition, a big portion of dagaa placed on rocky areas adjacent to the lake is easily washed back to the lake.

Re-drying of dagaa on the third day could make sense; unfortunately this option is not practical due to limited drying spaces. As a matter of fact, fishers are compelled to pay T Sh 50,000 per month, as an average fee for using small drying space capable of handling about 150 dumu at a time. Such open spaces are few in number thus have to be used for fresh batches caught on consecutive days.

The estimated physical loss associated with rain is 4% of the amount produced during the rainy season, which is calculated to about T Sh 2.2 billion. The loss affects financiers, fishers, processors and the children cum guards.

Theft
Theft stands at about 0.1% of dried weight subjecting traders to a loss of about T Sh 70 million. Nevertheless, this was the least of physical losses identified during the study being an improvement from the 4% reported a decade ago (Ward, 1996). The positive trend could be a function of successful introduction of community-based security system developed under what is locally known as sungu-sungu.

Sinking sacks during transportation
After the drying process, the product is transported to major transit markets by using transport canoes. Most of the canoes are propelled by outboard engines but they are small and unstable to withstand strong winds. Splashes of water enter the canoe and soak the fish, in such cases the load becomes heavier compelling a skipper to throw a certain number of sacks over-board for the sake of stability and safety.

Sometimes these canoes capsize dropping the whole load of dagaa. Such scenario occurs about four times per transport canoe per annum. The problem is more pronounced during windy seasons, particularly in February, May, June and December of each year. It was estimated that 0.7% of dried weight is lost equivalent to a loss of over T Sh 1 billion.

Unfair marketing practices
Selling of dried dagaa takes place immediately after the sun drying process in the evening. The product is collected into heaps before being measured in a 20 litres container locally known as dumu. The mean weight of dried dagaa is 4 kg per dumu (sd=0.26), selling at about T Sh 3,500 in fishing villages.

The price is determined through an open bidding process governed by the law of supply and demand. According to existing procedures, it is the owner himself who measures the product into dumu. He does it so sparsely to avoid compact-filling of dagaa in the dumu. However, when a trader gets to a market he would not be allowed to measure it; it is the secondary buyer at the market who takes the measurement by pressing or compact-filling the dumu. In the process a sack of 9 dumu from a fishing village will measure 8 dumu only, generating a loss in weight of about 11%. This unfair marketing practice causes huge loss of over T Sh 15 billion affecting primary traders. Dagaa fishers are not alone in being affected by such arrangements as Nile perch fishers are equally affected by the practice, whereby weighing scales are adjusted to reap unsuspecting sellers.

Sometimes primary traders mix up good and bad quality dagaa in sacks. The trader may get high price out of the adulteration practice. But it happens quite often that a trick is detected and the whole lot treated as bad quality product fetching low price.

Presence of bycatch
An increased level of bycatch *(Haplochromis* spp.*)* is another cause of losses to fishers and traders. The volume of bycatch in dagaa landings seems to be increasing over time probably due to decreasing population of its main predator: the Nile perch. At the moment, bycatch constitutes about 6% of the catch. Most of it is sorted out and given free of charge to people who happen to be at the landing site. Failure to sort it out lowers the quality of dried product resulting into low prices.

Despite the effort to sort out the bycatch at the fishing village, it represents about 2.5% of dagaa reaching the wholesale market. Usually, the amount is deducted from the total and classified as unwanted material, causing a loss of about T Sh 3.5 billion to fish traders.

Quality degradation through rain
In addition to physical loss caused by rain (4.3.4), the rainy season creates drying and storage difficulties because most of the days experience unfavourable drying conditions (low temperature and higher relative humidity). Hence higher volumes of poor quality products are produced during the rainy season.

Figure 3. Dagaa soaked with rain water

Figure 4. Rain water washing dagaa back to the lake

As if that is not enough, demand declines mainly due to declining number of traders visiting fishing villages during the rainy season to avoid the risk involved over quality loss. Also, availability of substitute goods such as green vegetables and transportation difficulties makes it difficult to sell out the product in good time. Consequently, increased proportion of dagaa is degraded selling as animal feed as opposed to human food. The study estimated that the quality of about 11% of the catch, landed in wet season, is degraded causing a loss of over T Sh 14 billion per annum.

Change in colour before being sold
Colour change from silvery to brownish, as a function of biochemical processes including fat oxidation and autolysis is considered to be a major indicator used by customers in determining quality of dagaa. High water content and prolonged storage are some of the factors that accelerate the rate of change. The colour tends to change after a period of about 10 days depending on drying conditions. The dagaa dried on rocks seems to take a bit longer before it can change colour compared to drying on sand or Kinshwi. The study estimated that 30% of the dried product is sold after the colour has changed causing a loss of over T Sh 10 billion per annum.

Fragments/drying grass

Fragmentation is another cause of high post-harvest loss. Initially, it was being assumed that the problem was closely related to poor road and bad transportation. However, the study found that this could hardly be the case for areas connected with improved tarmac roads such as Lake Victoria area and Dar es Salaam.

Rather, it was found that the problem rests with government regulations on levy per sack instead of per kgme and the arrangement of charging transport cost by using sacks as units. These two arrangements entice traders to over-pack the dagaa into large sacks through a practice locally known as lumbesa. In the process they increase proportions of fragments.

Figure 5. Stepping on dagaa to make it portable

Figure 6. Compact packing to reduce transport cost and levy paid per sack regardless of weight

Brokers at a wholesale market will take out sample of dagaa for assessing fragment level and determining quantity of unwanted material such as grass and bycatch contained in sacks. The results from repeated experiments suggest that fragments constitute 8% of the load sold in wholesale markets. Hence, it is being estimated that over T Sh 10 billion is lost through fragmentation.

On the other hand, large quantity of grass found in dried dagaa is another problem causing quality degradation. This is mostly associated with dagaa dried on grass (*kinshwi),* a common practice in Kagera region of Lake Victoria. It was estimated that kinshwi constitutes about 5% of dagaa load getting to markets.

Loss through levy evasion

Over 50% of dried dagaa from the Tanzanian side of Lake Victoria is believed to be sold in the regional market through cross-border trade. The common practice is that a trader would purchase dried dagaa from fishing villages or at a transit market declaring to be sending it to towns located closer to border areas but within the country. This enables him to evade paying the export levy. On getting to border towns he would store his product in large warehouses constructed in respective areas to facilitate the cross-border trade. The actual crossing takes place at night when law enforcers are out of sight. This practice makes the government lose potential revenue from cross-border trade.

Interventions being made

Initiative towards reduction of post-harvest losses in dagaa fishery has so far included trials on using raised drying racks, the use of solar driers and application of smoking method. Also, some attempts have been made to produce value added products such as brined and spiced smoked products for the supermarket outlet. Based on field observation, however, there is more to be done in improving processing and storage technologies if tangible reduction of PHFL has to be realized.

On the other hand, strengthening of regional cooperation is gradually paying dividend by opening up the bottle-neck to rewarding market though harmonization process should continue so that increased volume of dagaa is sold out through legal cross-border trade.

Stakeholders perceptions

Stakeholders perceive that increased productivity and profitability of dagaa fishery rely heavily on reducing PHFL and securing access to rewarding local and regional markets. Low level of technology and literacy, unfavourable weather conditions and remaining trade barriers in accessing the regional market are factors that have been highlighted to be affecting initiatives to reduce PHFL in dagaa fishery.

5. RECOMMENDATIONS

The three PHFLA methods, IFLAM, LT and QLAM, have proved to be effective tools for assessing fish losses in small-scale fisheries. Hence, it is worth applying the same methods in other similar fisheries.

In view of existing complexity and the magnitude of losses in dagaa fishery especially during the rainy season, it would be ideal for public and private institutions to assist in promoting technical innovation and the use of improved technologies in the post-harvest handling, processing and storage of dagaa. Such intervention should focus on production of improved quality products and prolonging the shelf-life of dried dagaa.
Institutions that facilitate appropriate innovations and technology development transfer have to be assisted to address technological challenges of improving processing and storage technologies, including problems associated with drying on grass or bare sandy ground.

The regional governments should help to create conditions that will enable increased cross-border trade in dagaa by harmonizing policies, quality standards and customs procedures. Such measures will open-up existing bottle-neck in accessing the regional market and facilitate speedy distribution of dagaa reducing storage time and quality loss.

It is important to conduct a thorough study in order to determine the nature and remedy for biochemical colour change problem, which is causing high quality loss. Similarly, it is important to search for better selectivity methods in order to reduce the amount of bycatch especially *Haplochromis* spp*.,* in dagaa catches, while looking for better ways of utilizing the increasing bycatch volumes.

6. CONCLUSIONS

IFLAM, LT and QLAM have proved to be effective methods in assessing PHFL in small-scale fisheries worth taking up. On the other hand, increased productivity and profitability of dagaa fishery will depend on reducing post-harvest dagaa losses and securing access to rewarding local and regional markets. This calls for harmonization of regional trade policy in order to eliminate trade barriers and establish basic quality standards and custom procedures. Making markets work for the traders will also benefit not only those involved in the post-harvest sector, but also the harvesting sector by providing an outlet for its catch and potentially by improving prices.

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ADDRESSING POST-HARVEST LOSSES IN ARTISANAL FISHERIES: SOME KEY CONSIDERATIONS

[ABORDER LES PERTES POST-CAPTURE EN PÊCHE ARTISANALE: QUELQUES CONSIDÉRATIONS CLÉ]

by/par

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Abstract

While artisanal fisheries are said to incur high post-harvest losses, with data from 15% to 75% (FAO, Mills, Moes) commonly quoted, in many cases the key factors behind these figures have not been meaningfully clarified. This makes planning and implementation of effective loss reduction strategies difficult, and risks wasting already scarce development resources.

Reducing post-harvest losses may be addressed through technical or non-technical measures. Solutions might be within or outside the fisheries sector and therefore an effective loss reduction strategy rests upon a systematic loss assessment and a holistic approach to identification and planning of the interventions. This requires that all stakeholders (government officers, development practitioners, policy-makers and researchers, etc.) have a common understanding of these considerations that are elaborated on in this paper. These are mainly the terminology about the type of loss, the stepwise approach to quantifying the losses, the participatory approach, the issue of quality and spoilage within post-harvest loss assessment, the non-existence of universal established solutions to post-harvest losses, paying attention to existing coping strategies and to the socio-economic context within the fisheries.

Keywords: Post-harvest losses, Loss assessment, Small-scale fisheries

Résumé

Alors que les pêches artisanales sont connues pour avoir de fortes pertes post capture, avec des données de 15% à 75% (FAO, Mills, Moes) communément citées, dans de nombreux cas les facteurs clés guidant ces données n'ont pas été minutieusement clarifiées. Ceci rend difficile la planification et la mise en œuvre de stratégies efficaces de réduction des pertes et risque le gaspillage de ressources de développement déjà rares.

Les pertes post capture peut être réduites à travers les mesures techniques ou non techniques. Les solutions peuvent être dans ou en dehors du secteur de la pêche et par conséquent une stratégie efficace de réduction de perte repose sur une évaluation systématique et une approche holistique pour l'identification et la planification des interventions. Ceci exige que tous les acteurs (agents gouvernementaux, agences de développement, décideurs politiques, chercheurs, etc.) aient une compréhension commune de ces considérations élaborées dans ce document. Ce sont notamment la terminologie à propos du type de perte, l'approche par étape pour quantifier les pertes, l'approche participative, la question de la qualité et altération dans l'évaluation des pertes post capture, la non existence de solutions universelles établies pour les pertes, tenir compte des stratégies endogènes existantes et du contexte socioéconomique dans la pêche.

Mots clés: Pertes post-capture, Évaluation des pertes, Pêche à petite-échelle

1. INTRODUCTION

Post-harvest losses are said to occur all over the world in any type of fishery from production to point of final sale to consumer, although the type and level of loss as well as who is affected varies according to the type of fishery, post-harvest activities, skills, knowledge and infrastructure and access to equipment and facilities. This variation and the influencing factors will have important implications for any eventual loss reduction measures.

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While artisanal fisheries are said to incur high post-harvest losses, with data from 15% to 75% (FAO, Mills, Moes) commonly quoted, in many cases the key factors behind these figures have not been meaningfully clarified. This makes planning and implementation of effective loss reduction strategies difficult, and risks wasting already scarce development resources.

The process of assessing losses is therefore key to reducing them effectively. Assessment leads to a good understanding of the type, cause, effects and perceptions of losses. FAO is currently in the process of producing a comprehensive document which compiles the data from field loss assessment studies and methodological guides in fish loss assessment for the extension officers and fish operators, as a result of long-lasting joint initiatives with the Natural Resource Institute (NRI) in developing fish loss assessment methodologies (Ward and Jeffries, 2000).

This paper introduces some of the key issues to be considered in terms of assessing and reducing post-harvest fish loss (PHFL) associated with small-scale fisheries. It builds upon lessons learnt from implementing pilot fish loss assessment studies in selected sub-Sahara African artisanal fisheries, especially the recently implemented two-year FAO Africa regional post-harvest loss assessment (PHLA) programme (2006–2008). By sharing these lessons the paper aims at easing the understanding and providing institutions and development practitioners with the basic information required to effectively address post-harvest losses. Key issues discussed in terms of the post-harvest loss assessment process and the identification of loss reduction strategies follow below.

2. PHLA PROCESS

Standard terminology to describe different types of losses

PHFL are associated with the complete loss of fish protein from the post-harvest food chain, the spoilage of fish and quality degradation that occurs post-harvest, as well as losses due to market forces. One of the important aspects to assessing losses is that there is a common understanding of what these different losses are. The following are definitions that can help develop this common understanding:

- Physical loss: should be understood as fish that is not used, is either thrown away (accidentally, voluntarily or as authorized). It also includes losses due to insects and birds/animals. Such losses are expressed either in percentages, volume (kg, tonnes) or financial terms;
- Quality loss: refers to fish that has undergone changes (due to spoilage or physical damage) and is sold for a lower price than if no/minimum deterioration in quality had taken place;
- Market force loss: induced/led by market changes or developments, where the fish operator has to sell their product at a price below his/her expectations. The loss is the difference in expected price and realized price within a certain market environment[1].

All three types of losses can have financial implications for fishermen, processors and traders (operators). Different approaches may be necessary to address these different types of loss; therefore, it is important to report or describe post-harvest losses as physical, quality, market force or, in some situations, as a combination of the different types.

Field experience has shown cases of close relationship between these types of losses (e.g. change in quality or fish thrown away because of market developments/oversupply, drastic price changes) that should be well figured out by a loss assessor as they are likely to influence the type of information to be conveyed, the way loss data are expressed and the eventual required interventions. The illustration of this consideration is schematized in Figure 1 based on information on losses associated with fresh tilapia in Kenya and Uganda (Load Tracking (LT) country reports). It can be seen that market forces, such as over supply, lead to both physical, quality and market force losses.

[1] Other causes may be inadequate price information or market information, or barriers preventing the producer from gaining access to the right market with the right product at the right time.

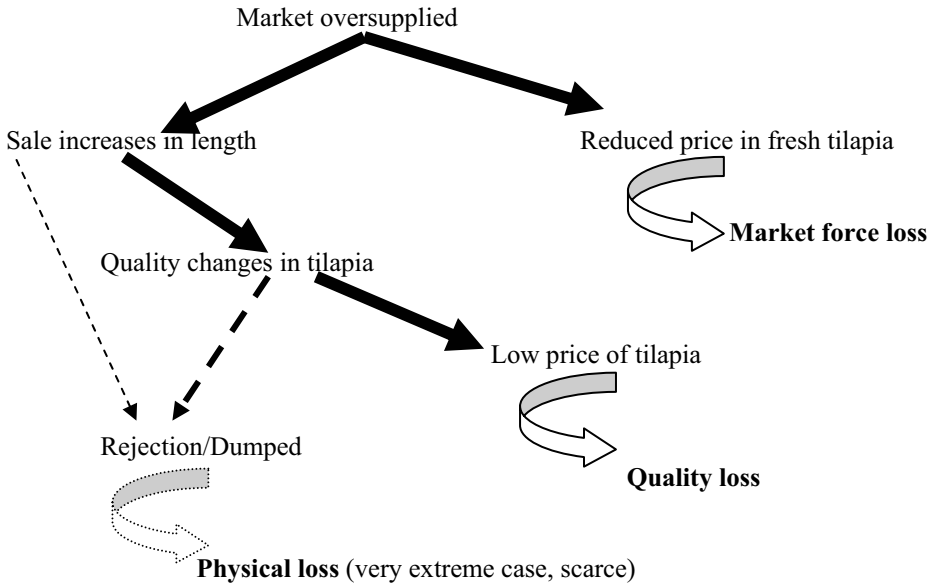

Figure 1. Occurrence of different types of losses in a mono specific fishery (tilapia)

A stepwise approach to quantifying the losses

There may be several different types of loss occurring in a particular fishery, distribution chain or geographical area. Some losses may be more important and some minor and, at the same time, development resources to tackle losses may be restricted. Often, therefore, there will be a need to prioritize losses after an initial qualitative assessment using a method such as Informal Fish Loss Assessment (IFLAM) (Ward and Jeffries, 2000) so that attention can be paid to the more significant losses which can then be quantified using LT and a questionnaire survey approach (QLAM) (Ward and Jeffries, 2000) and, if need be, addressed.

Participatory approach

The assessment process and subsequent planning processes should aim to be as participatory as possible and involve all key stakeholders. This will help develop a more accurate understanding of losses, develop a sense of ownership of the process and solutions to losses by fishermen, processors, traders, government, NGOs, associations. Involving fish operators right from the beginning is a prerequisite to collecting reliable fish loss data. Importantly the type of data to present to them is also noteworthy to encourage their willingness and sense of ownership and responsibility to take actions to control losses, including individual initiatives. In fact, the restitution sessions and reflection of the PRA-based flow diagram-centered approach demonstrated that field data are more self-explanatory and, moreover, figures on financial losses are powerful awareness-raising tools and raise the question of who feels more affected by a given type of loss. It is also important to recognize the different interests of operators, consumers and government. While most fish operators are interested in the financial impact of losses, consumers are often focussed on the price they pay for fish its quality and safety, while development practitioners and government officers are often concerned with ensuring food security, promoting trade and long term resource sustainability.

The issue of quality and spoilage within PHLA

Most stakeholders in the distribution chain can determine quality, and different qualities of fish are often associated with different value/price. The difference between the potential value of fish or product if no/minimum deterioration had taken place and the actual value of the fish after it had undergone change (low quality due to spoilage or fragmentation) gives an indication in financial terms of the extent of quality loss. In the process of identifying quality loss (expressed in volume terms or percentage of the landings or given consignment), it is often practical to apply indigenous quality indicators understood easily by all, as these often relate to price differences. Scientific assessments to determine the level of spoilage or changes occurred can be useful but may not be effective in raising factors for the operators' awareness, hence may not help fishermen or processors to get a better price. More scientific assessments of quality can show differences in quality, but the differences in quality may not be directly translated into price differentials, which is what operators relate to.

Vast quantities of fish are traditionally smoke dried in Africa. The issue of fragmented (broken smoked fish) fish has been extensively elaborated during the implementation of the PHLA programme and it was reported that depending on whether fish has been thrown away or eaten by insects/animals or physically damaged but sold for consumption (often sold for animal feed also), it can be considered either physical or quality type loss.

3. IDENTIFICATION OF LOSS REDUCTION STRATEGIES

Non-universal established solutions to post-harvest losses

Reducing PHFL will most likely rely on a combination of improvement in awareness, knowledge and skills, as well as technical, financial, infrastructural and policy support. While acknowledging the importance of common control measures (such as maintaining the cold chain, improving processing technology), assessing loss stresses the fundamental fact that no one size fits all in addressing fish losses. Therefore, one must keep in mind that solutions to post-harvest losses may not necessarily always be technical and may rely on actions outside the post-harvest, or the fisheries sector as a whole. Some losses may be controlled as a result of a slight intervention, e.g. law enforcement, to deter illegal fishing or downstream to post-harvest or even, sometimes, just a shift in the pattern of fish utilization, e.g. curbing the trend in fishmeal towards human consumption fish production, may have a great impact on the magnitude of losses within a given fishery.

Paying attention to existing coping strategies

Learning and applying lessons from elsewhere is an important approach to reducing losses. Cases of effective indigenous loss prevention or reduction measures have been reported within some fishing communities in Ghana and Tanzania IFLAM country reports. The PHLA programme found examples of some noteworthy coping strategies to control losses, especially during processing. In particular, techniques such as the prevention in Ghana of insect infestation during fermentation and the use of a bird repellent ghost in Tanzania to reduce physical loss during natural drying of *dagaa* (see Figure 2) are ideas that should be disseminated to other communities in the countries concerned, as well as to operators in other countries experiencing similar losses.

Figure 2. Birds' predation during drying of fish was minimized by placing within the drying fish dead birds to generate deterrence!

This highlights the importance of searching out existing coping strategies as well as learning lessons from other attempts at reducing losses and sharing this information with operators to design effective practical loss control measures.

Paying attention to the socio-economic context within the fisheries

As well as understanding the technical reasons for and potential solutions to losses, it is also important to understand the cultural and socio-economic context of the operators concerned and reflect this in loss reduction initiatives. As a matter of emphasis of the non-universal established solutions to post-harvest losses, assessing post-harvest loss enables one to appraise the relevance or extent of limitations of the assumption that technical interventions to reduce losses (e.g. in fresh fish) will ensure quality preservation, and therefore increase the value of the fish and income of the operator. This, of course, can guide in seeking the actual adequate loss reduction measure. Field observation in Tanzania and Uganda highlighted that the improvement in the return was not systematic since any quality rewarding development is intimately linked to the critical issue of the purchasing power of the fishmonger, fish processor or the final consumer; hence the socio-economics within the community at stake and the economic feasibility of the adoption of technical solutions play an important role. It

was stressed that such good quality fish is denied to the smallest operators who, in certain communities, form the major part of the buyers. As an alternative, even considering the negative effect of the time/temperature on the quality of raw material (hence a low value end product), these operators refrain from buying (or intentionally delay the transactions) until the seller/fisherman in a desperate search for customers is forced to cut the price in order to get rid of a deteriorating consignment. The picture below reports an interview of a fresh fish operator in one of the biggest fish markets in Dar es Salaam, Tanzania.

"A few buyers would show up in the morning, when the price is high and the fish is still fresh. As time goes, the quality of fish is degraded compelling a trader to reduce the price in order to attract more buyers who can save his neck from heavy physical loss at the end of a day. Failure to use ice results into huger quality losses!"

Figure 3. Interview of fresh fish trader awaiting desperately buyers

As part of the loss reduction process policy measures also need to be considered and it may be necessary to ensure that the objective of the loss reduction intervention is met. For example, if improving quality leads to an increase in price and to fish becoming less affordable to low-income consumers, then policy change to promote the food security of this group should be seen as a remedy. This may involve encouraging greater access to alternative and cheaper sources of protein, including cheaper species or fish products. Failing to consider these knock-on effects of reducing losses may mean that some stakeholders lose out and find themselves to be more vulnerable to poverty and food insecurity.

4. CONCLUSIONS AND RECOMMENDATIONS

Reducing post-harvest losses in artisanal fisheries should consider both technical and non-technical measures. Solutions might be within or outside the fisheries sector and therefore an effective loss reduction strategy rests upon a systematic loss assessment and a holistic approach to identification and planning of the interventions. This requires that all stakeholders (government officers, development practitioners, policy makers and researchers, etc.) have a common understanding of these considerations and are involved in the decision making processes regarding loss assessment and reduction.

As a matter of upgrading the understanding among all people involved, the experience gained from the implementation of the PHLA and lessons learnt from similar field programmes should be documented and shared amongst development practitioners worldwide.

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ASSESSMENT OF THE EFFECTS OF THE SMOKE GENERATION PROCESSES AND OF SMOKING PARAMETERS ON THE ORGANOLEPTIC PERCEPTION, THE LEVELS OF THE MOST ODORANT COMPOUNDS AND PAH CONTENT OF SMOKED SALMON FILLETS

[ÉVALUATION DES EFFETS DU PROCESSUS DE GÉNÉRATION DE LA FUMÉE ET DES PARAMÈTRES DE FUMAGE SUR LA PERCEPTION ORGANOLEPTIQUE, LES NIVEAUX DES COMPOSÉS PLUS ODORANTS ET LA TENEUR EN HAP DES FILETS DE SAUMON FUMÉ]

by/par

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Abstract

Salmon fillets were smoked by using four different smoke generation processes pyrolysis: by smouldering, with thermostatic plates or friction and liquid smoke vaporization. Different smoking times (1, 2 or 3 hours) and smokehouse temperatures (22 °C and 32 °C) were applied. The effects of these parameters on smoked salmon flavour, odour and odorant compounds and PAH content were evaluated. Smoked salmon fillets were submitted to sensory analysis and the concentration of odorant volatile compounds were investigated by gas chromatography coupled to mass spectrometry and olfactometry (GC-MS/O/FID). Liquid smoke atomization smoking process led to products described by "cold smoke" and "vegetal" odour and flavour attributes; a PLS 2 regression shown that these odour and flavour could be related to several phenolic compounds such as syringol or p-cresol and lipid oxidation products, and pyridine derivatives, respectively. The other smoked salmons were characterized by "salmon-like" attributes for a short time and low temperature of smoking and "wood fire smoke" flavour attributes when smoking parameters increase. This organoleptique evolution could be related to the increase of the deposition of phenolic and furannic compounds with increases of smoking parameters (time of smoke exposure and smokehouse temperature).

The results show a significant correlation between the smoking process parameters, and the presence of PAHs. Smouldering is the smoke generation process that leads to smoked fish with the highest TEQs. The difference is caused by the higher levels of low molecular-weight PAHs than in fish smoked by other techniques However, the contents are always under the legal threshold concerning benzo(a)pyrene (5 µg.kg-1). Smoked fish obtained by liquid smoke vaporization presented the lowest level of PAHs but benzo(a)pyrene concentration is nevertheless important.

Key words: Fish smoking process, Smoke generation, Smoked salmon, Organoleptic properties, GC/olfactometry, Odor-active compounds, PAH, GC/MS/MS

Résumé

Des filets de saumon ont été fumés en utilisant quatre procédés de génération de fumée: la pyrolysis du bois par autocombustion, friction ou à l'aide de plaques thermostatées, et par atomisation de fumée liquide. Différentes durées de fumage (1, 2 ou 3 heures) et de températures du fumoir (22 °C et 32 °C) ont été utilisées. L'effet de tous ces paramètres sur la flaveur et l'odeur, la teneur en composés odorants et en HAP a été évaluée. Les filets de saumon fumé ont été soumis à une analyse sensorielle et leur concentration en composés volatils odorant a été étudiée à l'aide d'une technique de chromatographie en phase gazeuse/olfactométrie (GC-MS/O/FID). Le fumage par atomisation de fumée liquide conduit à des produits décrits par des notes de «fumée froide» et «végétale» Une régression PLS2 (Partial Least Squares) a permis de montré que ces odeurs étaient dues à plusieurs composés phénoliques tels que le syringol ou le p-crésol et à des produits d'oxydation des lipides et des dérivés de pyridine respectivement. Les autres saumons fumés ont été caractérisés par les descripteurs «saumon» pour un temps court et une température de fumage basse et «fumée feu de bois» lorsque les valeurs des paramètres de fumage augmentaient. Cette évolution pourrait être liée à l'augmentation des dépôts de composés phénoliques et des composés furannic lors de l'augmentation des paramètres (temps d'exposition de la fumée et fumoir température). Les résultats montrent également une corrélation significative

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entre les modes de fumage, et la présence de HAP. L'autocombustion est le processus de génération de fumée qui conduit à des poissons fumés présentant la TEQ la plus élevée. La différence pourrait être causée par des niveaux plus élevés de HAP de faible poids moléculaire que dans les poissons fumés par d'autres techniques.

Toutefois, la teneur est toujours sous le seuil légal concernant le benzo (a) pyrène (5 µg.kg-1). Les poissons fumés obtenus après atomisation de fumée liquide présentent le niveau le plus bas de HAP, mais la concentration en benzo(a)pyrène est néanmoins similaire aux autres procédés.

Mots Clés: Procédé de fumage du poisson, Génération de fumée, Saumon fumé, Propriétés organoleptiques, Chromatographie en phase gazeuse/olfactometrie, Composés odorants, HAP, CG/SM/SM

1. INTRODUCTION

The smoking of fish is a traditional process whose objective is the preservation of the product. The preservation effect is generally attributed to the anti oxydant and antimicrobial properties of phenolic compounds. This process is also responsible for significant modifications of the organoleptic properties of fishmeal (Kjallstrand and Petersson, 2001).

The control of the organoleptic characteristics can be of real interest to processors who want to adapt their products to consumers demand. Previous works have shown that the method of smoke generation and the smoking process used (Cardinal *et al*., 1997) have a considerable influence on the sensory characteristics of smoked fish, particularly on smoke flavour perception (Cardinal *et al*., 2006). However, these works did not allow to establish a relationship between sensory properties and chemical composition of smoked fish, particularly composition of odorant compounds provided by smoke.

There are also strong pressures on chemical safety for smoked products from the EU institutions. Thus the Codex Alimentarius Commission on contaminants in food, at its 29th session from 16 to 20 April 2007 established a reflection on reducing levels of Polycyclic Aromatic Hydrocarbons (PAHs) in food dried and smoked. In addition, the EU Regulation 1881/2006 requires a formal setting new stricter rule on the content of PAH in smoked products.

The presence of PAHs, especially benzo[a]pyrene, in smoked fish has previously been reported (Simko *et al*., 2002) but little information is available concerning the influence of the smoking processes. Some studies compare modern and traditional smokehouses (Karl and Leinemann 1996; Karl 1997) but, to our knowledge, there is no comparative study of modern industrial smoking processes for fish with respect to the 20 PAHs suspected to be carcinogens (European Commission, 2005b). Moreover, to reduce PAH levels in smoked fish, a liquid smoke atomization process has been developed in recent decades. No comparative studies of liquid smoke with traditional smoking techniques, applying wood pyrolysis, are available.

The decision of the Codex Alimentarius Commission is very important for the activity of the smoked fish industry because it will lead to the questioning of certain practices and the necessity of an absolute control of processes to produce smoked fish presenting both excellent organoleptic and all guarantees in terms of food safety.

There is, therefore, on the part of industry players a strong demand for information on the parameters of generation of smoke compounds and on the mechanisms of their deposition on the flesh and their development over conservation.

The aim of the works carried out in our laboratory and in collaboration with IFREMER and ENV Nantes was to elucidate, by using GC-MS/O, the main odorant compounds in smoked salmon flesh (Varlet *et al*., 2006, 2007a). Then we assess the impact of parameters of smoking process (type of generator, temperature of the smokehouse, duration of smoking) on the nature and content of odorant volatile compounds and PAH in smoked fish fillets.

We also try, by means of Partial Least Square regression, to explain the data of sensory analysis performed on smoked salmon with data of GC-MS/O.

2. MATERIAL AND METHODS

Fish processing

Salmon (*Salmo salar*) (3~4 kg) were filleted, trimmed and put on grids in a cold chamber at + 2 °C for 2 hours. All the fillets were about 1 kg. They were hand-salted with refined salt (Salins du Midi, France) and left for 3 hours at + 12 °C before being rinsed with water (15 °C) and stored at + 2 °C for 18 hours until smoking.

Before smoking, a drying step was carried out by putting the fillets in the smokehouse at 18 °C during 15 min in order to standardize the internal temperature at 8 °C for all the samples. After smoking the fillets were stored during less than one week (5 days) at + 2 °C prior to be frozen at –80 °C until sensory analysis.

Smoking equipment and procedures

The smokehouse consists in a separate chamber from the wood smoke generators. It was a HMI Thirode (PC90 Model) device (Thirode, France), 1500 × 1300 × 2250 mm with a capacity of 380 kg, mounted on a trolley with 28 grids on which the fillets were deposited. The air/smoke circulation was horizontal. Salmon fillets were exposed to the smoke for 1, 2 and 3 hours at a temperature of 22 and 32 °C. The exhaust valve opening was 1/3 and closed for liquid smoke and the relative hygrometry was sat at 60%. For each process, except liquid smoke, the smoke was introduced in the smokehouse with a flow rate of 90 m^3/h.

Smouldering parameters

A generator (Thirode, France) produced smoke by pyrolysis (between 400 and 450 °C) of beech sawdust using the smouldering method. The pyrolysis was maintained thanks to an air intake producing a continuous flow around the heated ring by a fan. The sawdust fell on the heated ring by gravity from a hopper. Introduction of sawdust was programmed every six minutes. The sawdust moisture was close to 20%.

Thermostated plates parameters

A generator 720 × 1120 × 1730 mm (Thirode, France) produced smoke by pyrolysis (500 °C) of beech chips. A system spreads the chips on thermostatic. The smoke was pulsed by a ventilator in order to obtain the same flow rate of smoke in the smokehouse than smouldering and friction.

Friction parameters

A generator type FR 1002 (Muvero, The Netherlands) produced smoke by friction (380 °C) by pressing a beech log (8 × 8 ×100 cm) against a rotating friction wheel during 10 seconds and every 30 seconds. The beech log is pressed pneumatically by means of a wood gripper with a pressure of 3.5 bars.

Liquid smoke atomization parameters

Liquid smoke was purchased from a smoke flavouring manufacturer (France). It is a purified condensate of beech smoke. Liquid smoke is atomized by pressurized air in the smokehouse at ambient temperature with a vaporization device (Lutetia, France). Liquid smoke was injected in the smokehouse for 2 minutes every 3 minutes. The hygrometry of the smokehouse was sat at 70%.

Isolation of volatiles compounds

Volatile compounds from 50 grams of smoked salmon were extracted by SDE (Simultaneous Steam Distillation – Solvent Extraction with a Likens-Nickerson apparatus). The distillation-extraction was continued for 3 hours. The extract was concentrated to 5 ml by evaporating the solvent thanks to a Kuderna Danish apparatus and to 500 µL under a gentle cold stream of nitrogen.

GC-O-MS analysis

The volatiles compounds were detected and identified according to the methods described by Varlet *et al*., (2006).

Sensory evaluations

A descriptive test with conventional profiling (Stone *et al*., 1998) was carried out to evaluate the sensory characteristics of smoked salmon fillets. Samples were scored by twenty panellists belonging to the IFREMER staff and trained on sensory descriptors for smoked salmon. The panellists were asked to evaluate the intensity of odour and flavour descriptors on a continuous scale displayed on the computer screen, from "0" (low intensity) to "10" (high intensity). The descriptors, "wood fire smoke", "cold smoke", "butter", "vegetal", "salmon-like" and "herring-like" odours were chosen according to their efficiency to differentiate fish sample characteristics.

Extraction and analysis of PAH

Extraction, washing and analysis by GC/MS/MS of PAH were carried out according to method described by Varlet *et al*. (2007c).

Statistical treatments

All the statistical analyses (Analysis of variance (ANOVA)) were performed with STATGRAPHICS Plus 5.1 software (Statistical Graphics Corp., Herndon, USA).

3. RESULTS AND DISCUSSION

Effect of smoke generation processes and smoking parameters on sensorial properties of smoked salmon

The ANOVA performed on sensory attributes identified two groups, one constituted by fillets smoked by external smoke generators (thermostatic plates, friction and smouldering) and the other constituted by salmons treated by liquid smoke. The results of a Fischer's Least Significant Difference (LSD) procedure shows that there is no significant difference at 5% between the intensities of odour attributes for all samples smoked by thermostatic plates, smouldering and friction wood smoke generators (Table 1).

The same test performed on flavour attributes shows that the products smoked by thermostatic plates, smouldering and friction have obtained significantly different marks for the attributes global flavour and butter flavour.

Products treated with liquid smoke were characterized by high scores for the sensory attributes "cold smoke" and "vegetal" whereas salmons smoked by smouldering, friction or thermostatic plates exhibit a "wood fire smoke" and "salmon-like" odour and flavour. The products smoked by friction have been characterized by the highest scores for "butter" sensory attribute.

The results of multi-way ANOVA highlighted an increase of "global", "wood fire smoke" and "cold smoke" odour and flavour and also of "herring-like" flavour when time of smoking increases (Table 1) while the increase of smokehouse temperature leads to an increase of "global" odour and flavour, of "wood fire smoke", "cold smoke" and "herring-like" odours of smoked salmon. However a negative effect of these parameters has been found on "butter" odour and "vegetal" flavour.

When liquid smoke was used the "vegetal" odour was more significantly perceived by the assessors when products are smoked at 22 °C than at 32 °C.

The increase of "smoky" sensory attributes intensity (cold smoke, global odour, wood fire smoke) with the increase of the time to smoke exposure could be explained by a greater deposition of the smoke aroma compounds (Chan *et al*., 1975). The increase of "smoky" odour and flavour intensity could be responsible for the decrease of "butter" and "vegetal" flavour and odour perception by masking this note.

Table 1. Representation of the effects and interactions on scores of each attribute given by the 20 panellists produced by smoking processes, time and temperature parameters

Attribute *	Process **	Time	Temperature	Process-Time	Process - Temperature	Time - Temperature
oglo	+ LS[a], TP[b], F[b], S[b]	+ □	+ □	-	+	-
owf	+ TP[a], F[a], S[a], LS[b]	+ □	+ □	-	-	-
ocs	+ LS[a], TP[b], F[b], S[b]	+ □	+ □	-	+	-
obut	+ F[a], TP[b], S[b], LS[c]	-	+ □	-	+	-
oveg	+ LS[a], TP[b], F[b], S[b]	-	-	-	+	-
osalm	+ TP[a], F[a], S[a], LS[b]	-	-	-	+	-
oher	-	-	+ □	-	-	-
fglo	+ LS[a], TP[a,b], F[b,c], S[c]	+ □	+ □	-	-	-
fwf	+ TP[a], F[a], S[a], LS[b]	+ □	-	-	-	-
fcs	+ LS[a], TP[b], F[b], S[b]	+ □	-	-	-	-
fbut	+ F[a], TP[a,b], S[b,c], LS[c]	-	-	-	-	-
fveg	+ LS[a], TP[b], F[b], S[b]	-	+ □	-	-	-
fsalm	+ TP[a], F[a], S[a], LS[b]	-	-	-	-	-
fher	-	+ □	-	-	-	-

+: Significant effect of the considered factor or interaction at a risk of 5 %.

-: No effect of the considered factor or interaction at a risk of 5 %.

□: Increase of scores with the increase of the parameters of the factor considered.

□: Decrease of scores with the increase of the parameters of the factor considered.

*: Global odour (oglo), wood fire smoke odour (owf), cold smoke odour (ocs), butter odour (obut), vegetal odour (oveg), salmon-like odour (osalm), herring-like odour (oher), global flavour (fglo), wood fire smoke flavour (fwf), cold smoke flavour (fcs), butter flavour (fbut), vegetal flavour (fveg), salmon-like flavour (fsalm), herring-like flavour (fher).

**: Process followed by the same letter on a same line is not significantly different. The processes are ranked from the process where the compound concentration is the strongest to the lowest. TP Thermostated Plates, LS: Liquid Smoke, F: Friction, S: Smouldering.

Effect of smoke generation processes and smoking parameters on odorant compounds content of smoked salmon

Eighty-eight odorant areas were detected by at least four judges in smoked fish extract by GC-O and 74 were identified by GC/MS. But for this study a volatile compound was considered as a potent odorant if it was detected by at least six judges. According to the criteria chosen, 18 odour-active compounds have been found in the aromatic extract of salmon smoked by smouldering, 26 in the aromatic extract of salmon smoked by thermostatic plates and 25 and 27 aromatic compounds have been found in “friction” and “liquid smoke” extracts, respectively. Odorant compounds were mainly represented by phenolic and furannic compounds (Table 2).

The results of ANOVA (Table 2) show significant differences concerning the contents of the furannic compounds (furfural (1), furfuryl alcohol (3), 5–methylfurfural (8)), and enolones derivatives (2–methyl–2–cyclopenten–1–one (6), 2–hydroxyl–3–methyl–2–cyclopenten–1–one (10), 2,3–dimethyl–2–cyclopenten–1–one (11)) between fishes processed by thermostatic plates and the by the other techniques. The concentrations of phenolic compounds (phenol (9), o-cresol (12), guaiacol (14), guaiacol derivatives (20, 24, 27, 30) and isoeugenol isomers (32, 33) are also significantly higher in salmons smoked by this technique. Friction and smouldering lead to products with close odour-active compounds contents except for 2–acetylfuran (7), 2.4–hexadienal (5), 4–vinylguaiacol (27) and 4–allylsyringol (35) higher concentration in salmon smoked by friction.

These results confirm previous works carried out in our laboratory (Serot *et al*., 2004; Cardinal *et al*., 2006; Varlet *et al*., 2007) and can be explained by the high wood pyrolysis temperature used for the thermostatic plates process (close to 500 °C vs 380 °C for friction and 450 °C for smouldering). High quantities of aroma compounds are generated at high pyrolysis temperatures. Conversely, lower concentrations of phenolic, furannic and enolones compounds can be observed with the decrease of wood pyrolysis temperature as it is noticeable for smouldering.

Products treated by liquid smoke show the highest concentrations 2–hydroxyl–3–ethyl–2–cyclopenten–1–one (17), syringol (28), p-cresol (13) It can be also noted that some odorant volatile compounds are found only in salmon treated by liquid smoke atomization such as pyridine derivatives (4–methylpyridine (2) and 2,6–dimethylpyridine (4)).

Table 2. Representation of effects and interaction on the concentrations of the odorant volatile compounds produced by smoking processes, time and temperature parameters

Number code	Compounds	Odour in smoked salmon	Process *		Time		Temperature		Process-Time	Process - Temperature	Time - Temperature
1	furfural	smoke, green	+	TP^a, F^b, S^c, LS^d	+	□	+	□	+	+	+
2	4-methylpyridine	green, milk	+	LS^a, F^b, TP^b, S^b	+	□	-		+	-	-
3	furfuryl alcohol	cooked/soup, chemical	+	TP^a, F^b, S^b, LS^c	+	□	+	□	+	+	+
4	2,6-dimethylpyridine	roasty, green, milk	+	LS^a, F^b, TP^b, S^b	-		-		-	-	-
5	2,4-hexadienal	cooked vegetable, fatty	+	F^a, TP^b, S^c, LS^d	+	□	+	□	-	+	-
6	2-methyl-2-cyclopenten-1-one	cooked potato, green	+	TP^a, F^b, S^b, LS^c	+	□	+	□	+	+	-
7	2-acetylfuran	cooked vegetable, potato	+	F^a, TP^b, S^c, LS^c	+	□	+	□	+	+	+
8	5-methylfurfural	cooked, earthy, green	+	TP^a, F^b, S^c, LS^c	+	□	+	□	+	+	+
9	phenol	marine, metallic, chemical, mushroom	+	TP^a, LS^b, S^b, F^c	+	□	+	□	-	+	+
10	2-hydroxy-3-methyl-2-cyclopenten-1-one	cooked, spicy	+	TP^a, LS^b, F^c, S^d	+	□	+	□	-	-	-
11	2,3-dimethyl-2-cyclopenten-1-one	spicy, wood fire, roasty	+	TP^a, F^b, S^b, LS^b	+	□	+	□	-	+	-
12	o-cresol	chemical, spicy, burnt,	+	TP^a, LS^a, F^b, S^b	+	□	+	□	-	+	+
13	p-cresol	Burnt, animal, spicy	+	LS^a, TP^b, F^c, S^c	+	□	+	□	-	+	+
14	guaiacol	smoked, vanilla, ink	+	TP^a, F^b, S^c, LS^c	+	□	+	□	-	-	+
15	2,6-dimethylphenol	chemical, burnt, spicy/woody	+	TP^a, S^b, F^c, LS^c	+	□	+	□	+	+	+
16	2,3,4-trimethylcyclopenten-1-one	cooked, green, spicy	+	TP^a, S^b, F^b, LS^b	+	□	+	□	+	-	+
17	3-ethyl-2-hydroxy-2-cyclopenten-1-one	solvent, medicinal	+	LS^a, F^b, TP^b, S^b	+	□	+	□	+	-	+
18	1,2-dimethoxybenzene	ashes, green	+	TP^a, LS^a, F^b, S^b	+	□	+	□	-	-	-
19	2,4 and 2,5-dimethylphenol / (E)-2-nonenal	cucumber, violet, spicy, smoked	+	TP^a, LS^a, S^b, F^c	+	□	+	□	-	+	-
20	4-methylguaiacol	candy, spicy, smoked	+	TP^a, LS^a, S^b, F^b	+	□	+	□	-	-	-
21	2,3-dimethoxytoluene	cooked vegetable, fatty, green	+	TP^a, F^a, S^b, LS^b	+	□	+	□	-	-	-
22	3,5-dimethoxytoluene	burnt, green, chemical	+	TP^a, F^b, LS^b, S^b	+	□	+	□	-	-	-
23	(E)-2-decenal	spicy, green, milk	+	TP^a, F^a, LS^a, S^b	-		-		-	-	-
24	4-ethylguaiacol	green, smoke, vanilla, clove	+	TP^a, F^b, LS^b, S^b	+	□	+	□	-	+	+
25	indanone	sawdust, rotten, burnt	+	TP^a, F^a, LS^a, S^b	+	□	+	□	+	+	+
26	(E,E)-2,4-decadienal	oily, green, fatty	+	TP^a, S^b, F^c, LS^d	-		+	□	+	-	-
27	4-vinylguaiacol	smoke, green, spicy	+	F^a, LS^b, S^c, TP^c	+	□	+	□	-	-	-
28	syringol	burnt rubber, spicy	+	LS^a, F^b, TP^b, S^b	+	□	+	□	-	-	-
29	eugenol	spicy, smoke, clove	+	F^a, $TP^{a,b}$, $LS^{b,c}$, S^d	+	□	+	□	-	+	+
30	4-propylguaiacol	green, spicy, vanilla	+	TP^a, LS^b, $F^{b,c}$, S^c	+	□	+	□	-	+	-
31	1,2,3-trimethoxy-5-methylbenzene	cooked, earthy	+	TP^a, F^b, LS^b, S^b	+	□	+	□	+	+	+
32	(Z)-isoeugenol	burnt rubber, spicy	+	TP^a, F^a, LS^b, S^b	+	□	+	□	+	+	+
33	(E)-isoeugenol	clove, green, roasty	+	TP^a, F^a, LS^b, S^b	+	□	+	□	-	-	+
34	2,3,5-trimethoxytoluene	spicy, woody	+	LS^a, F^b, TP^b, S^b	+	□	+	□	-	-	-
35	4-allylsyringol	smoke, rotten	+	F^a, $LS^{a,b}$, S^b, TP^b	+	□	+	□	-	-	-
36	8-heptadecene	animal, roasty, chemical	+	LS^a, F^b, TP^b, S^c	+	□	-		-	-	-

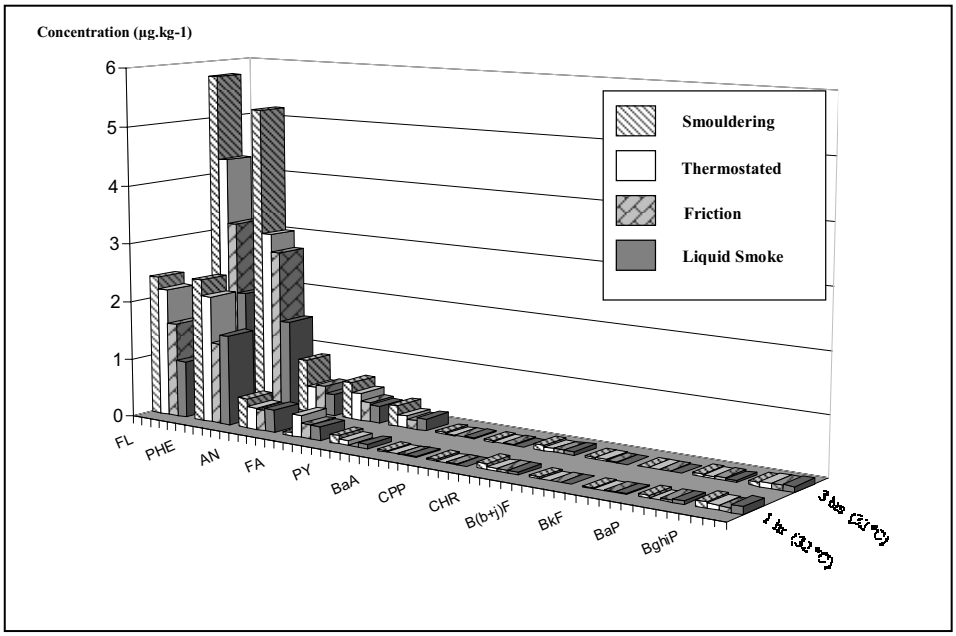
+ : Significant effect of the considered factor or interaction at a risk of 5%.
- : No effect of the considered factor or interaction at a risk of 5%.
□ : Increase of concentration with the increase of the parameters of the factor considered.
* : Process followed by the same letter in a same line are not significantly different. The processes are ranked from the process where the compound concentration is the strongest to the lowest.

A multi-way ANOVA (Table 3) indicated that time and temperature had significant effects on the deposition of odorant compounds in fish fillets ($p < 0.05$).

The increase of odorant compound contents related to the increase of smokehouse temperature could be due to higher fluidity of the lipid phase of fish flesh when temperature increased (Sérot *et al*., 2004). A high temperature could also prevent condensation of water vapour on the surface of fish fillets resulting in a washing out of deposited smoke compounds (Chan 1975). These results could be related to the sensory data, as the notes for "smoky" attributes are higher when products are smoked at 32 °C related to the increase of deposition of wood smoke components.

Effect of smoke generation processes and smoking parameters on PAH content of smoked salmon

We can note that whatever the settings of the parameters, all smoking processes lead to higher levels of low molecular-weight PAHs than those of high molecular-weight (Figure 1). The concentrations of PAH from fluorene to fluoranthene varied between 1 and 5 µg kg-1. Regarding the four processes, it should be noted that 5–methylchrysene, indeno [1, 2, 3–c,d]pyrene, dibenz[a,h]anthracene and all the dibenzopyrenes were not found in samples, whatever the time of smoke exposure or smokehouse temperature. These PAHs are considered much more toxic than low molecular-weight PAHs, such as fluorene.



FL: Fluorene,
PHE: Phenanthrene,
AN: Anthracene,
FA: Fluoranthene,
PY: Pyrene,
BA: Benzo(a)anthracene,
CPP: Cyclopenta(c,d) pyrene,
CHR: Chrysene, B(b+j) F: Benzo(b)fluoranthene + Benzo(j)fluoranthene,
BkF: Benzo(k)fluoranthene,
BaP: Benzo(a)pyrene and
BghiP: Benzo(g,h,i perylene.

Figure 1. Distribution of PAHs contents according to the smoking process for one or three hours of smoking time at 32 °C

Since PAHs do not have the same level of toxicity, a TEF (toxic equivalent factor), expressed in comparison to benzo[a]pyrene, was defined for each PAH (Table 3). The concentration of each PAH is multiplied by its corresponding TEF and then added to obtain a single value illustrating the toxicity of the foodstuff studied. This value corresponds to the TEQ (toxic equivalent quantity) (AFSSA, 2003). The TEQ approach was chosen to express the total PAH contamination of a smoked or unsmoked product.

Table 3. Toxic equivalent factor for the studied PAHs

List of PAHs	TEF (INERIS)	TEF (Larsen *et al.*, 1998)
Fluorene	0.001	0.05
Phenanthrene	0.001	0.0005
Anthracene	0.01	0.0005
Fluoranthene	0.001	0.05
Pyrene	0.001	0.001
Benzo(a)anthracene	0.1	0.005
Cyclopenta(c,d)pyrene	0.1	0.02
Chrysene	0.01	0.03
5–methyl-chrysene		
Benzo(b)fluoranthene	0.01	0.1
Benzo(j)fluoranthene		0.05
Benzo(k)fluoranthene	0.01	0.05
Benzo(a)pyrene	1	1
Benzo(g,h,i)perylene	0.01	0.02
Indeno (1,2,3–cd)pyrene	0.1	0.1
Dibenzo(a,h)anthracene	1	1.1
Dibenzo(a,l)pyrene		1
Dibenzo(a,e)pyrene		0.2
Dibenzo(a,h)pyrene		1
Dibenzo(a,i)pyrene		0.1

TEF of 5–methylchrysene was only assessed for an aerial contamination and sat at 1 (Collins et al., 1998)

The ANOVA performed on data, shows significant differences of the PAH concentrations according to the smoking process. Smouldering gave the highest and liquid smoke the lowest concentrations of low molecular-weight PAHs. Friction and thermostatic plates lead to intermediary and similar levels of contamination, especially for fluoranthene and pyrene (from 0.10 to 0.40 µg kg-1) or phenanthrene. Whereas the content of the PAH with a higher molecular weigh (Benzo[a]pyrene, Benzo[g,h,i]perylene) is the highest when friction process is used and no significant difference is observed for the other processes.

Fisher's least significant difference (LSD) procedure performed on TEQ data calculation allows a comparison between two groups (Figure 2). The first group consists in fish smoked by using friction and smouldering processes and whose fillets present a high TEQ value. The second group consists in fish smoked by using thermostatic plated and liquid smoke atomization; in the latter case the fillets presented TEQ value significantly weaker.

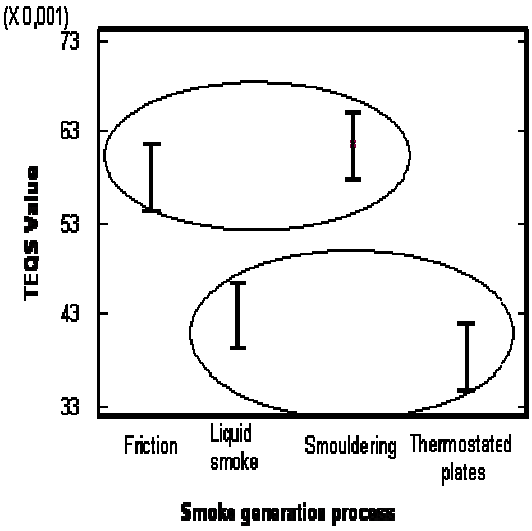


Figure 2. Comparison of TEQ value means according to the smoke generation process, 95% Least Significant Difference was plotted

It is important to note that when smoke comes from wood pyrolysis the maximum residue limit of 5 µg.kg–1 of benzo(a)pyrene fixed by the European Commission for smoked seafood products is never reached.

The statistical analysis of data shows that the effect of time and temperature of smoking depends on the molecular weight of PAH. The effect of temperature smoking was highlighted only for the most lightweight compounds, i.e. Fluorene, Phenanthrene, Anthracene (Figure 3) The effets of smoking times concern also the low molecular weight compounds like Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene and Benz[a]anthracene.

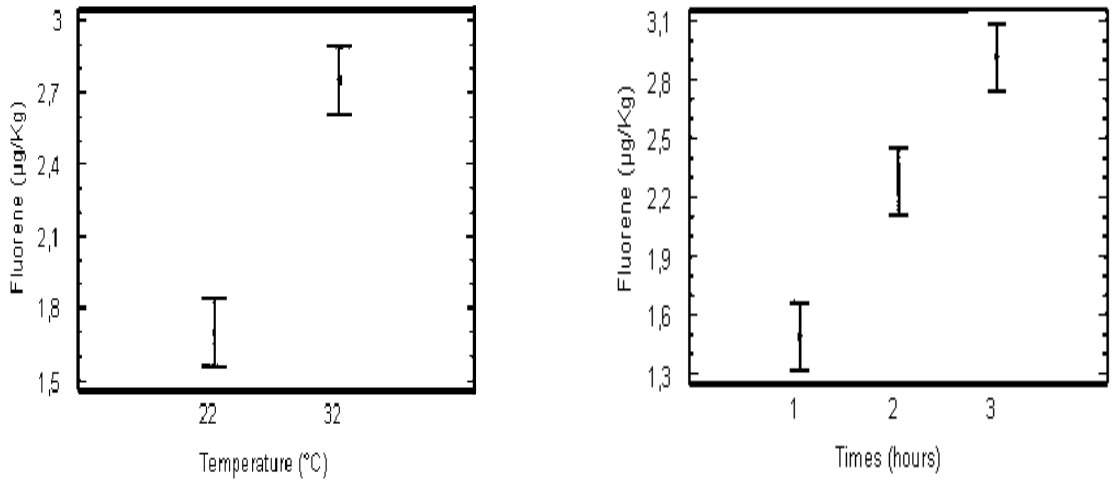


Figure 3. Comparison of fluorine content in smoked salmon according to time and temperature values: 95% Least Significant Difference was plotted

Furthermore, a multiway ANOVA shows a strong interaction between times of smoking and smoke generation process. Indeed, when smoking times increase the PAH content is significantly more important during the production of smoke by smouldering than by other processes.

4. CONCLUSIONS

This study shows the complexity of the composition of smoke compounds deposited on fish fillets during smoking.

We have shown, through olfactometric methods, the importance of smoking process parameters on the odorant compound contents. Furthermore for the first time we were able to establish a statistical relationship between the odorant volatile compounds content, the parameters of smoking and organoleptic perception of the flavour of smoked salmon. The results of this study confirm the importance of phenolic and furannic compounds in smoked salmon aroma, particularly for “wood fire smoke” odour and flavour in products smoked by thermostatic plates, friction or smouldering. Syringol and cresols seem to be implied in the “cold smoke” sensory attributes of the products treated by liquid smoke.

The development of an efficient analytical method has allowed to characterize and quantify the PAH present in smoked fish. The content of PAH is related to smoke generation process and smoking parameters. Nevertheless the PAH quantities are always below the European legal limit for smoked fish. The highest concentration of benzo(a)pyrene is found after three hours of smoke exposure and reaches 0.04 µg.kg-1, still clearly below 5 µg.kg-1.

It can be noted that there is no correlation between volatile compounds content and PAH content. Indeed, the thermostatic plates’ process leads to high contents in odorant compounds and allows to obtain smoked products with a low TEQ, while we have a reverse situation for friction and smouldering processes.

However, to obtain additional information, further trials are necessary, including not only the effect of the parameters of the smoke generation (kind of wood, wood moisture, temperature air quantity) but also the impacts of the composition of fish fillets, particularly lipid and water contents.

5. RECOMMENDATIONS

Our work shows that traditional industrial smoking processes give smoked fish with some organoleptic characteristics and that a high perception of smoke flavour can be related to high time and temperature of smoking. So the organoleptic quality of smoked fish can be easily adapted to consumer's demands. However, when lightly smoked fish is produced, some safety problems can occur.

The use of liquid smoke atomization can produce smoked fish with organoleptic characteristics significantly different from traditional industrial processes. However, our trials were carried out with one kind of liquid smoke. Studies actually performed in our laboratories with other kinds of liquid smoke tend to demonstrate that it could be possible to obtain, by liquid smoke atomization, smoked fish with organoleptic properties very close to those of fish smoked with traditional processes.

The formation of PAH during smoking and drying is dependent on a number of variables, including:

- Kind of wood;
- Wood moisture;
- Smoking method (smoking or drying - direct or indirect);
- The distance between the food and the heat source (not really shown);
- Processing time;
- Temperature during processing;
- Smoke generation mode; and
- Cleanliness and maintenance of equipment.

Many authors reported that the use of the soft wood species (resinous wood) results in increased levels of benzo[a]pyrene compared to the use of hard wood. Maga, 1988, proposed to use hard woods instead of soft woods to reduce the PAH content. However, limited research has been conducted showing some discrepancies. (Guillén *et al*., 2000).

Direct smoking is the traditional type of smoking process where the smoke is produced in the same chamber in which the food is processed; indirect smoking uses smoke generators, with the smoke being produced in a separate chamber and possibly cleaned in various ways before being fed into the smoking chamber. Direct smoking requires less equipment than indirect smoking but can result in higher levels of PAH in the product. Previous studies show that when direct smoking process was used PAH contents could be 10 times higher than PAH contents when indirect smoking process was used.

In our study we used three indirect smoking processes and we can observe that the PAH content was always lower than the European legal limit.

Recent trials performed in our laboratory seem to show that the use of wet wood could decrease the PAH contents, so we can propose that PAH content of smoked can be minimized by:

- Use of hard wood rather than soft wood to generate smoke;
- Use wood that is not too dry;
- Using indirect smoking process whenever possible instead of direct smoking;
- Control of smoke generation temperature should include assessment of the resulting PAH content in the smoke;
- Filter or cool the smoke between generator and smokehouse; and
- In the case of facilities with a certain production capacity, the use of liquid smoke atomization could be an alternative. This process allows both the organoleptic quality control and production process with a low rate of PAH. It also helps to eliminate fire hazards.

Reduction of time and temperature of smoking did not seem defining parameters for PAH contamination especially as their decrease could provide an inadequate microbial food safety.

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COMMERCIAL FISH SPECIES IDENTIFICATION WITH ISOELECTRIC FOCUSING: APPLICATION TO BREADED FISH PRODUCTS

[IDENTIFICATION DES ESPÈCES COMMERCIALES AVEC LA FOCALISATION ISOÉLECTRIQUE: APPLICATION AUX PRODUITS DE LA PÊCHE]

by/par

V. Tepedino, L. Ababouch , M. Ferri[1] and A. Berrini

Abstract

The globalization of fish and fishery products markets combined with the increase of consumer demand lead to a huge variety of non-endemic fish species in the marketplace. This might raise concerns about the inability of fish inspectors to distinguish fish species with similar morphological characteristics, particularly when they are processed and sold as fillets or slices in the country of origin, and to detect fish substitution, a practice where high value species are mislabeled and/or substituted in whole or in part with low value, species or products with potential toxins.

Several biochemical methods have been developed in order to identify fish species. The isoelectric focusing (IEF) of the water soluble sarcoplasmic proteins proved to be suitable, fast and reliable. A project funded by the Italian Agricultural Ministry aimed at identifying fish species with IEF has recently been concluded. The results demonstrated the suitability of the method in identifying most of the commercial fish species. The database developed contains the patterns of more than 250 fish species, and the software is able to compare the IEF patterns and identify unknown species.

In the present paper we show the application of the IEF method to semicooked products in order to demonstrate the usefulness of the method also in the identification of species used in breaded fish products (breaded fish fingers and fillets). The importance and advantages of using the IEF technique in the African fish industry exporting to Europe in the context of self-control and certification program are also highligthed.

Key words: Isoelectric focusing (IEF), Breaded fish products, Commercial fraud, Traceability

Résumé

La globalisation des marchés de poisson et produits de la pêche combinée à la demande croissante du consommateur conduit à une grande variété d'espèces non endémiques de poisson sur le marché de poisson. La conséquence directe est l'incapacité pour les inspecteurs du poisson de distinguer les espèces de poisson ayant des traits morphologiques similaires, en particulier quand elles sont transformées et vendues comme filets ou tranches dans le pays d'origine. Une identification correcte du poisson est fondamentale pour éviter une substitution frauduleuse.

Plusieurs méthodes biochimiques ont été développées dans le but d'identifier les espèces de poisson. La focalisation isoélectrique (IEF) sur les protéines sarcoplasmiques hydrosolubles a montré sa pertinence, sa rapidité et sa fiabilité. Un projet financé par le Ministère italien de l'agriculture visant à identifier les espèces de poisson avec IEF a été récemment accompli. Les résultats ont démontré la pertinence de la méthode dans l'identification de la plupart des espèces commerciales de poisson. La base de données contient les modèles de plus de 250 espèces de poisson, et le logiciel est capable de comparer les modèles IEF et identifier des espèces inconnues.

Dans le document présent nous avons appliqué la méthode IEF aux produits semi-cuits pour démontrer l'utilité de la méthode également dans l'identification des espèces utilisées dans les produits de poisson pané (bâtonnets et filets de poisson pané).

Mots clés: Focalisation isoélectrique (IEF), Produits de pêches panés, Fraude commerciale, Traçabilité

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1. INTRODUCTION

Consumers, and particularly children, like breaded fish products due to the enriched flavour, lack of bones and easiness to prepare. For their manufacture different fish species belonging to Order of Gadiformes and Pleuronectiformes are used. In the marketplace these products are labelled as breaded cod fish fingers, breaded cod medallions and breaded plaice fillets. The fish species declared on the label and mostly used for the manufacture of cod fish fingers and cod medallion are the Argentine hake (*Merluccius hubbsj*) and the shallow water Cape hake (*Merluccius capensis*), while for the plaice fillets the specie commonly used is the plaice (*Pleuronectes platessa*).

Current EU legislation does not require a compulsory indication on the label of the scientific or common denomination of the species used in the processed fish products. According to traceability and transparency requirements specified in the White Book and subsequent EU Regulations, consumers must be provided with all information regarding ingredients and species used in the manufacturing of any food products, including fish products.

In order to check if processed food products are properly labeled and to identify fraudulent use it is necessary to employ an analytic laboratory method for the identification of species.

The Isoelectric focusing (IEF) on polyacrylamide gels of the sarcoplasmic proteins proved to be particularly effective for the identification of species on fresh and frozen fish products (Lundstrom, 1979; Rehbein,1990; Tepedino, 2001). In processed and thermal treated products, proteins can be denatured and might lose their own characteristics. This often leads to an IEF pattern altered compared to the standard, and therefore not identifiable. However, most breaded products (fish fingers, medallions and fillets) are quickly pre-fried in oil and such heat treatment does not seem to alter the proteins.

2. OBJECTIVES

The purpose of this research was to use the IEF technique to identify fish species used to prepare breaded cod fish fingers, and breaded plaice fillets. A preliminary market investigation was carried out in Milan (Italy) with the purchase of fifteen packages of processed and quick frozen fish products of different brands with the selling denomination of “Breaded Cod fish fingers”, “Breaded Cod medallions” and “Breaded Plaice fillets”.

3. METHODOLOGY

Frozen breaded fish fingers, medallions and fillets were cut in the central part in order to sample the muscular tissue. Special care was used to avoid sampling the breaded parts. 0.2–0.5 g of tissue were collected using a scalpel, and suspended in H_2O to obtain a concentration of 1 g/ml. The protein extraction was carried out as previously described (Berrini, 2005; Tepedino, 2004; Tepedino, 2003).

The extracted proteins were analyzed with the IEF technique described earlier. Briefly, 30 μg of extracted proteins were loaded on a gel for IEF (GelBond PAG pH 3.5–9.5, GE Healthcare). The separation was performed at 10 °C, applying constantly 30W, with a maximum voltage of 1500V. The run time was 90 min. At the end of the run, the gel was fixed on TCA, acetylsalicylic acid for 60 min and stained with Coomassie Brilliant blue. The gel image was acquired using a scanner with a resolution of 300 points/cm and inserted into the data-base to perform the pattern analysis (Gel Compar II, AppliedMath, Saint-Martens, Belgium).

4. RESULTS

The IEF patterns obtained from breaded products were perfectly identifiable in comparison with the standard patterns obtained from the fresh products. This confirms that the quick pre-fry does not alter sarcoplasmic proteins of the inner part of breaded fish.

Figure 1 shows an example of the standard patterns of Argentine hake (*Merluccius hubbsi*), Cape hake (*Merluccius capensis*), plaice (*Pleuronectes platessa*) and dab (*Limanda limanda*) and the patterns obtained from breaded fish fingers and fillets. The patterns from unknown breaded samples are perfectly comparable with the patterns from standard species. This allows a certain identification of the species used in the preparations.
Table 1 reports the results obtained from the 15 products analysed.

As far as cod-based products are concerned, the species identified were the Argentine hake (*Merluccius hubbsi*) (n. 5), the Alaska pollack (*Theragra chalcogramma*) (n. 2), the Cape hake (*Merluccius capensis*) (n. 2) and the blue whiting (*Micromesistius poutassou*) (n. 1). The results showed that for the manufacture of breaded products, different fish species with diverse commercial value and quality are commonly used. In fact, the generic term "cod" includes different species belonging to either the Gadidae family or Merluccidae family. Since the indication on the label of the scientific denomination of fish species used in processed fish products is not compulsory, the majority of the analysed samples complied with current legislation. The only products not complying with the legislation were those containing Alaska pollack and Blue whiting, that cannot be labelled with the generic term "cod".

Regarding the samples of breaded plaice fillets, only 1 out of 5 was manufactured using the species *Pleuronectes platessa*, while the others were made with the Dab (*Limanda limanda*). It has to be noted that for all these commercial products the species reported on the label was *Pleuronectes platessa*. This is an illegal labelling.

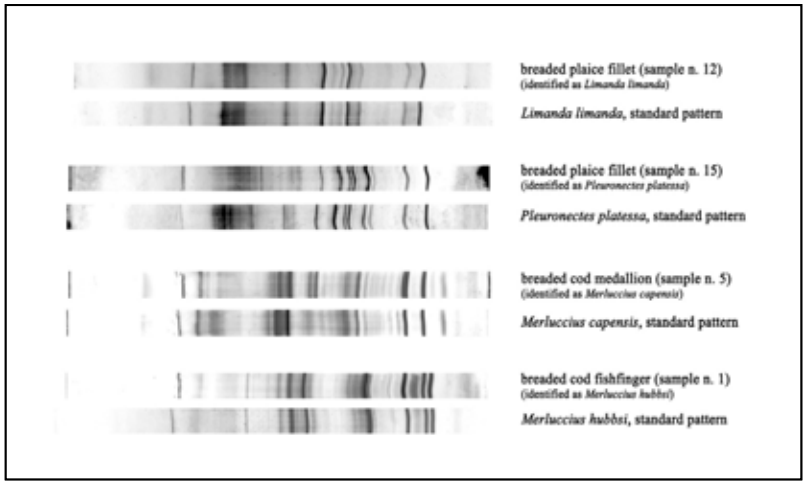

Figure 1. Standard patterns of some fish species and the patterns of breaded fish fingers and fillets

Table 1. Market research

Sample n.	Selling denomination of the product	Fish species indicated on the label (where present)	Fish species actually used and detected with IEF
1	Breaded cod fishfingers	*Merluccius hubbsi*	*Merluccius hubbsi*
2	Breaded cod fishfingers	*Merluccius hubbsi*	*Merluccius hubbsi*
3	Breaded cod fishfingers	*Merluccius hubbsi*	*Merluccius hubbsi*
4	Breaded cod medallions		*Theragra chalcogramma*
5	Breaded cod medallions		*Merluccius capensis*
6	Breaded cod medallions		*Theragra chalcogramma*
7	Cod slices in crunchy breading		*Merluccius capensis*
8	Cod slices in crunchy breading		*Micromesistius poutassou*
9	Cod slices in crunchy breading		*Merluccius hubbsi*
10	Cod slices in crunchy breading		*Merluccius hubbsi*
11	Breaded plaice fillets	*Pleuronectes platessa*	*Limanda limanda*
12	Breaded plaice fillets	*Pleuronectes platessa*	*Limanda limanda*
13	Breaded plaice fillets	*Pleuronectes platessa*	*Limanda limanda*
14	Breaded plaice fillets	*Pleuronectes platessa*	*Limanda limanda*
15	Breaded plaice fillets	*Pleuronectes platessa*	*Pleuronectes platessa*

5. CONCLUSIONS

Electrophoretic methods are widely employed in investigations of food products. IEF is a particularly well known technique used for species identification in fish products, even in those partially processed (breaded preparations). The correct fish identification is fundamental to avoid fraudulent substitution as in the case of Plaice fraud described above, and is a challenge faced by consumers and regulators. The direct advantages of using the IEF technique are to:

- help the inspectors identify fish products that, due to processing, are not easily identified macroscopically, and also detect species substitution that could result in potential adverse health consequences or could be a source of economic fraud; and
- provide consumers with true information about the product and its origin. This is particularly true nowdays with a growing appreciation of these "ready to cook" products by consumers, which requires a proper label indication of fish species used and their origin.

6. SPECIAL RECOMMENDATION FOR DEVELOPING COUNTRIES

Protein IEF, which is the most popular official method for fish species identification in the United States of America, can be of great interest to developing countries, in particular the African region where, in the last decade, artisanal and industrial processing plants increased their export to the European market of fish products mostly in the form of fillets. Species commonly used for fillets production belong to *Merluccius capensis* (Cape hake), *Solea senegalensis* (Senegalese soley), *Pseudupeneus prayensis* (West African goatfish), *Lates niloticus* (Nile perch) and *Zenopsis conchifer* (Slevery John Dory). These fillets are used in the European post-processing industry to manufacture breaded fish fingers, breaded fish medallions and other products.

The economy of IEF (which with around US$15/IEF pattern is cheaper than DNA method), its practicability (no need for sophisticated laboratory and expertise) and rapidity (results obtained in less than 2 days), make this technique a practical and friendly method to use for developing countries affected by economic and laboratory infrastructure constraints. The African fish industry in the context of self-control programs, might apply IEF techniques as pre-verification tests by randomly checking batches of fillets and other fish products destined for export and, consequently, certify what is declared on the label. In Italy the IEF is being positively evaluted as a potential official method and this will help mutual verification between exporter and importer.

IEF techniques will definitely allow the African fish industry to comply with transparency and traceability requirements specified under EU legislation, add value to their products and offer better guarantees to European and worldwide consumers, providing them with correct information on the origin of, and species utilized in, processed fish products.

Ultimately the technical cooperation and information exchange between countries will pave the way for transferring this technology and make it available to African research institutions involved in fish quality and safety.

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ÉTUDE COMPARATIVE DE LA QUALITÉ BACTÉRIOLOGIQUE DE L'EAU UTILISÉE DANS LES INDUSTRIES DE LA PÊCHE AU SÉNÉGAL EN FONCTION DU TRAITEMENT APPLIQUÉ

[COMPARATIVE STUDY OF THE BACTERIOLOGICAL QUALITY OF WATER USED IN FISHING INDUSTRIES IN SENEGAL ACCORDING TO THE TREATMENT APPLIED]

by/par

K.S.B. Sylla[1], B. Musabyemariya and M.G. Seydi

Résumé

Au Sénégal, les traitements les plus utilisés sont la chloration, l'ozonisation et le traitement par les rayons ultra - violets. Cette étude menée au niveau de 5 usines de transformation des produits de la pêche (A, B, C, D et E) a pour objectif d'apprécier l'efficacité des traitements appliqués sur l'eau du réseau publique (eau potable) mais également sur l'eau de mer. Elle a consisté en des analyses bactériologiques (500 échantillons) de l'eau et de la glace utilisées dans ces unités.

Des résultats il ressort que, 77,3% des échantillons d'eau et de glace de l'ensemble des usines sont satisfaisants avant traitement et 91,2% le sont après application des différents traitements.

L'analyse de l'effet des traitements appliqués a montré que:

Au niveau de l'usine A (utilisant l'ozone)
Absence d'efficacité en ce qui concerne les coliformes fécaux, thermotolérants et les ASR. Pour les streptocoques et la flore aérobie l'ozone a permis une réduction respectivement de 25% et 15% de la contamination initiale.

Au niveau des usines B et C (utilisant le chlore)
Le chlore a permis la diminution respectivement de 15% et 7% de la contamination par les coliformes fécaux et les staphylocoques. Pour les autres germes, une conformité totale est obtenue après traitement.

Au niveau de l'usine D (utilisant les UV)
Le traitement aux rayons ultraviolets a conduit à l'élimination respectivement de 15% et 35% de la flore totale et des coliformes totaux. Par contre pour les ASR et les streptocoques, l'effet est plus faible car les pourcentages obtenus sont de 5%.

Au niveau de l'usine E (utilisant le chlore + les UV)
Le traitement combiné a entraîné une élimination de toutes les contaminations observées avant.

Il découle de cette étude que l'eau traitée aux rayons ultra violets et au chlore est moins contaminée. En effet, d'après les statistiques du bureau de contrôle des produits de la pêche, les usines utilisant les autres méthodes de traitement ont connu plus d'alertes communautaires (UE).

Mots clés: Eau, Glace, Bactériologie, Industrie de pêche

Abstract

In Senegal, the most used water purification treatments are by chlorination, ozone or UV rays. The aim of this study, which was carried out in five fish processing factories in Dakar (A, B, C, D and E), was to understand the effectiveness of treatments applied to water in the public network (drinking water) and also to sea water. 500 water and ice samples from these factories were collected for bacteriological analysis.

Results showed that 77.3% of the water and ice samples from all the factories were satisfactory before treatment and 91.2% after the various treatments had been applied.

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The analysis of the effects of the treatments applied showed that:

In factory A (using ozone)
Absence of effectiveness regarding the faecal coliforms and sulfite-reducing anaerobic bacteria (SRAB). For streptococci and aerobic flora, ozone allowed a reduction of 25% and 15%, respectively, of the initial counts.

In factory B and C (using chlorine)
Chlorine allowed a reduction of 15% and 7%, respectively, of contamination by faecal coliforms and staphylococci. For other germs, a total compliance with microbiological criteria was obtained after treatment.

In factory D (using UV rays)
UV ray treatment led to the elimination of 15% and 35%, respectively, of the total aerobic flora and coliforms. However, for SRAB and streptococci, the effect was weaker as the obtained results were 5%.

In factory E (using chlorine + UV rays)
The combined treatment resulted in the elimination of all the previous contamination.

This work showed that the water treated using UV rays and chlorine is less contaminated. Indeed, according to the statistics of the control office of fishery products, the factories using the other methods of treatment have had more EC alerts.

Keywords: Water, Ice, Bacteriology, Fish industry

1. INTRODUCTION

L'eau est pratiquement le seul moyen utilisé dans les industries alimentaires pour laver les locaux, les installations et les denrées; notamment dans les établissements de transformation des produits de la mer (J.C. Minla'a *et al*., 2001).

A cet effet, elle intervient dans le transport, les opérations de prétraitement des poissons, dans la fabrication de glace et dans les autres opérations de filetage, de marinade, de congélation et de mise en conserve. Son usage est donc incontournable.

Cependant l'eau peut constituer un vecteur potentiel de germes pathogènes (salmonelles, vibrion cholérique, etc.) mais aussi des germes d'altération (*Pseudomonas*), ou de contamination fécale (coliformes fécaux). Ainsi des analyses bactériologiques sont effectuées régulièrement sur l'eau afin de déterminer leur niveau de potabilité. La qualité de l'eau utilisée diffère énormément d'un endroit à l'autre, de même que la méthode de traitement.

Pour prévenir les conséquences néfastes d'une contamination de l'eau chez les consommateurs et sur la qualité du produit, les industries des produits de la pêche doivent mettre en place des moyens efficaces de traitement de l'eau, afin de respecter les normes de qualité requises par l'Union européenne pour les produits à l'exportation.

L'objectif de ce travail est de vérifier par sondage, l'efficacité des systèmes de traitement de l'eau utilisée dans cinq usines de traitement des produits de la pêche situés à Dakar. Il présente les résultats d'analyses officielles réalisées au laboratoire d'HIDAOA de l'école vétérinaire de Dakar, pour le compte de la direction des pêches maritimes.

2. MATÉRIEL ET MÉTHODES

Matériel

Milieu de l'étude

Cette étude a été réalisée au niveau de cinq unités de transformation des produits de la pêche (usines de filetage-réfrigération-congélation) qui détiennent tous un agrément pour l'exportation de leurs produits élaborés au niveau de l'Union européenne. Les noms de ces entreprises ont été mis sous anonymat sur demande de l'autorité

compétente chargée du contrôle et de l'inspection. Les lettres de l'alphabet A, B, C, D et E ont été utilisés à cet effet.

Matériel de prélèvement
- Glacières;
- Flacons en verre pyrex de 500 ml;
- Bouchons stériles;
- Papier collant pour identifier les flacons;
- Carboglaces; et
- Petit chalumeau (camping gaz).

Matériel de laboratoire
Il est constitué par l'ensemble des éléments utilisés dans un laboratoire d'analyse bactériologique des produits alimentaires, il s'agit:

- des milieux de culture et des réactifs;
- d'une balance de précision pour la pesée;
- de la verrerie: tubes à essai, erlenmeyer, flacons, boîte de Pétri, pipettes, étaleur;
- du matériel de stérilisation;
- des bains-marie pour la régénération des milieux; et
- du matériel d'incubation.

Méthodes

Prélèvement
- Les flacons utilisés sont des flacons de 500 ml en verre, lavés, séchés et stérilisés au four Pasteur pendant 45 minutes à 180 °C;
- Les prélèvements sont effectués au robinet. Avant de procéder au prélèvement le robinet est stérilisé avec une flamme pendant 2 minutes;
- Après l'ouverture du robinet, l'eau coule librement pendant quelques minutes avant que le remplissage des flacons ne soit fait;
- Une fois le flacon rempli le goulot est flambé avant de fermer avec le bouchon, ensuite le flacon est placé dans une glacière.

Échantillonnage
Au niveau de chaque usine et durant 3 mois (de janvier à mars 2007), 100 échantillons ont été prélevés en raison de 50 échantillons avant traitement et 50 autres après application du traitement en fonction des méthodes suivantes:
- l'usine A, utilisant l'ozonisation de l'eau;
- l'usine B et C, utilisant la chloration de l'eau;
- l'usine D, utilisant le traitement par les rayons UV; et
- l'usine E, utilisant la combinaison UV + chloration.

Germes recherchés
Les groupes de germes recherchés et les méthodes utilisées sont consignés dans le Tableau 1.

Tableau 1. Germes recherchés et normes utilisées

Germes recherchés	**Normes utilisées (AFNOR)**
Germes aérobies viables à 37 °C et 22 °C	NF EN ISO 6222
Coliformes totaux	NFT 90–413
Coliformes thermotolérants (*E. Coli*)	NF EN ISO 9308–1
Anaérobies sulfito-réducteurs (*Clostridium perfringens*)	NF EN ISO 26461–2
Entérocoques intestinaux (streptocoques)	NF EN ISO 7899–2
Staphylocoques pathogènes	NFT 90–421

L'interprétation des résultats a été faite selon les critères microbiologiques établis par la réglementation européenne en vigueur dans le domaine.

3. RÉSULTATS ET DISCUSSION

Résultats

Les flores totales à 37 °C, 22 °C et les anaérobies sulfito-réducteurs ont donné des résultats chiffrés (germes/ml).

Pour les coliformes totaux, coliformes thermotolérants, les staphylocoques, les streptocoques fécaux, les résultats sont qualitatifs c'est-à-dire indiqués par des signes: positif pour présence de germes et négatif pour absence de germes.

Niveau de contamination par la flore aérobie à 37 °C et 22 °C

Tableau 2. Niveau de contamination de l'eau par la flore aérobie mésophile totale

Usine de pêche	Niveau de conformité des échantillons en pourcentage	
	Avant traitement de l'eau	Après traitement de l'eau
A	80%	95%
B	79%	100%
C	80%	100%
D	80%	95%
E	80%	100%

Niveau de contamination par les anaérobies sulfito-réducteurs (ASR)

Tableau 3. Niveau de contamination de l'eau par les ASR

Usine de pêche	Niveau de conformité des échantillons en pourcentage	
	Avant traitement de l'eau	Après traitement de l'eau
A	20%	25%
B	92%	100%
C	90%	100%
D	91%	95%
E	90%	100%

Niveau de contamination par les coliformes totaux

Tableau 4. Niveau de contamination de l'eau par les coliformes totaux

Usine de pêche	Niveau de conformité des échantillons en pourcentage	
	Avant traitement de l'eau	Après traitement de l'eau
A	Présence dans 90%	Présence dans 85%
B	Présence dans 40%	Absence dans 100%
C	Présence dans 35%	Présence dans 5%
D	Présence dans 39%	Présence dans 4%
E	Présence dans 38%	Absence dans 100%

Niveau de contamination par les coliformes thermotolérants

Tableau 5. Niveau de contamination de l'eau par les coliformes thermotolérants

Usine de pêche	Niveau de conformité des échantillons en pourcentage	
	Avant traitement de l'eau	Après traitement de l'eau
A	Présence dans 39%	Présence dans 30%
B	Présence dans 21%	Absence dans 100%
C	Présence dans 25%	Présence dans 10%
D	Présence dans 6%	Absence dans 100%
E	Présence dans 5%	Absence dans 100%

Niveau de contamination par les streptocoques fécaux

Tableau 6. Niveau de contamination de l'eau par les entérocoques

Usine de pêche	Niveau de conformité des échantillons en pourcentage	
	Avant traitement de l'eau	Après traitement de l'eau
A	Présence dans 35%	Présence dans 10%
B	Absence dans 100%	Absence dans 100%
C	Absence dans 100%	Absence dans 100%
D	Présence dans 20%	Présence dans 15%
E	Présence dans 25%	Absence dans 100%

Niveau de contamination par les staphylocoques

Il a été observé l'absence de ces germes dans tous les échantillons des usines B, D et E. S'agissant des usines A et C, une contamination de 10% des échantillons a été constaté avant traitement de l'eau. Les résultats après application des traitements montrent une baisse de la contamination jusqu'à 3% des échantillons.

Discussion

Pour la flore aérobie à 37 °C, la moyenne trouvée est de 155,85 germes/ml d'eau; elle est de 503,5 germes/ml pour la flore à 22 °C. Selon Galzy (1981), une eau présentant moins de 1000 bactéries/ml est pure. Toutefois, les normes de références de la CEE autorisent respectivement des taux inférieurs à 20 germes/ml pour la flore à 37 °C et 100 germes/ml pour la flore à 22 °C. L'interprétation de nos résultats selon ces normes, montre que 20% et 2% des échantillons sont non satisfaisants respectivement avant et après traitement de l'eau. Ces non conformités sont liées d'une part à une pollution importante de la nappe phréatique et d'autre part, à une insuffisance dans le processus de traitement de l'eau pour les entreprises utilisant l'ozone et les UV seuls.

S'agissant des ASR, il ne doit pas exister plus d'une spore de bactéries anaérobies sulfito-réductrices dans 20 ml d'eau, selon les critères microbiologiques. Cette étude a révélé que 16% des échantillons provenant des usines sont non-conformes pour ce groupe de germes. Il convient de préciser que, la présence d'ASR a été observée uniquement dans les échantillons d'eau de mer traitée à l'ozone provenant de l'usine A. En effet, plusieurs travaux (Huss, 2004 and Nigel, 2002) ont montré la présence de ces germes dans le milieu aquatique; ce qui témoigne d'une contamination fécale.

En ce qui concerne les coliformes totaux et thermotolérants, la réglementation stipule que 95% des échantillons ne doivent pas contenir de coliformes totaux dans 100 ml d'eau. Elle exige également l'absence de coliformes thermotolérants dans 100 ml d'eau. Nos résultats ont révélé que 10% des échantillons étaient non satisfaisants. Cette présence de coliformes pourrait être due essentiellement à la contamination de la glace par le personnel d'une part, et d'autre part, aux instruments et le matériel de prélèvement ou de conservation.

Pour les streptocoques fécaux, la réglementation exige aussi l'absence de germes dans 100 ml d'eau. Nos résultats ont montré un niveau de contamination moins important que pour les coliformes fécaux ce qui explique leur résistance beaucoup moins importante dans le milieu extérieur.

Enfin, il a été observé l'absence de staphylocoques présumés pathogènes dans tous les échantillons des usines B, D et E. Pour les deux autres entreprises le traitement mis en place a permis de réduire la contamination initiale de 7%.

Globalement, il ressort de cette étude que:

- l'ozonation utilisée par l'usine A, a donné une non conformité pour tous les germes;
- la chloration utilisée par les usines B et C, a donné une non conformité pour les coliformes totaux;
- le traitement aux rayons ultraviolets utilisés par l'usine D, a donné une non conformité surtout pour les coliformes et les streptocoques; et
- le traitement combiné aux rayons ultraviolets et au chlore utilisé par l'usine E, a permis d'avoir une conformité pour tous les germes.

Suite à ces résultats, l'autorité compétente a pris des mesures à l'encontre de ces entreprises de pêche:

Usine A: fermeture de la ligne utilisant l'eau de mer traitée (crevettes et seiches) + remplacement par la chloration du système de traitement à l'ozone qui s'avère inefficace;
Usines B et C: renforcement des contrôles microbiologiques + suivi des durées de stockage de l'eau et de la glace;
Usine D: diminution des débits importants d'eau dans les canalisations pour augmenter l'efficacité des rayons UV + contrôles microbiologiques renforcés.

4. CONCLUSIONS

L'eau utilisée pour la transformation des produits de la pêche est l'un des points de contrôle critique les plus importants. En effet, cette étude a montré qu'il peut exister des différences de contamination avant traitement de l'eau d'une usine à une autre. Cependant, les traitements appliqués ont permis une réduction de la charge microbienne pour l'ensemble des germes recherchés. Mais, il faut noter que les résultats ont montré également, une diminution de la contamination plus importante pour la méthode de traitement combiné alliant les UV et le chlore. Ce traitement épuratif présente l'avantage d'être moins coûteux que l'ozonisation en termes d'investissement, c'est pourquoi nous recommandons aux industriels du secteur l'installation de lampes UV au niveau des canalisations d'eau. En effet, la plupart des usines utilisent déjà la méthode de chloration de l'eau.

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THE INFLUENCE OF DAGAA-BASED POULTRY FEED QUALITY ON CHICKEN EGG PRODUCTION WITHIN LAKE VICTORIA BASIN

[L'INFLUENCE DE LA QUALITÉ DE L'ALIMENT À BASE DE VOLAILLE À BASE DE DAGAA SUR LA PRODUCTION D'ŒUFS DANS LE BASSIN DU LAC VICTORIA]

by/par

Margaret Masette[1]

Abstract

A preliminary study to assess the influence of dagaa quality on the egg production was conducted in three selected districts within the Lake Victoria basin where post-harvest losses in dagaa fishery are known to vary between 25% and 90%. Besides, most dagaa products are socially stigmatized for various reasons. Dagaa intended for animal feed production is haphazardly handled and processed which results in unacceptable quality. However, the effects of this malpractice on the ultimate users/consumers have not been established. Between March and July 2008, an assessment to link dagaa quality and egg production was conducted. Fifteen randomly selected poultry farmers were interviewed; physical as well as chemical tests were conducted to evaluate the quality of dagaa. For one month, two flocks of laying chicken were fed on two different qualities of dagaa-based feeds. Results indicated that the principal constraint among poultry farmers was the quality of dagaa which was exacerbated by adulteration with extraneous materials which included livestock dung, plant materials, stones and sand/soil. The level of adulteration affected mixing ratios and egg production. The ash content of low quality feed was four times higher than in pure dagaa (control sample) and the protein content was 2–5 times less. Chicken fed on high quality feed laid twice as many eggs as the flock fed on low quality feed. Consequently, incidences of egg breakage were more frequent in flocks feeding on low quality than high quality feed; hence the need to improve dagaa handling and processing, curbing adulteration malpractices and regularizing pricing patterns. Implementation of the suggested mitigation measures will reduce post-harvest losses and increase dagaa for human consumption.

Key words: Dagaa quality, Feed, Egg production, Uganda

Résumé

Afin d'évaluer l'influence de la qualité du dagaa dans la production d'œufs, une étude préliminaire a été conduite dans trois districts sélectionnés dans le bassin du lac Victoria où les pertes post-capture dans la pêcherie du dagaa sont connues pour varier entre 25-90%. De plus la plupart des produits de dagaa sont socialement stigmatisés pour plusieurs raisons. Le dagaa destiné à la production d'aliment pour animaux est mal manipulé et traité, par conséquent de qualité inacceptable. Cependant, les effets de cette mauvaise manipulation sur les utilisateurs/consommateurs finaux n'ont pas été établis. Entre mars et juillet 2008, une évaluation a été conduite pour élucider le lien entre la qualité de dagaa et la production d'œufs. Quinze aviculteurs sélectionnés au hasard ont été interviewés; des tests physiques et chimiques ont été conduits pour évaluer la qualité du dagaa. Pendant un mois, deux batteries de poules pondeuses ont été nourries avec des aliments à base de dagaa de deux différentes qualités. Les résultats indiquent que la principale contrainte parmi les aviculteurs était la qualité de dagaa, qui était exacerbée par l'altération avec des substances étrangères y inclus les excréments de bétail, des matières végétales, cailloux et sable/terre. Le niveau d'altération a affecté les taux de mélange et la production d'œufs. La teneur en cendre dans l'aliment de basse qualité était quatre fois plus élevée que dans le dagaa pur (échantillon de contrôle) tandis que la teneur en protéines était 2-5 fois moins. Les poules nourries à l'aliment de haute qualité pondaient deux fois plus que la batterie de poules nourrie à l'aliment de faible qualité. Par conséquent, les incidences de brisure des œufs étaient plus fréquentes dans les poules nourries à l'aliment de basse plutôt que de haute qualité; d'où le besoin d'améliorer la manutention et transformation de dagaa, en réduisant les mauvaises pratiques et en régularisant le paramètre de fixation de prix. La mise en œuvre de ces mesures atténuantes proposées réduiraient les pertes post-capture et augmenteraient le dagaa pour consommation humaine.

Mots clés: Qualité du dagaa, Alimentation pour animaux, Production d'oeufs, Ouganda

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1. INTRODUCTION

Dagaa (*Rastrineobola argentea*) is a silvery sardine-like fish with an average length and weight of 5 cm and 15 g, respectively. With the declining Nile perch *(Lates niloticus)* and Nile tilapia *(Oreochromis niloticus)* catches, dagaa has been the mainstay for Uganda's 3.5% per annum increasing human populations as well as regional markets. In addition, it is an important protein and mineral source in the formulation of animal feed. Although the recent total catches in Lake Victoria seem to be decreasing, the value has tended to stabilize at about US$ one million mark (Figure 1) which is a significant contribution to the national economy.

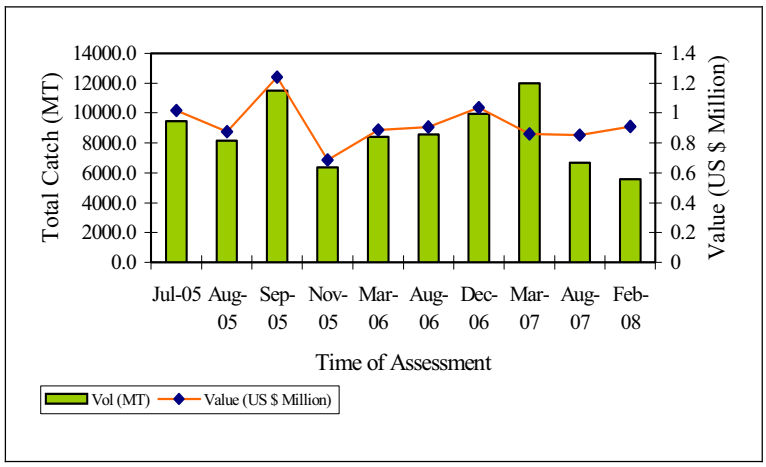

Figure 1. The status of Lake Victoria dagaa fishery, Uganda
*(**Source:** Catch Assessment Survey Report by Muhoozi L. – Researcher based at National Fisheries Resources Research Institute (NaFiRRI))*

Despite the declining catches, the post-harvest losses are fairly high. Using a load tracking method, a recent loss-assessment study at three landing sites around Lake Victoria (Uganda) estimated a 40% loss. According to the Department of Fisheries Resources (DFR), 80% of all dagaa caught in Ugandan waters is usually processed for animal feed and only 20% is marketed for human consumption. Essentially, the underlying criterion for division of the market space is the quality status of dagaa. During the rainy season, the losses may be as high as 90% and because of insufficient drying the quality deteriorates further which often relegates dagaa to animal feed production. Several contributory factors to high post-harvest losses in the dagaa fishery have been identified. They include poor handling and processing practices, birds (egrets), pigs, weather dependent preservation method (Okoche, 2008; Masette, 2005). With the declining per capita fish consumption from 13 kg in 1980 to the present 6 kg in Uganda, human health and economic development have been definitely affected but the impact(s) are as yet uncertain. Masette (2005) suggested low-cost preservation methods to reduce losses and thereby reversing the 80:20 marketing matrix. However, regardless of the marketing options, there is a need to ensure acceptable quality as an approach to demystify the social stigma attached to dagaa.

Currently, the major concern among dagaa end-users is the unacceptable quality. From field observations, several major factors that influence dagaa quality have been identified. Masette, (2005) observed that the fishing regimes, poor handling practices from fishing ground to processing sites and insufficient drying lowered dagaa quality through spoilage. In addition, the traditional way of sun-drying dagaa on rocks or bare ground exposes it to a myriad of potential contaminants, namely: sand, soil and livestock dung. Despite the high risk of contamination and adulteration, most processors dealing with dagaa for animal feed have resisted adoption of improved methods. The resistance is linked to the pricing pattern as noted by Masette and Atyang (2007). Apparently, dagaa processed for animal feed production was sold by weight as opposed to dagaa sold for human consumption that was sold by volume. As such, drying on bare ground is advantageous to the processor as adulterous materials increase weight of the final product. The careless attitude observed among dagaa dealers during the drying process and subsequent handling is a calculated strategy to prop up the malpractice. It is not uncommon to see processors walking over dagaa whilst drying or flocks of birds pecking. According to many of them this is "a way they compensate for the loss" by including sand or other extraneous materials. The pricing pattern also appears to be an impetus for unscrupulous dealers to deliberately add shovels of sand/gravel, soil or other extraneous materials into sacks of dagaa for monetary gain. The malpractice has inadvertently led to the social stigmatization of dagaa among middle and upper class potential consumers in Uganda. As such, dagaa is usually associated with low income earners who, by virtue of their limited economic outlay, rarely demand high quality products. On the contrary, the market in South Sudan and Democratic Republic of Congo (DRC) is so

insatiable and lucrative that dagaa of questionable quality is marketed expensively, probably to the middle class. It can therefore be inferred that because the consumers in these neighbouring countries do not demand high quality dagaa products, they inadvertently promote the adulteration of dagaa products in Uganda.

The quality of dagaa not only influences consumption patterns but also plays a significant role in other sectors of the economy. For instance, in the poultry sector, the quality of dagaa is known to influence the performance of laying chickens. Recently, one poultry farmer observed that when he changed from animal feed dagaa to the high quality dagaa intended for human consumption, the number of eggs increased by 40% per day (Wanda, pers. comm.). Another farmer also noted that the mixing ratio (maize bran: milled dagaa) increased by a factor of 3 when poor quality dagaa feed was used, compared to high quality dagaa meant for human consumption (Dhatemwa, pers. comm.). Since dagaa for human consumption was three times more expensive than dagaa meant for animal feed production, he had resorted to sieving out sand from the latter before milling. A dairy farmer also recorded a drop in the milk yield when she changed from high quality dagaa pellets to highly adulterated version (Okiror, pers.comm). It is evident that in the three cases, the quality of dagaa was the probable variable. The level of adulteration as well as pricing patterns highly compromized the quality of dagaa. The poor quality dagaa invariably affects the performance of the respective animal enterprise. However, despite the rampant malpractice in the dagaa fishery, many livestock farmers are not aware of the link between low egg/milk production and the quality of dagaa-based feed. Admittedly, there are many factors that could influence egg production, i.e. breed, feed and age (Larbier and Leclerco, 1994; Austic and Nesheim, 1990), but the link between dagaa quality and egg production requires urgent verification.

Overall objective

To identify factors affecting optimal utilization of dagaa.

Specific objectives

- To objectively establish the effect of mishandling and adulteration of dagaa on egg production;
- To assess the level of adulteration in dagaa-based poultry feed; and
- To determine selected chemical constituents of poultry feeds on the local market.

2. MATERIALS AND METHOD

Materials

Dagaa-based poultry feed for layers, flock of Golden Comet breed, structured questionnaire, weighing balance, relevant laboratory equipment and chemicals.

Methods

The baseline information on poultry sector in the three selected districts of Kampala, Wakiso and Jinja within Lake Victoria Basin (Uganda) was collected using a structured questionnaire which was designed with the help of a veterinary officer in charge of poultry sector based at the headquarters of the Ministry of Agriculture, Animal industry and Fisheries (MAAIF). It was then administered to 15 randomly selected poultry farmers engaged in egg production enterprises. Their responses were coded and analyzed using Excel package. The level of adulteration was assessed by identifying non-dagaa materials in ten batches (1 kg each) of dagaa intended for poultry feed production and their occurrence tallied. Five samples of low quality layers mash were purchased in duplicates from the market, one high quality sample was purchased from a reputable local dealer (A) and the control sample (pure milled dagaa) processed at FBRC laboratories. The six duplicate samples were subjected to chemical analyses for selected chemical constituents, namely proteins, ash and minerals (calcium and phosphorus) using standard AOAC methods. To determine the effect of dagaa-based feed quality on egg production, two different laying flocks (Golden Comet) were fed different types of feed with varying quality attributes in the dagaa component. The feed (A) was processed from high quality dagaa while the local feed (B) had doubtable quality owing to its high level of adulteration. The number of eggs laid daily was recorded for a period of one month and subjected to Levene's Test for Equality of Variances.

3. RESULTS AND DISCUSSION

The quality of dagaa varies with the intended use and market outlet. Whereas dagaa intended for human consumption exhibits high quality attributes and particularly lustre, colour and limited percentage of grit, dagaa

intended for animal feed production is highly adulterated, dull in colour and therefore low in quality. As such, the level of adulteration determines the respective product cost and it could be the driving force behind the malpractices in the dagaa fishery especially for that intended for animal feed production.

The linkage between dagaa quality and egg production in three districts - Uganda

The linkage between dagaa quality and egg production was deduced from the responses of poultry farmers in the three selected districts. Although, the location of nests had a bearing on the percentage of broken eggs, the latter was probably indicative of calcium deficiency associated with low quality dagaa-based feed (Figure 2). Only 40% of the respondents realized the linkage and correspondingly added an average of 12% dagaa to other ingredients in the mixing formula to improve chicken performance.

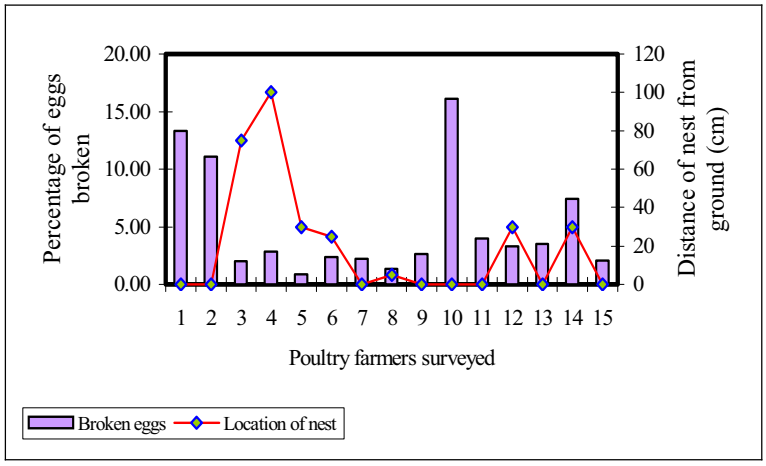

Figure 2. The relationship between location of nests and rate of egg breakage

Farmers 1, 2 and 10 in Figure 2 had the highest percentage of broken eggs per day which was attributed to the location of nests, soft shells (33.3%) and other factors (66.7%) which included mishandling by workers, oversized/misshaped and trampling under feet by the birds themselves. To reduce egg breakage, most farmers picked eggs 4 times a day on average. However, the breakage could also have been due to deficiencies in dietary calcium and phosphorus (Haumirtel, 1990; Sohail and Roland, 2002) which could have been adequately supplied by high quality dagaa-based feeds.

The effect of selected poultry feed on egg production

There are many factors that influence egg production for example breed, type of feed, feeding regimes and age (Larbier and Leclerco, 1994; Austic and Nesheim, 1990) but the present study focused on the type of feed. Two flocks of laying hens belonging to Golden Comet breed that were fed on different types of feed adequately demonstrated the assertion. The flock fed on feed (B) purchased locally had a significantly low laying performance than their counterparts fed on feed (A) ($P< 0.05$, $F= 5.840$ according to Levene's Test for Equality of Variances). The trend of egg production in the flock fed on feed (B) seemed to decrease with time while the flock that was fed on feed (A) seemed to increase (Figure 3).

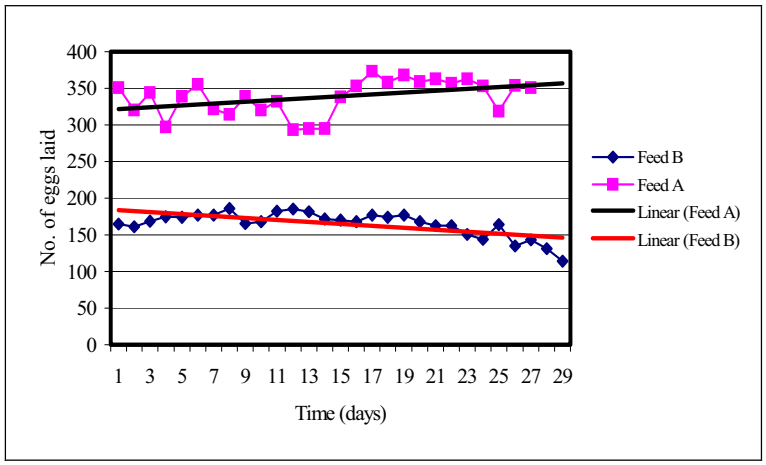

Figure 3. The effect of poultry feed on egg production of Golden Comet breed

As already mentioned, most local feeds seem to have high ratios of maize bran in their formulation to compensate for low quality dagaa which seem to have played a critical role in the performance of laying eggs observed in Figure 3.

Adulteration with extraneous materials

Within the Lake Victoria Basin, dagaa is mostly sun-dried on bare ground where it is exposed to all sorts of extraneous materials including livestock dung, soil, sand, stones and plant materials (barks, twigs and leaves). The magnitude of contamination varies with the type of drying surface and the presence of domestic animals at the landing site/processing site. Usually, dagaa intended for animal feed is not sorted for quality hence the presence of various extraneous materials in dagaa samples found on the local market (Figure 4).

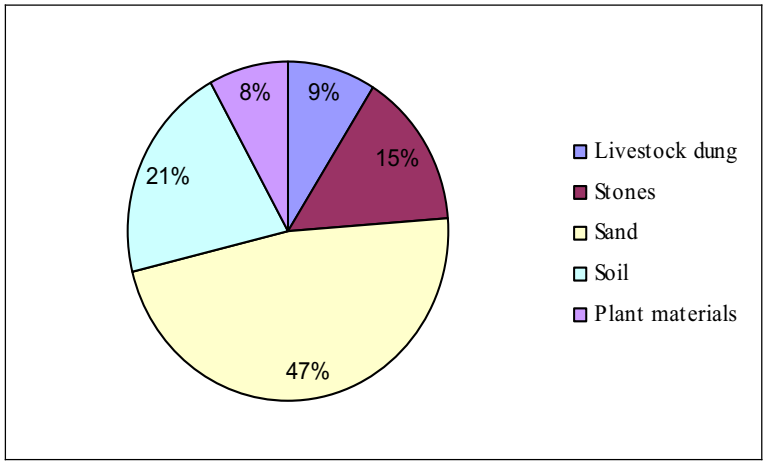

Figure 4. Extraneous materials found in dagaa intended for livestock feed manufacture

At the feed milling plant, there have been unsubstantiated reports that dagaa traders deliberately add sawdust to milled products to increase volume and weight. The malpractice undoubtedly creates a nutritional imbalance in the final feed which subsequently interferes with mixing ratios. During the present survey, it was evident that sand (≈ 50%) represented a substantial component in dagaa intended for livestock feed production (Figure 4). According to previous studies (Masette and Atyang, 2006; Masette, 2005) dagaa intended for animal feed was sold per unit weight as opposed to sales of dagaa for human consumption that was sold per unit volume. This scenario allows dagaa traders to deliberately add sand and soil into dagaa sacks to increase weight. This malpractice undoubtedly earns them abnormal profits at the expense of end-users.

Chemical constituents of poultry feed on the local market

Like other livestock, chickens require basic chemical nutrients (proteins, fats and minerals) in sufficient quantities to maintain life, promote growth and health. Invariably, the type of feed consumed determines the amounts and quality of the respective chemical constituents. In the present study, the low quality feeds (1–5) showed high levels of ash and comparatively low protein content (Figure 5).

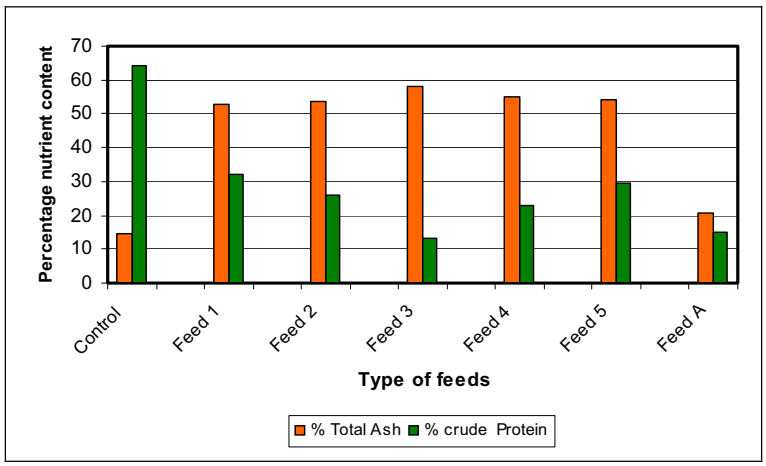

Figure 5. Ash and protein content of sample (B) and sample (A) poultry feed in Kampala

The ash content of 15% in the control sample was almost four (4) times and 1.4 times the ash content of the low quality feeds' average and sample (A), respectively. The high ash content in Feeds 1–5 may be attributed to the malpractice (Figure 4) and to the inclusion of mollusc shells in most poultry feed formulations in Uganda. The comparatively high protein content in Feeds 1, 2, 4 and 5 (Figure 5) may be due to the addition of large quantities of maize bran of which, according to the animal feed analyst, the Ugandan variety contains 10.5% protein on average (Katongole; pers. comm.). Although all the feeds investigated (with the exception of Feed 3), meet the protein requirement of 16–17% for laying hens (Ensminger, 1992), it is probable that the protein in low quality feeds was from plant source (maize bran) which invariably has a low biological value (Potter and Hotchkiss, 1995). Probably, it was this type of plant protein which partly contributed to low average egg production of 165 eggs per day (Figure 3). According to Larbier and Leclerco (1994), dietary regimes containing lower protein levels around 15% do not seem to influence subsequent laying performance provided lysine and sulphur amino acids are supplemented. Arguably, dagaa has more of these amino supplements than plant based protein sources (Huss, 1994, Potter and Hotchkiss, 1995), hence use of less dagaa and more maize bran in feed formulations undermines egg production regardless of the breed.

Although sample (A) feed had comparatively less protein content than Feeds 1, 2, 4 and 5 (Figure 5), it was consistent with the 16–17% requirement for laying hens (Ensminger, 1992). Probably, the low protein ash ratio in the feed had an effect on performance of laying hens in that the higher the ratio, the lower the performance but this assertion can only be proved by subsequent studies. Evidently the sample (A) feed was a better quality than low quality feeds which contributed to high egg production in Figure 3.

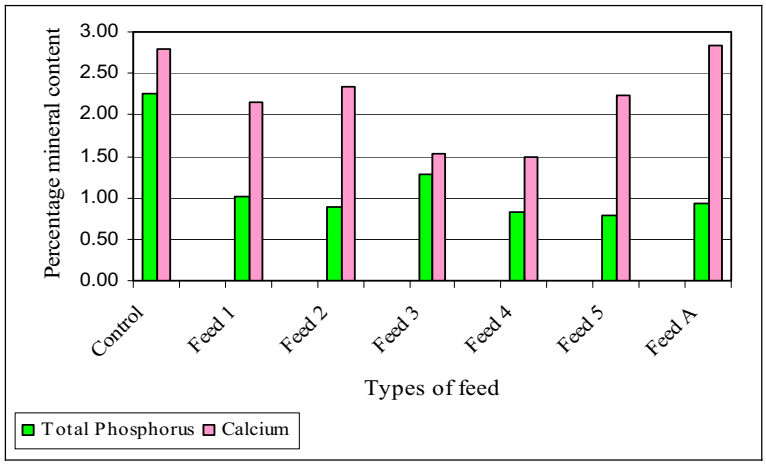

Figure 6. Phosphorus and calcium content of sample (A) and (B) poultry feed in Kampala

Phosphorus is an essential nutrient for laying hens because of its role in eggshell formation and metabolism (Said *et al*., 1984; Roland, 1990) while calcium is an important dietary requirement for maximum egg shell thickness (Zollitsch *et al*., 1996) when layers are fed on only 3.25 for 100 gram intake. Dagaa and mollusc shells are included in Ugandan poultry feed formulations to provide the necessary calcium and phosphorus for purposes of minimizing incidences of egg breakage. The level of egg breakage observed during the survey (Figure 3) was partly attributed to soft or lack of egg shells which was presumably indicative of Ca and P deficiency. According to Austic and Nesheim (1990) a laying hen requires 3.7% calcium and 0.4% phosphorus. Based on this requirement all feeds available on the local market (Figure 6) were deficient with regard to calcium but had adequate amounts of phosphorus. Since the control was significantly lower than the required calcium amounts, the extension workers normally urge farmers to supplement their feeds with mollusc shells (Aisu, pers. comm.). Probably, the optimum performance of a laying hen is only achievable by varying quantities and mixing ratios of relevant minerals which was beyond the scope of this study. Indeed, Haumirtel (1990) concluded that the minimum phosphorus requirement for the laying hen was 360 mg P/hen/day when the calcium concentration was restricted to 25 g/kg. However, to achieve the highest egg production and lowest mortality, 7.0 to 8.0 g/kg or 880–1020 mg P/hen/day were needed. Generally, well handled and processed dagaa can bridge the calcium deficiency in poultry feeds to enhance egg performance.

4. CONCLUSIONS

Although there are a myriad of factors that influence egg production, the preliminary results of this study indicated that the quality of dagaa had a significant influence on the egg production in Golden Comet breed in that when low quality or highly adulterated dagaa sample (A) was used in the formulation of feed, the egg

production was low and egg breakage was high due to inadequate protein and calcium. The level of adulteration seemed to interfere with mixing ratios and causes nutritional imbalance as minerals (calcium and phosphorus) content decreases in the final product. Supplementing low quality dagaa with other ingredients is an expensive alternative regardless of the end use. The pricing patterns in the dagaa fishery seemed to encourage adulteration and careless attitude among processors which in turn contribute to high post-harvest losses in the sector. Improvement of handling and processing of dagaa will reduce these losses, lift the social stigma and channel substantial quantities of dagaa for human consumption.

5. RECOMMENDATIONS

- Regardless of the intended use, dagaa should be appropriately handled to reduce post-harvest fish losses, and ensure quality and food security.
- Value-added and user friendly products should be developed from dagaa to increase the percentage of fish for human consumption.
- Comprehensive study should be conducted to provide consolidated data for better pricing pattern and other regulatory tools within the Lake Victoria Basin.
- Policy makers should institute bylaws to mitigate the malpractices and standardize measurement tools in dagaa fishery.
- Further sensitization of all stakeholders involved in handling, processing and marketing of dagaa with back-up from further researchable aspects in the fishery.

Acknowledgement
I am greatly indebted to Eng. Alfonse Candia, poultry farmer, who provided study inputs and recorded the relevant data for the duration of the study on his farm.

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ÉVOLUTION HISTAMINIQUE ET MICROBIOLOGIQUE DURANT LE STOCKAGE DE SEMI-CONSERVES D'ANCHOIS

[HISTAMINE AND MICROBIOLOGICAL CHANGE DURING THE STORAGE OF SEMI-PRESERVED ANCHOVIES]

by/par

Fayssal El Filali[1], S. Hanoune, B. Khbaya, N. Bou M'Handi and A. Kaaya

Résumé

Durant les différentes étapes de l'élaboration de la semi-conserve d'anchois, l'histamine enregistre des augmentations significatives. Cette élévation est favorisée par la fragilité de la chaire de ce poisson d'une part, et sa richesse en histidine, acide aminé précurseur de l'histamine d'autre part. La décarboxylation de l'histidine se présente alors comme étant un problème important dans l'industrie de la semi-conserve, notamment au moment de la maturation de l'anchois. L'objectif de ce travail est de cerner les bactéries qui sont responsables de la dégradation de cet acide aminé et de déterminer les conditions optimums de leur développement.

Ce travail a été entrepris dans le but de suivre et mieux définir les changements intervenant dans le produit fini après incubation à 30 °C, température favorable pour accélérer son processus de vieillissement. Différents paramètres ont été suivis à fréquence mensuelle, à savoir l'histamine, le pH et le dénombrement bactérien sur différents milieux (PCA, PCA à l'eau de mer, VRBG, MRS et M17). Les entérobactéries semblent ne pas résister à la concentration en sel appliquée au produit et disparaissent en moins d'un mois de stockage, de même pour les lactobacilles sur milieu MRS. Le suivi de l'histamine reste en rapport avec l'état hygiénique de chaque société, un contrôle régulier et une parfaite maîtrise des procédures de nettoyage et désinfection s'imposent pour une bonne qualité du produit.

Mots clés: Anchois, Bactérie, Histamine, Histidine, Semi-conserve d'anchois

Abstract

During the various stages of the development of anchovy semi-preserved food, histamine content increase significantly. This increment is favoured because the flesh of this fish is known as fragile on the one hand and rich in histidine, precursor of histamine, on the other hand. The decarboxylation of histidine arises then as being an important problem in the industry of semi-preserved anchovy and constitutes a great disadvantage at the time of the ripening. The objective of this work is to understand the bacteria which are responsible for the degradation of this amino acid and to determine the optimum conditions of their development.

This work is undertaken with an aim of following and, better, of defining the changes intervening in the end product after incubation at 30 °C, ideal temperature for accelerating the product's process of ageing. Various parameters were followed on a monthly basis, namely histamine, the pH and the bacterial count on various mediums (PCA, PCA with sea water, VRBG, MRS and M17). The Enterobacteriaceae seem not to resist the salt concentration applied to the product and disappear within less than a month of storage, as well as the lactobacillus on medium MRS. Histamine level reflect the hygienic status of each company a regular and a perfect control of the cleaning and disinfection procedures are essential for a good quality of the product.

Key words: Anchovy, Bacteria, Histamine, Histidine, Semi-preserved anchovy

1. INTRODUCTION

La préparation des semi-conserves d'anchois Engraulis Encrasicholus correspond à un processus de salaison et de maturation (Hernández-Herrero *et al*., 1999). Le processus de maturation est commun dans quelques secteurs méditerranéens et en Argentine où l'espèce est engraulis anchoita (Triqui and Reineccius, 1995). L'anchois (Engraulis Encrasicholus) est principalement commercialisé et transformée en Espagne, Italie, Grèce, France, et au Maroc (Hernández-Herrero *et al*., 1999).

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La maturation des anchois peut être divisée en deux étapes. La première étape est rapide et inclut la diffusion du sel dans les poissons et l'élimination de l'eau. Le taux de pénétration du sel change avec l'épaisseur du muscle, la température, la fraîcheur des poissons et la teneur en graisse (Clucas, 1982). La deuxième étape, plus longue et plus lente, et qui rend au produit ses caractéristiques uniformes de tendreté, d'arome et de goût (Filsinger, 1987). La maturation de l'anchois salée inclut les processus biochimiques qui causent les changements typiques des caractéristiques chimiques et physico-chimiques des tissus de poissons. Ces changements sont induits par les enzymes qui décomposent les protéines et les graisses (Voskresensky, 1965).

Bien que le sel empêche la croissance des bactéries de détérioration, d'autres micro-organismes peuvent ne pas être affectés par sa présence. Des micro-organismes ont été commodément divisés en quatre groupes basés sur leur sensibilité pour saler: halotolérantes, légèrement halophiles, halophiles modérés et halophiles extrêmes. (Baross et Lenovich, 1992).

Notre étude a été lancée en octobre 2006 et a pour objectif étudier l'effet du vieillissement du produit par incubation prolongée à 30 °C sur des boites de semi-conserve d'anchois, en provenance de trois sociétés différentes, sur quelques paramètres microbiologiques et physico-chimiques et de révéler la persistance des bactéries formatrices d'histamine durant le stockage du produit fini.

2. MATÉRIELS ET MÉTHODES

Echantillonnage

Les échantillons de semi-conserve d'anchois sont en provenance de trois sociétés différentes (A, B et C). Les anchois utilisées sont pêchées au large des côtes marocaines et préparées de la même façon dans ces trois sociétés (étêtage et éviscération, maturation, lavage, filetage, immersion dans l'huile et emballage) 90 boites de chaque société sont incubées dans une étuve à 30 °C (SANYO MCO 175), dont les valeurs en histamine au départ sont respectivement de 3, 12 et 70 ppm pour les sociétés A, B et C. Les échantillons pour analyses sont prélevés d'un mélange de 5 boites pour déterminer la teneur en histamine et un dénombrement bactérien après une année de stockage à un mois d'intervalle. Une quantité d'échantillon a été déposé à l'air libre et à 4 °C pour servir de témoin.

Tableau 1. Répartition et caractérisation des échantillons utilisées

Provenance	Description du produit	Conditionnement
Société A	Filet d'anchois roulé à la câpre	Boîte 1/15ème métallique
Société B	Filet d'anchois allongés	Bocaux en verre
Société C	Filet d'anchois allongés	Boîte 1/15ème métallique

Analyses physicochimiques

Le dosage de l'histamine se fait selon la méthode spectrofluorimétrique de Lerke et Bell 1978. 10 g d'échantillon sont homogénéisés dans 90 ml de tampon trichloracétique puis filtré. 200 µl du filtrat est transvasé avec 150 ml de tampon acétate dans une colonne échangeuse d'ions, l'histamine est ensuite éluée par l'acide chlorhydrique. La lecture de la DO se fait à 275 nm après complexassions de 20 µl du filtrat avec l'Ortho-phtaldéhyde. Pour la mesure du pH, un échantillon de 10 g est homogénéisé dans 10 ml d'eau distillée est utilisé après broyage, la lecture est ensuite réalisé à l'aide d'un pH mètre TOA DKK HM-20J.

Analyses microbiologiques

De chaque échantillon, 25 grammes sont prélevées aseptiquement et homogénéisées avec 225 ml d'eau peptonée tamponnée dans un sac stomacher pour un dénombrement de la flore totale sur milieu PCA (Plate Count Agar) à 30 °C pendant 72 heures, de la flore totale halophile sur milieu PCA à base d'eau de mer, filtrée à une porosité de 0,45 µm, à 25 °C pendant 5 jours (SANYO MIK-153), des entérobactéries sur milieu VRBG (Gélose Glucose au Violet Cristal, au Rouge Neutre et à la Bile) à 30 °C pendant 24 heures (ISUZU FR-114S), de la flore lactique sur milieux MRS (De Man, Rogosa and Sharpe) et M17 respectivement pour les bacilles et les coques à 30 °C pendant 48 heures (ISUZU FR-115S). L'ensemencement se fait en double couche pour le milieu VRBG, MRS et M17 et en profondeur pour les deux autres milieux.

Après dénombrement sur différents milieux, 665 souches sont isolées sur milieux correspondant puis testée sur milieu Niven (L-Histidine 2Hcl 27%, Tryptone 5%, Extrait de levure 5%, Chlorure de sodium 5%, Carbonate de

calcium 1%, Agar 30%, Pourpre de bromocrésol 0.6%). et sur milieu Yamani and Unterman (Peptone 2%, Lab lemco powder 1%, Chlorure de sodium 5%, L-Histidine Hcl 10%, Vert de bromocrésol 0.1%, Rouge de chlorophénol 0.2%). La lecture se fait après incubation à 30 °C pendant 24 heures (ISUZU FR-114S), les souches sont considérées positives si elles présentent un halo bleu mauve sur gélose Niven, ou par virage du bouillon du vert au bleu sur milieu Yamani and Unterman.

3. RÉSULTATS ET DISCUSSIONS

La teneur en histamine enregistrée durant le stockage du produit fini évolue de manière différente pour les trois sociétés. La société C affiche les valeurs les plus élevées avec un pic de 450 ppm au bout d'une année de stockage.

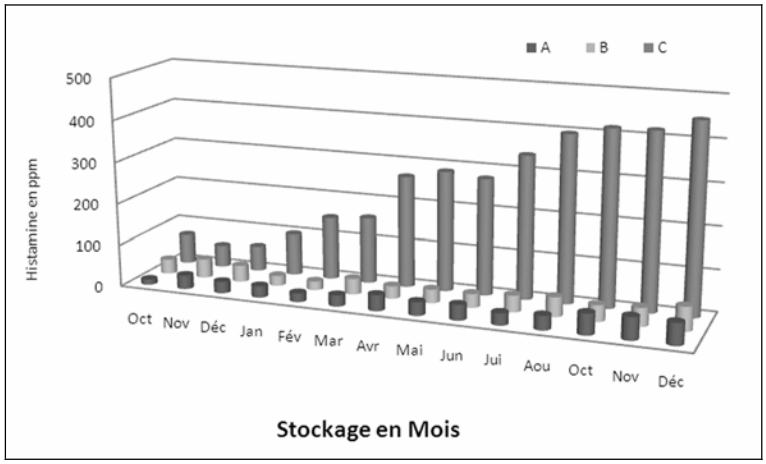

Figure 1. Evolution de l'histamine au cours de l'incubation des semi-conserves d'anchois à 30 °C en provenance de trois sociétés différentes A, B et C

Les deux sociétés A et B ont des valeurs d'histamine voisines et qui restent faible par rapport aux normes exigées à l'export (Figure 1). Dans une étude similaire, Veciana-Nogue *et al*., ont montré que les teneurs en amines biogènes dans des semi-conserves d'anchois en provenance de trois sociétés différentes et stockées à 20 °C augmentent au fur et à mesure. L'élévation de l'histamine est remarquable après le troisième mois du stockage à 20 °C et évolue de manière différente pour les trois sociétés étudiées. Les valeurs de pH enregistrées suivent l'évolution de l'histamine et sont comprises entre 5,4 et 6.

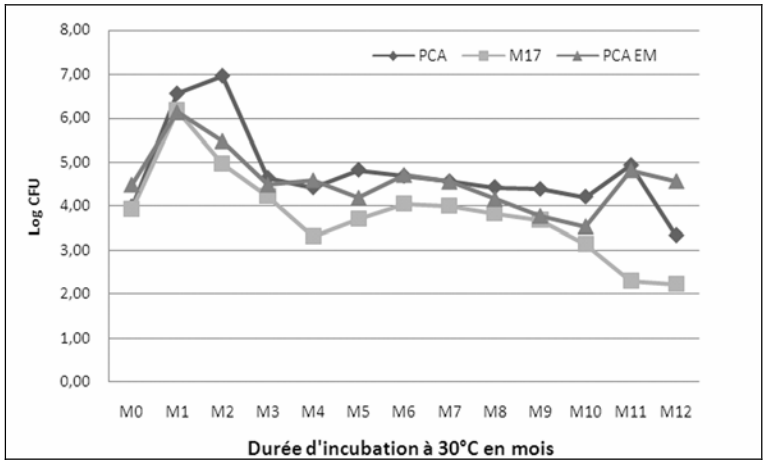

Figure 2. Evolution moyenne de la flore bactérienne au cours de l'incubation des boites de semi-conserves d'anchois à 30 °C en provenance de trois sociétés différentes

Le dénombrement bactérien affiche une évolution quasi parallèle sur les différents milieux utilisés et presque identique pour les trois sociétés étudiées. On note une légère augmentation durant les deux premiers mois suivie d'une baisse progressive jusqu'à la fin de la période du stockage (Figure 2). Il faut signaler que les entérobactéries disparaissent au bout du premier mois de stockage, ceci est dû à leur incapacité de tolérer des

teneurs élevées en sel. Quant à la flore lactique, les lactococcus prédominent sur les lactobacilles du moment que le dénombrement sur milieu MRS reste nul.

Sur les 665 souches testées sur milieu Niven et Yamani and Unterman, 137 souches sont positives et jugées formatrices d'histamine (Figure 3). La majorité des souches est représentée par la flore totale, la flore halophile et la flore lactique. Les entérobactéries dénombrées sont issues des différentes étapes de la journée de production des échantillons probablement à cause d'une contamination directe induite par le personnel des usines étudiés. Une étude de caractérisation sera lancée ultérieurement pour pouvoir identifier ces souches et étudier l'effet de certains facteurs limitant dans le but de cerner la problématique de la formation d'histamine dans la semi-conserve d'anchois.

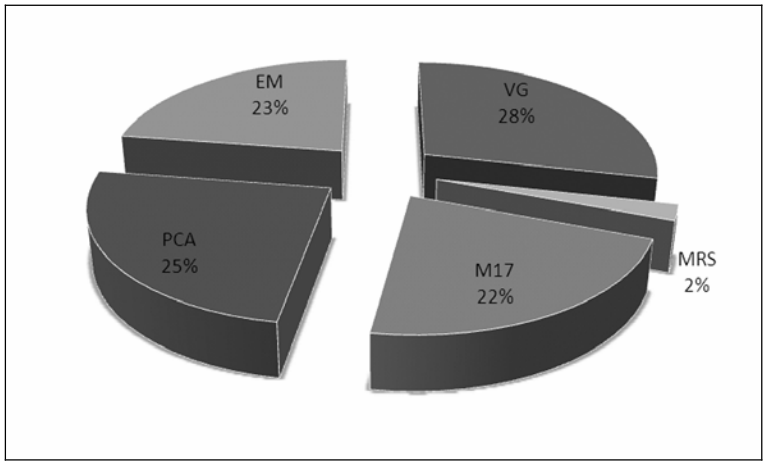

Figure 3. Répartition par type de milieux des souches formatrices d'histamine issues des boites de semi-conserves d'anchois incubées à 30 °C

4. CONCLUSIONS

Les valeurs d'histamine enregistrées durant l'incubation des boites des semi-conserves d'anchois à 30 °C permettent de conclure que chaque société contribue au sort qualitatif de son produit. Durant notre étude, la société C, à laquelle correspondent les fortes valeurs d'histamine, enregistre aussi des niveaux élevés des entérobactéries durant le processus de fabrication. Ces bactéries reflètent l'état hygiénique de chaque société et sont réputées les plus formatrices d'histamine.

Les résultats préliminaires de ce travail vont contribuer à mieux cerner le processus de formation de l'histamine au cours du stockage du produit fini. La formation d'histamine étant un facteur limitant de la qualité du produit, ainsi la maîtrise des bactéries formatrices d'histamine dans la semi-conserve d'anchois va permettre aux producteurs locaux de réduire la production de l'histamine dans le produit fini et de la sorte préserver sa qualité initiale. Pour ce faire, une bonne contribution des responsables qualité s'impose auprès de leurs unités et entre eux pour renforcer et exiger une bonne manutention de la matière première et une parfaite maîtrise de la qualité du produit durant le processus de fabrication.

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QUALITY CHANGES AND HEAVY METAL ANALYSIS OF MARINE WATER PRAWN AND FRESH WATER PRAWN STORED IN ICE – *Penaeus notialis/Macrobrachium vollenhovenii*

[CHANGEMENTS DE QUALITÉ ET ANALYSE DES MÉTAUX LOURDS DE CREVETTES D'EAU DE MER ET DE CREVETTES D'EAU DOUCE CONSERVÉES SOUS GLACE]

by/par

M.M. Salaudeen[1], G.R. Akande and E.O. Oyewo

Abstract

Sensory evaluation, microbiological examination and heavy metal analysis of marine water prawn *(Penaeus notialis)* and freshwater prawn *(Macrobrachium vollenhovenii)* during storage in ice were determined. Sensory evaluation of raw prawns based on colour, odour and texture showed deterioration after the 8th day in ice. The successions of bacterial genera during the storage in ice were *Bacillus*, *Corynebacteria, Escherichia coli, Klebsiella* sp., *Salmonella* and *Shigella* for both types of prawns. The mean total bacterial counts were $1.17x10^7$ Cfu/g and $1.23x10^7$ Cfu/g for *P. notialis* and *M. vollenhovenii*, respectively. There was no significant difference ($p>0.05$) in the total bacterial counts for both types of prawn. However, there was a correlation ($r = 0.7$) between storage days in ice and total bacterial counts for the two types of prawn. The levels of cadmium, lead, copper, zinc, chromium, iron, cobalt, nickel and manganese in the tissues of *P. notialis* and *M. vollenhovenii* were 0.28µg/g, 0.96µg/g, 6.15µg/g, 0.56µg/g, 15.0µg/g, 1.14µg/g, 5.52µg/g, 2.05µg/g, 1.82µg/g, and 0.33µg/g, 1.25µg/g, 5.40µg/g, 1.54µg/g, 2.61µg/g, 2.04µg/g, 5.69µg/g, 1.52µg/g, 0.45µg/g, respectively. These levels for both types of prawn were lower than the maximum permissible international standards, implying that there is little or no possibility of heavy metal toxicity hazards associated with consumption of the prawns and suggesting that they were caught from waters relatively free from pollution by heavy metals.

Key words: Quality changes, Prawns, Heavy metals, ice, Bacteria counts, Penaeus notialis, Macrobrachium vollenhovenii

Résumé

Une évaluation sensorielle, un examen microbiologique et une analyse des métaux lourds de crevettes d'eau de mer *(Penaeus notialis)* et de crevettes d'eau douce *(Macrobrachium vollenhovenii)* ont été déterminés pendant la conservation sous glace. L'évaluation sensorielle de crevettes crues portant sur la couleur, l'odeur et la texture a montré une détérioration après le huitième jour dans la glace. Les genres bactériens successifs pendant la conservation sous glace étaient *Bacillus*, *Corynebacteria, Escherichia coli, Klebsiella* sp., *Salmonella* et *Shigella* pour tous les deux types de crevettes. Le total de colonies bactériennes était respectivement $1,17x10^7$ UFC/g et $1,23x10^7$ UFC /g pour *P. notialis* et *M. vollenhovenii.* Il n'y avait pas une différence significative ($p>0,05$) dans le total des colonies pour tous les deux type de crevettes. Toutefois, il y avait une corrélation ($r = 0,7$) entre les jours de conservation sous glace et le total de colonies bactériennes pour les deux types de crevettes. Les niveaux de cadmium, plomb, cuivre, zinc, chrome, fer, cobalt, nickel et manganèse dans les tissus de *P. notialis et du M. vollenhovenii* étaient respectivement 0,28µg/g; 0,96µg/g; 6,15µg/g; 0,56µg/g; 15,0µg/g; 1,14µg/g; 5,52µg/g; 2,05µg/g; 1,82µg/g; et 0,33µg/g; 1,25µg/g; 5,40µg/g; 1,54µg/g; 2,61µg/g; 2,04µg/g; 5,69µg/g; 1,52µg/g; 0,45µg/g. Ces niveaux pour les deux types de crevettes étaient inférieurs aux nomes maximales internationales admissible, c'est-à-dire qu'il y a un faible risque ou pas de possibilité de risques de toxicité de métaux lourds associés à la consommation de crevettes, ce qui sous-entend qu'elles ont été capturées dans des eaux relativement exemptes de pollution par les métaux lourds.

Mots clés: Changements de qualité, crevettes, métaux lourds, glace, colonies bactériennes, Penaeus notialis, Macrobrachium vollenbovenii

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1. INTRODUCTION

Seafood is one of the major food items in Nigeria. It is often the cheapest principal source of animal protein, especially for the low-income group. Today, more people are turning to finfish and shellfish as a healthy alternative to meat because they provide high quality protein and have a broad spectrum of fatty acids especially polyunsaturated fatty acids (PUFA).

Frozen shrimp is the most important seafood produce export by Nigeria. Annual export of frozen shrimp earns considerable foreign exchange for the country. However, produce are often seized, detained, rejected or destroyed by health authorities of various importing countries due to problems such as decomposition, high total viable bacterial count, filth, food-borne microbial pathogens and foreign materials (Pong Pen *et al*., 1990).

Shrimp is the principal traded fisheries commodity in value and volume. It accounted for about 20% of world fisheries trade by value in the late 1990's (FAO, 2001). The flow of trade is primarily from the developing to the developed world. A wide range of fish and fishery products is produced in Nigeria for the international markets. Shrimps account for about 84% of seafood exported to Europe in 2002 (FDF 2002), followed by crabs (6%) fish (4%) and cephalopods (4%). Export of frozen shrimp from Nigeria generates an average of US$50 million annually.

The increasing globalization of fish trade, the need to export fish and shellfish and the increasing consumer awareness of quality and safety requires that all institutions in the fish industry should ensure that produce put on market pose no health risks. For these reasons, it is very important that issues of quality and safety of fish products should start from the production segment through the chain of consumption.

Concerns about heavy metals and other contaminants in marine fish and shellfish arose from the "Minimata" and "Itai Itai" incidences in Japan involving Mercury and Cadmium, respectively (Gerlach, 1980), but Arsenic, Zinc, other metals and polychlorinated biphenyls (PCB's) from industrial wastes are also worrisome, as are air-borne pollutants from industrial smoke emissions.

The present work examined the quality changes in terms of sensory, microbiological and heavy metal levels in marine and fresh water prawns caught in Nigerian waters. Marine water prawns and freshwater prawns were investigated for this work because of their export potential and foreign exchange capacity.

2. MATERIALS AND METHODS

Marine water prawns and freshwater prawns were collected on the same day from the landing centres at Ebute Chief, Aiyetoro, Epe and Ebute Ilaje, Bariga, respectively. The prawns were mixed with ice made from clean potable water (1:1 ratio) in different insulated boxes.

Sensory evaluation

Samples of both types of prawn were arranged on the 1st, 5th, 8th, 12th and 15th day in ice for sensory evaluation. Sensory evaluation of both types of prawn was done based on appearance, colour, odour and texture according to Clucas and Ward (1996). Seven individuals were trained to make informed judgments. Scoring was expressed with grade I, grade II, just acceptable and reject.

Microbiological examination

Samples of both types of prawns were drawn on the 1st, 5th, 8th, 12th and 15th day of storage in ice in sterile bottles for microbiological studies.

One gram of the muscle of both freshwater and marine water prawns were separately and aseptically introduced into 9 mls of sterile distilled water in sterile MacCartney bottles to provide 10^{-1} dilution, which were then used for further dilutions up to 10^{-7}. Then 0.1 ml of the diluted samples were inoculated into the media in duplicates and incubated at 37 °C for 18–24 hours following the pour plate method.

Nutrient Agar was used for Total Viable Counts (TVC), Mac Conkey Agar and Eosin Methylene Blue agar were used for *E. coli* and *Klebsiella* sp. while *Salmonella, Shigella* agar was used for examination of *Salmonella* and *Shigella* species.

In order to identify each isolate, pure cultures were examined for cultural and morphological characteristics based on their colour, shape and pigmentation, by Gram staining.

Heavy metal analysis

Samples of freshwater and marine water prawns were also drawn on the first day of storage in ice in sterile bottles for heavy metal analysis.

Wet-ashing of the prawns was done and metal concentrations for all extracts were determined by Atomic Absorption Spectrophotometry, using air-acetylene flame.

Statistical analysis

The statistical analysis was done by using mean correlation coefficient equation and chi-square tests.

3. RESULTS

Details on sensory evaluation of freshwater prawn and marine water prawn are shown in Table 1 and 2, respectively.

Microbiological examination
Different genera of bacteria were isolated and identified on the basis of their morphological characteristics. The succession of bacteria genera during the storage in ice is presented in Tables 3 and 4.

The total bacterial count on the 1st day in ice was $4.0x10^5$ Cfu/g for *P. notialis* and $4.5x10^5$ Cfu/g for *M. vollenhovenii*.

The total bacterial count decreased slightly during the first week in ice. After the 8^{th} day in ice, the bacterial count increased rapidly as shown in Table 5.

Heavy metal analysis
Results on heavy metal analysis of both prawns are shown in Table 6.

Of the nine heavy metal species measured in the freshwater prawn, Cd and Co occurred at the lowest and highest concentrations of 0.33 μg/g and 5.69 μg/g, respectively. In the marine prawn, Cd and Cr occurred at the lowest and highest concentrations of 0.28 μg/g and 15.0 μg/g, respectively.

4. DISCUSSION

The prawns used in this study were un-iced up to the time of landing which was about 8–10 hours after they were caught. The prawns were rejected based on dull colours, strong bad odour, black spots and very soft texture after the 8^{th} day in ice. If icing was done earlier, the shelf life may have been even longer.

Immediate icing of the catch is important especially in the tropical areas where the surface temperature of the seawater and the ambient air is about 27 °C to 33 °C. At this temperature, bacteria may cause significant spoilage only 8–12 hours after the death of the fish (Jensen and Hansen, 1973). The higher the temperature of storage, the shorter the shelf-life, as a general rule, for every hour that fish are kept at ambient temperature, the equivalent of one day storage life in ice is lost and for every 5 °C above 0 °C that they are stored, the storage life in ice is reduced by half (Clucas and Ward, 1996).

The formation of black spots is due to melanosis occurring during the storage of prawns. Though this is not connected directly with spoilage, it gives a poor appearance to the consumer.

The bacterial counts on the 1^{st} day in ice were $4.5x10^5$ and $4.0x10^5$ for *M. Vollenhovenii* and *P. notialis,* respectively. The total bacterial count increased rapidly as shown in Table 5. The counts indicate onset of spoilage after the 8^{th} day rather than the level of freshness. The results obtained in this work is similar to that of Cann (1977), the change in total bacterial count was not significant at 5% degree of freedom till after the 8^{th} day in ice. The coefficient of correlation 'r' between days in ice and total bacterial count was 0.7045 and 0.7019 for *P. notialis* and *M. vollenhovenii,* respectively. There was no significant difference at ($p > 0.05$) in the total bacterial counts for both types of prawn used in this study.

The succession of bacteria genera during the storage in ice were *Bacillus, Coryne-bacteria, E. coli, Klebsiella* sp*., Salmonella* and *Shigella*. The succession of bacteria genera is the same in both types of prawn as presented in Tables 3 and 4 with no significant difference on the percentage of occurrence. Like prawns from most tropical environments, the prawns in this study had a fairly high bacterial load. However, organisms of public health significance e.g. *Salmonella* and *Shigella* were found at very low levels in this study. The presence of coliforms such as *E. coli* and *Klebsiella* sp. in the prawns used in this study indicate that their environments were contaminated with faeces because the natural habitat of the family Entrobacteriaceae to which these bacteria belong is the faeces of man and other mammals. Cann, 1977 reported that the number and types of bacteria in a shellfish product reflect the changes that have occurred in the initial flora and the degree of contamination that has taken place in the course of handling on shore.

The results of heavy metal analysed in this study showed that metal uptake by *P. notialis* and *M. vollenhovenii* was a function of concentration of the effluent to which the prawns were exposed. The levels reported for both types of prawn in this study (Table 6) were lower than the WHO/FEPA maximum permissible limit in foods (FEPA, 1991 and WHO, 1971). This suggests little or no possibility of heavy metal toxicity hazard associated with their consumption, and the waters where these prawns were caught are relatively free from pollution by heavy metals. Generally, low levels of heavy metals have been reported for Nigerian inland and near-shore waters as well as in sea foods from these environments: In the freshwater and marine water, (EIA, 1998) did not detect Cd. zinc occurred at concentrations ranging between 0.04µg/g and 0.07µg/g while Pb occurred at concentrations between 0.30µg/g and 0.35µg/g. (EIA, 1998) . Aremu and Inajoh (2007) did not detect Cd and Pb in seafoods from Nigerian inland waters. In the case of marine water prawn, the low level may be due to effective control and monitoring of the drilling operations of the oil companies by Agencies charged with the responsibility. The law prohibiting dumping of untreated industrial effluents is effective. The industries are treating their effluents which therefore do not find their way into the rivers and reservoirs, as was the case in the past.

5. CONCLUSIONS

The quality of marine water prawns and freshwater prawns stored in ice was evaluated by sensory, microbiological and heavy metal analyses .The prawns were acceptable up to the 8th day in ice.

The succession of bacteria genera during the storage in ice were *Bacillus, Corynebacteria, E.coli, klebsiella* sp*., Salmonella* and *Shigella* for both types of prawn.

Prawns in this study had a fairly high bacterial load; however organisms of public health significance, e.g. *Salmonella* and *Shigella,* were found at very low levels and were within the limits specified by ICSMF (1974).

Heavy metal levels reported for both types of prawn in this study were lower than the WHO/FEPA maximum permissible limit in foods .This suggests little or no possibility of heavy metal toxicity hazard associated with their consumption and that the waters where these prawns were caught are relatively free of pollution from heavy metals.

Table 1. Changes in raw appearance and grade of *M. vollenhovenii* stored in ice

Days in ice	Grade	Raw Appearance
1	I	Fresh characteristic odour; texture firm, colour normal
5	II	Neutral odour; head loose; texture slightly firm
8	Just acceptable	Slight off odour, head very loose and black spots on head, texture of flesh soft
12	Reject	Strong off odour, heads very loose, most heads broken from body, black spots more texture of flesh very soft
15	Reject	Putrid odour, black spots very severe, texture of flesh very soft

Table 2. Changes in raw appearance and grade of *P. notialis* stored in ice

Days in ice	Grade	Raw appearance
1	I	Fresh characteristic odour, texture firm, colour normal.
5	II	Neutral odour, head slightly loose; texture firm.
8	Just acceptable	Slightly off odour, head loose and black spots on head, texture of flesh soft.
12	Reject	Strong off odour, head very loose, black spots more, texture of flesh soft.
15	Reject	Putrid odour, most heads broken from body, black spots severe, texture of flesh very soft.

Table 3. Succession of microflora during ice storage of *M. vollenhovenii*

Microorganism	Days in ice (% occurrence)				
	1	5	8	12	15
Bacillus	20	15	15	10	5
Corynebacteria	35	30	20	10	5
E. coli	18	20	25	33	40
Klebsiella sp.	15	20	20	25	25
Salmonella	5	5	8	10	10
Shigella	7	10	12	12	12

Table 4. Succession of microflora during ice storage of *P. notialis*

Microorganism	Days in ice (% occurrence)				
	1	5	8	12	15
Bacillus	20	15	15	10	5
Corynebacteria	35	30	20	10	5
E. coli	18	20	25	33	40
Klebsiella sp.	15	20	20	25	25
Salmonella	5	5	8	10	10
Shigella	7	10	12	12	12

Table 5. Total bacterial count of *M. vollenhovenii* and *P. notialis* during storage

	Days in ice and total bacterial count (CFu/g)				
	1	5	8	12	15
M. vollenhovenii	$4.5x10^5$	$4.0x10^5$	$3.5x10^5$	$2.5x10^6$	$5.8x10^7$
P. notialis	$4.0x10^5$	$3.5x10^5$	$3.2x10^5$	$2.4x10^6$	$5.5x10^7$

Table 6. Comparison of heavy metal levels in *M. vollenhovenii* and *P. notialis* (µg/g)

	Cd	Pb	Cu	Zn	Cr	Fe	Co	Ni	Mn
M. vollenhovenii	0.33	1.25	5.40	1.54	2.61	2.04	5.69	1.52	0.45
P. notialis	0.28	0.96	6.15	0.56	15.0	1.14	5.52	2.05	1.82

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PRODUCTION AND EXPORT OF FISHERY PRODUCTS: CHALLENGES FACING THE INDUSTRY IN SEYCHELLES

[PRODUCTION ET EXPORTATION DES PRODUITS DE LA PÊCHE, DÉFI DE L'INDUSTRIE AUX SEYCHELLES]

by/par

Christopher Hoareau[1]

Abstract

Export of fish and fishery products is the second most important source of foreign exchange earning for Seychelles after tourism. In 2006, Seychelles produced 45,223 tonnes of fish products, of which 40,222 tonnes were canned tuna and the remaining were fresh fish whole and fillets exported on ice, smoked fish, fish oil and frozen prawns. More than 95% of the canned tuna produced are exported to the European Union (EU).

The major sanitary concern for the export market has been the high level of histamine in canned tuna for which two rapid alerts were notified in 2007. However, no alerts were notified in 2005, 2006 and 2008. Another sanitary issue of major concern is the non compliance to the stringent limit for heavy metals in the large pelagic, namely swordfish. Industrial tuna fishing is dominated by the EU purse seiners licensed to fish in Seychelles' waters and adjoining seas. In 2006, 371,000 tonnes of brine frozen tuna was landed and 90,000 tonnes were processed by the local canning factory, whilst the rest were directly transshipped in Port Victoria. About 79,340 tonnes from the above figure was landed by Seychelles- flagged vessels owned by European companies.

The artisanal sector produces around 4,000 to 4,500 tonnes of fish per year and 90% of this quantity is consumed domestically. This sector has reached a point of sustainability and more fishing effort could lead to over-exploitation of demersal species, such as groupers, snappers, jobfish and emperors. Projects are in progress to start on an industrial scale the production of value-added seafood products, such as fish fingers, fish burgers, fish nuggets and fish soup, with the aim of maximizing earnings from export. One of the biggest challenges for the making of fishery products in Seychelles is the cost of production which is indeed much higher than that of most other countries in the region. With the projected erosion of preferential tariffs given by the EU in years to come, products from Seychelles may lose their competitiveness in the export market. Opportunities exist in the semi-industrial longline sector targeting tuna and swordfish, currently underexploited when comparison is made to the number of vessels practising this fishery and the size of Seychelles' exclusive economic zone (EEZ).

Key Words: Export of fishery products, Rapid alerts, Industrial tuna fishing, Semi-industrial fishing, Artisanal fishing, Value- added products, Preferential tariff

Résumé

L'exportation de poissons et produits de la pêche est la deuxième source de devises étrangères pour les Seychelles après le tourisme. En 2006, les Seychelles ont produit 45.223 tonnes de produits de la pêche desquels 40.222 tonnes étaient des conserves de thon et le reste poisson frais entier et en filets exportés sous glace, poissons fumés, l'huile de poisson et des crevettes surgelées. Plus de 95% des conserves de thon produites est exporté vers l'Union européenne (UE).

La principale préoccupation sanitaire sur le marché d'exportation a été le niveau élevé d'histamine dans les conserves de thon dont deux alertes rapides ont été notifiées en 2007. Cependant, il n'y a eu aucune alerte en 2005, 2006 et 2008. L'autre préoccupation sanitaire majeure est la non conformité à la limite rigoureuse pour les métaux lourds dans les grands pélagiques, notamment l'espadon. La pêche industrielle du thon est dominée par les senneurs de l'UE autorisés à pêcher dans les eaux des Seychelles et les mers contiguës. En 2006, 371.000 tonnes de thon congelé en saumure ont été débarquées et 90.000 tonnes ont été traitées par la conserverie locale tandis que le reste a été transbordé directement au Port Victoria. Environ 79.340 tonnes de cette figure ont été débarquées par les navires battant pavillon des Seychelles et propriétés de compagnies européennes.

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Le secteur artisanal produit environ 4.000 à 4.500 tonnes de poissons par an et 90% de cette quantité est consommé sur le marché local. Ce secteur a atteint un point de durabilité et davantage d'effort de pêche pourrait mener à la surexploitation des espèces démersales telles que des mérous, des cordelettes, le jobfish et des empereurs. Des projets sont en cours pour commencer à une échelle industrielle la production des produits à valeur ajoutée de fruits de mer tels que le bâton de poisson, l'hamburger de poissons, les pépites de poissons et le potage de poissons, dans le but de maximiser des gains provenant de l'exportation. Un des plus grands défis à la production des produits de la pêche des Seychelles est le coût de production qui est en effet beaucoup plus élevé que celui de la plupart des autres pays dans la région. Avec l'érosion prévisionnelle dans les années à venir des tarifs préférentiels qui étaient offerts par l'UE, les produits de Seychelles pourraient perdre leur compétitivité sur le marché d'exportation. Les chances existent dans le secteur semi-industriel de la pêche aux palangriers ciblant le thon et les espadons, qui sont actuellement sous exploités, par comparaison au nombre de navires qui pratiquent ce type de pêche et la taille de la zone économique exclusive (ZEE) des Seychelles.

Mots clés : Exportation des produits de la pêche, Alertes rapides, Pêche industrielle de thon, pêche semi-industrielle, Pêche artisanale, Produits à valeur ajoutée, Tarif préférentiel

1. INTRODUCTION

The Seychelles Islands - geography and development status

Seychelles is a small island state in the western Indian Ocean, situated just south of the Equator. It comprises an archipelago of three main, and more than a hundred, small islands. The country's total land area is only 455 km² (177 square miles), and there is only limited cultivatable land. There are no known mineral resources. The country's vast EEZ covers an area of 1.35 million km², and is located on one of the most productive fishing grounds in the South-West Indian Ocean. Seychelles is relatively isolated from neighbouring countries and the nearest continental coastline is 1,600 km away.

The population is static and estimated at 82,000 (estimated mid-year 2006 - MISD statistical abstract). GDP per capita is about US$8,000 and the development indicator compares favourably with other countries in the region. Seychelles ranks first in Africa (and 47th in the world) in the Human Development Index (HDI) of UNDP 2007–2008.

2. A BRIEF ACCOUNT ON THE FISH INDUSTRY

The fish industry is the second most important source of income for the country after tourism, and the primary source of visible exports. In 2006, domestic production of fish and fish products was an estimated 45,223 tonnes. About 371,000 tonnes of tuna were landed in Port Victoria, Mahé, from EU and Seychelles' flagged purse seiners and 90,000 tonnes went to the local tuna canning plant, whereas the rest were directly transshipped and destined for canning in other African Caribbean and Pacific (ACP) countries or the EU.

The fishery sector is diverse. Apart from industrial purse seining for tunas, there are both domestic (semi industrial longliners) and international surface longline fleets targeting large pelagic fish, including shark and swordfish. There are also smaller line fishing vessels and the artisanal fleet targeting snappers and demersal fish species. Trawling is banned. A government-owned shrimp hatchery and farm is located on the remote island of Coetivy, about 160 km southwest of Mahé. Aquaculture also supplies ornamental clams and pearls for export. The processing and export sector includes the Indian Ocean Tuna cannery (IOT) (which also supplies frozen loins), by far the largest single employer in the country, with a workforce of over 2,500. In addition there are two establishments processing fresh and frozen fish (including tuna loins and demersal fish consigned by air to EC markets). Several exporters deal in dried shark fins and sea cucumbers, a shrimp processing and packing facility associated with the Coetivy shrimp farm, fishmeal and oil processing, and a new high technology plant extracting fish oils for human consumption from tuna heads. Aquaculture feeds are also manufactured in Mahé, supplying shrimp farming in Seychelles, Tanzania and Madagascar. Direct and indirect employment in the fishery sector is estimated to be approximately 6,000 people, representing around 13% of the total formal employment in the country.

Given the economic importance of the fishery sector, maintaining market access through compliance with sanitary conditions is a strategic imperative for the Government of Seychelles and the diversity of the sector presents a significant challenge.

The artisanal sector

This fishery is reserved for the local fisherman only. About 90% of the catch produced by this sector is consumed locally; a good percentage of this is supplied to tourism establishments. Currently there are about 450 to 500 artisanal fishing vessels, ranging from 5 to 13 metres in length. Most are equipped with inboards engines, although the smaller ones around 5 to 8 metres in length have outboard engines. The larger vessels are fitted with fibreglass-built insulated fish boxes and preserve their catch with ice. A typical fishing trip would last around 5 to 6 days. The smaller boats rarely carry ice, spend less than a day at sea and all their catch is sold on the domestic market. Fishing is done mostly on the large continental shelf surrounding the granitic islands, known as the Mahe plateau. The main species landed are the snapper, grouper, emperor, trevally, job fish, Indian mackerel, etc.

The semi-industrial sector

This sector was recently developed around the mid-nineties with the support of the EU and its main objective was to supply the export market with fresh tuna, swordfish and other bycatch species. Semi-industrial longlining was very strongly promoted since it was viewed as being very profitable and expected to provide employment opportunities to several full-time fishermen. One of the expected results was to reduce pressure on coastal fisheries which have themselves reached a point of near over-exploitation. Incentives were provided by the government to encourage investment in this sector, e.g. favourable loans granted by the local development bank. Despite these efforts, the results have not been as expected for several reasons, such as:

- high predation rate by false killer whales;
- high cost of imported squid bait;
- an EU ban on the export of swordfish from Seychelles in 2003–2004 due to high level of cadmium/mercury;
- more profit is earned in shark fishing for the fin than in fishing tuna and swordfish; and
- generally low catch during certain period of the year.

Currently there are only four boats practising this fishery on a full-time basis out of 12 that initially started. The authority is in the process of reviewing its policies with the aim of revitalizing this important fishery.

Industrial sector

This sector is the largest contributor to Seychelles' economy (refer to Table 1). Fishing is practised by European purse seiners mostly belonging to the French and Spanish, ten of these flying the Seychelles' flag. About fifty of these vessels were licensed to fish in Seychelles waters and their adjoining seas. About 95% of the catch (SFA Annual Report 2006) landed in Port Victoria in 2006. One third of that was supplied to IOT and the rest transshipped and exported to other ACP and EU countries for tuna canning.

Economic contribution of the fisheries sector

Similarly to the previous year, mixed results were observed in the fisheries sector in 2007. In value terms, satisfactory growths were observed in trade and total revenue generation, whilst local production and volume traded recorded unfavourable results. As a result of this and compounded with rising fuel prices and poor catches in the Indian Ocean, per unit price of fish and fish products, both on the local and external markets experienced a general upward trend.

There was a slight growth in the production of the traditional artisanal sector. Landed catch grew by 8.8% and despite a decrease in export of fish from this subsector there was a general increase of about 5.8% in the average price of fish in 2007. This increase follows the general inflationary upward trend in the economy.

The semi-industrial subsector performed remarkably well in 2007 with an increase in total landing, but still very far from the peak achieved in 1999. Gross inflow of foreign exchange generated by the industrial tuna fishing activity continued to grow as a result of the continuing increase in fuel prices on the global market.

Employment

It is estimated that employment in the fisheries and related sectors for the year 2007 have remained fairly constant compared to the previous year. Direct and indirect employment is estimated to be about 6,000 people representing around 15% of total formal employment in the country, a slight increase of 2% compared to 2006. Direct employment in this sector includes factory employees, fisherman, stevedores and employees from the Fishing Authority, accounting to more than 75% of the above stated figure. The number of full-time and part-time commercial fishermen oscillates between 1,700 and 1,800 primarily due to the seasonal mobility associated with this sector. The Indian Ocean Tuna canning factory, by far the largest single employer in the country, had a workforce of over 2,500 workers.

Production

In 2007, there was a significant drop in domestic production of fish and fish products compared to 2006. Total production fell by almost 19% to reach 36,771 tonnes, compared to 42,263 tonnes produced in 2006 when total output dropped by 3%. Increases were registered in the artisanal catch (+8.8%), the semi-industrial sector (+10.8%) and output of other processed fish (+26.6%). Production of smoked fish increased by 15% to reach 29 tonnes, whilst sea cucumber and dried shark fins amounted to 53 tonnes, a slight increase of about 2.5% over the previous year.

Table 1. Production of Fish and Fish Products 2005–2007 (tonnes)

	2005	**2006**	**% Change**	**2007**	**% Change**
Artisanal catch	4,583.10	3,849	-16.02	4,189	8.83
Semi-industrial catch	312.08	237	-24.06	268.65	13.35
Canned tuna	40,606	40,222	-0.95	31,569	-21.51
Other processed tuna	334	218	-34.73	276	26.61
Prawns	772	638	-17.36	368	-42.32
Smoked fish	14.80	25.20	70.27	29	15.08
Others	36.80	51.70	40.49	53	2.51
Total	46,658.78	45,240.90	-3.04	36,752.65	-18.76
Purse seiner catch*	87,534	79,340	-9.36	49,938	-37.06
Longliner catch*	14,359	8,374	-41.68	8,462	1.05

** Seychelles flagged vessels*

Output from the Coetivy Prawn Farm dropped quite significantly by 42.3% over the previous year to reach only 368 tonnes, far from its total production capacity. Canned tuna production also suffered, realizing an output of 31,569 tonnes in 2007, a drop of 21.5% over the previous year when output topped 40,222 tonnes.

The landed catch from the semi-industrial subsector showed a moderate increase in 2007 after a drop in 2006. The landing of tuna, swordfish and shark meat increased by 13.4% to reach 268.7 tonnes.

After a drop of 9.4% in 2006, the catch of tuna by Seychelles' flagged purse seiners dropped by a considerable 37% in 2007 to reach only 49,938 tonnes. This is a drop of 29,400 tonnes over the previous year. Seychelles' flagged longliners hauled in 8,462 tonnes 1% more than the 8,374 tonnes catch in 2006.

For the last two years a downward trend is being observed in the total domestic output of fish and fish products and, as in previous years, the total output is almost entirely dependent on the trend in production of canned tuna. Figure 1 below shows the trend in total output of fish and fish products over the last 18 years.

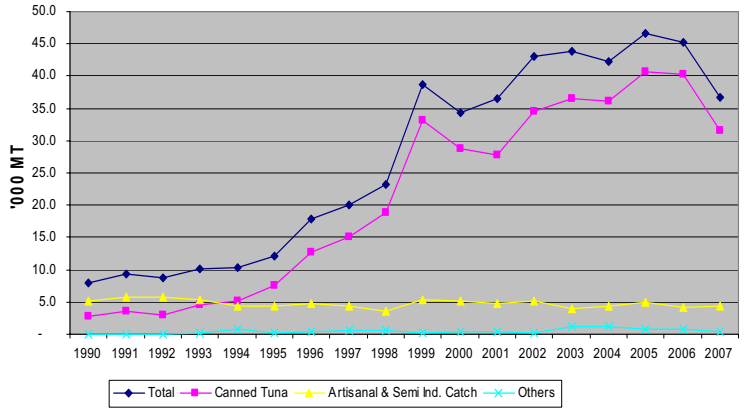

Figure 1. Trends in the output of fish and fish products 1990–2007 (tonnes)

Revenue from industrial tuna fishing activity

The industrial tuna fishing activity by purse seiners and longliners remains an increasingly important source of foreign exchange for the local economy. Gross income from this activity is derived mainly from payments on goods and services in Port Victoria by foreign fishing vessels and companies based in Port Victoria, as well as through payment for licences and financial compensation paid by the EU for fishing rights in Seychelles' EEZ. In 2007 the total gross income derived from these sources amounted to SR[1] 986.080 million, 22.5% more than the SR 804.8 million generated in 2006 (see Table 2).

Table 2. Main sources of revenue from the industrial tuna fishing activity 2005–2007 (SR million)

	2005	**2006**	**% change**	**2007**	**% change**
Vessels' spending	559.60	737.70	31.83	931.44	26.26
Companies' expenditure	5.55	5.59	0.72	3.79	(32.20)
Licence fees/EU payments	71.95	61.53	(14.49)	50.85	(17.36)
Total	637.10	804.82	26.32	986.08	22.52

Spending by vessels in Port Victoria remains by far the biggest component of foreign exchange earnings from the industrial tuna fishing activity. This component increased by 26.3% in 2007 compared to the previous year. Spending by foreign companies based in Seychelles dropped by 32.2% whilst licence fee payment and EU financial contributions dropped by 17.4%. It is to be noted that the payment for the 2006 excess catch, which should have been paid in 2007, was not honoured during the year due to the clarification of under-reporting by EU vessels fishing in the EEZ.

Export of fish and fish products

Exports of fish and fish products constitute the biggest source of foreign exchange earnings by the industry and related activities. As can be observed in Table 3, there were mixed changes in both the volume and value of exports of fisheries products in 2007. Overall, whilst there was a 16% decrease in the total volume of processed marine products exported, the total value showed an increase of almost 18% over the same period.

[1] US$1 = SR 8.50

Table 3. Volume and value of export of fish and fish products 2006–2007

	2006		2007		% Change	
	Tonnes	**SR thousand**	**Tonnes**	**SR thousand**	**Tonnes**	**SR thousand**
Fresh and frozen fish	369.70	13,674	299	13,922	(19.12)	1.81
Canned tuna	38,498	1,034,498	32,328	1,231,207	(16.03)	19.01
Frozen prawns	624	25,252	365	17,214	(41.51)	(31.83)
Other processed fish	170	3,134	323	6,450	90	105.81
Dried shark fins and sea cucumber	52.23	2,790	53	5,657.	1.47	102.76
Others	1.10	1,979	-	-	-	-
Total	**39,715.03**	**1,081,327**	**33,368**	**1,274,450**	**(15.98)**	**17.86**
Total Domestic Exports		**1,194,600**		**1,346,527**		**12.72**
% of Domestic Exports		**90.52**		**94.65**		

Sources: *National Bureau of Statistic and Seychelles Fishing Authority*

The opposite shifts in volume and revenue earned reflect an overall increase in the unit price for Seychelles' fish products. This trend has been primarily driven by the export of canned tuna which jumped by 19% in earnings despite a 16% drop in volume exported. This is in line with development in the EU market for canned tuna where prices have been on the increasing trend.

Positive developments were also recorded in the export of other processed fish, dried sea cucumber and shark fins. On another positive note, despite an increase in total domestic exports, the share of exports of fish and fish products managed to show an increase of about 4.2% over the previous year to reach 94.7% in 2007. For the year, 92% of the value of export went to the traditional European markets.

Imports of fish and fish products

In 2007, mixed changes were observed in import of fish and fish products. Whilst the volume of imports dropped by 22.7% over the twelve month period, the value of imports increased by 28.3% over the same period, revealing a general increase in the average price per unit of fish and fish products imported.

Table 4. Volume and value of import of fish and fish products 2006–2007

	2006		2007		% Change	
	Tonnes	**SR thousand**	**Tonnes**	**SR thousand**	**Tonnes**	**SR thousand**
Fish, fresh or chilled	0.22	14.82	2.21	114.57	906.36	673.10
Fish, frozen	91,929.53	517,548.00	71,005	659,659	(22.76)	27.46
Fish, Fillets and other fish meat	0.50	35.56	1.29	85.37	158.40	140.07
Fish, dried, salted or in brine	46.21	1,434.38	11.00	1,630.96	(76.20)	3.71
Molluscs and crustaceans	159.20	7,425.88	218.80	14,146.57	37.44	90.50
Others	7.01	303.14	6.55	412.90	(6.53)	36.21
Total	**92,142.67**	**526,761.78**	**71,245.08**	**676,048.88**	**(22.68)**	**28.34**

Sources: *National Bureau of Statistic and Seychelles Fishing Authority*

There was a significant increase in the imports of fresh and frozen fish, fish fillets and other fish meat and to a lesser extent molluscs and crustaceans. This rise may be attributed to the increased demand by the hotel, restaurant and catering industry. A considerable drop was observed in the import of frozen tuna for the canning factory accompanied by an increase in price for that commodity. Frozen fish imports are mainly due to poor catches of *Thunnus alalunga* (germon) in the region, thus compelling the canning factory to import most of this species, which it processes quite frequently.

Rapid alerts notification

No rapid alert was notified in 2006, whilst in 2007 three alerts were notified against Seychelles. Two were in relation to the high level of histamine in canned tuna from Indian Ocean Tuna Ltd. The third was in relation to canned tuna produced by a factory in Italy of which the raw material (brine-frozen whole tuna) was linked to a Seychelles-registered freezer vessel. On follow-up by the Competent Authority, this last alert (AAM) could not be confirmed (Table 5 refers). The alerts BRF and BZE revealed some major non-conformances in the handling of products being processed under delayed packaging procedure. The investigation led to modification in the packing procedure and all corrective actions by the Fish Inspection and Quality Control Unit Project (FIQCU) are being implemented.

Table 5. Rapid alerts notified against Seychelles

Alert No	Product	Establishment	Reasons for Alert
AAM 2007 - week 09	Caned tuna	Erroxape	High level of histamine
BRF 2007 - week 27	Canned Tuna	IOT	High level of histamine
BZE 2007 - week 34	Caned tuna	IOT	High level of histamine

***Source**: Fish Inspection and Quality Control Unit - Seychelles*

3. ANALYSIS OF THE FISHING INDUSTRY

Strengths

One of the main strengths of the industry in Seychelles is that it provides employment to a good sector of Seychelles' workforce. As mentioned earlier, about 15% of people in formal employment are in the fisheries sector. This is significant for a small island state such as Seychelles which has very limited resources and a small industrial base. Many of the fisherman/skippers are themselves owners of their vessels. This has been possible through schemes established by the government to enable the borrowing of money on favourable terms and conditions. To further boost productivity and encourage investment is this sector, tax concessions on imported items used by the industry are in place. These include: processing equipment for the industry, vehicles, engines and spares for vessels, reduced fuel cost for registered boat operators, etc.

Looking on the side of safety and quality, products from Seychelles on the EU market (mainly fresh fish) have generally commanded a good reputation. Less than ten rapid alerts have been published over the past ten years and were mostly associated with heavy metals in swordfish and histamine in canned tuna.

Another factor which arguably constitutes a strength to the industry is the location of the main fishing grounds, generally at reasonable distance from the main fishing port. Therefore, not too much time is spent by the vessels steaming from port and back. Currently all processing establishments are centrally located and landing of product is focused in that particular area. There is limited transportation of fish from remote landing sites to processing plants and this provides a huge advantage in the maintenance of the cold chain and quality of products.

Weaknesses

One of the most visible difficulties that the industry is facing is the high cost of production in Seychelles compared to most other countries in the region. This puts the country in a very unfavourable position when one compares the cost of producing processed products with countries in the region, such as Madagascar, Mauritius, Thailand and Sri Lanka. With the erosion of the preferential tariffs provided by the EU in the years to come, Seychelles' products will face much stiffer competition from other suppliers on the EU market.

The availability of necessary infrastructures such as dry docks, net landing facilities for net repairs and approved cold storage facilities for bulk storage of brine-frozen tuna awaiting reefer vessels, also contribute to making the operations more costly.

On the artisanal side, a good many of the fishermen are fairly aged, not professional and it is very difficult to train them and convince them when it comes to aspects of sustainability of the industry. They cannot understand the need for managing the resources in a sustainable manner and its relation to the benefit of future generation. These fishermen are generally perceived as unreliable, have a tendency to abuse alcohol and, therefore, are unable to project the right image of the importance of their job and its contribution to the national economy.

Unfortunately, this has led to artisanal fishing being portrayed as a low status job and, therefore, it is not attractive to the upcoming generations.

The threat of overfishing is beginning to show signs, especially among the coastal fisheries for certain species such as lobsters, octopus, sea cucumber and other reef fish, where restrictions are in place to prevent over exploitation. Another factor contributing to overexploitation is pleasure or sport fishing. Many individuals, especially the more affluent members of society, own boats and enjoy fishing for pleasure. They compete directly with the full-time fisherman and sometimes land a substantial quantity of fish, especially during fishing competitions.

Comprehensive data on stock assessment is currently inadequate for certain types of fisheries to enable informed decisions to be made on the sustainability of certain fish stocks. This area calls for investment in research programs and assistance is being sought from countries such as Japan and the EU which have signed certain agreement to assist Seychelles in managing and developing its fisheries resources.

Seychelles' vessels involved in tuna fishing are in constant competition with foreign vessels fishing in Seychelles' EEZ and some of these vessels are listed as Illegal, Unreported and Unregulated (IUU). In the past, several vessels of different nationalities fishing illegally in Seychelles' EEZ have been apprehended by Seychelles' authorities. However, it is believed that many of the boats fishing illegally are not apprehended due to the difficulty associated with costs in undertaking proper surveillance and monitoring of the EEZ.

Opportunities

The development of a sustainable fishery for high value resources such as the red snapper (*Lutjanus sebae*) is regarded as an opportunity that, if successful, will enable stakeholders to obtain a much higher price for their product on the EU market. This project is aimed at providing a certification system for this particular species based on the sustainability of the fishing method (line and hook). This is in combination with the level of freshness of the fish assessed mainly by the length of time from harvest until it reaches the consumers in the EU. Each fish shall be accompanied by all necessary information required for a full traceability.

The large EEZ, of approximately 1.4 million km², would allow Seychelles the opportunity to have a reasonable fleet of industrial longliners and purse seiners to exploit and maximize benefits from the tuna resources (currently both fisheries are dominated by foreign-owned vessels, namely European purse seiners and Asian longliners). However, this matter has been discussed for a long time now but, due to a number of reasons, primarily funding related, its realization is still a distance away.

The exploitation of the bycatch from purse seiners has the potential to earn Seychelles valuable foreign exchange. Currently a small percentage of the bycatch is able to penetrate the export market in the form of frozen gutted fish of which the species are dominated by the *Coryphaena hippurus* (dorado) and the *Acanthocybium solandri* (king fish). The bulk of these species landed are brine-frozen and inadequately handled during unloading. Efforts are being made to improve handling so as to satisfy the quality requirement of the export market.

As mentioned earlier, the semi-industrial longlining sector depends heavily on imported squid for its supply of baits, which significantly add cost to the whole operation. Currently a project is underway to catch bait locally, mainly mackerel, to subsidize this dependency. The trials conducted so far have shown encouraging signs and the project is well in progress.

There is potential for Seychelles to conduct more research on the exploitation of other marine resources found in the deeper waters. Trials have started on the fishing of deep-sea prawns using traps with baits. Results have shown that the resource is present but more information is required on the stock biomass and the cost-effectiveness of its exploitation.

Threats

The semi-industrial longline sector is threatened by the ever-present predator species, such as the false killer whale that may consume as much as 40% of the catch of a vessel. Scientific methods to deter killer whales have been tried, but not with too much success. These marine mammals are protected species and, therefore, their destruction is strictly prohibited. At the moment no real long-term solutions have been found and the result is a serious loss in earnings by the boat operators.

The erosion of tariff preferences granted by the EU to ACP countries in the coming years is a real concern for the industry. The main threat is due primarily to the high cost of production in Seychelles when compared to other producers in the region where the cost of living is generally much lower. Unless Seychelles is able to produce high-value products able to attract a specific market sector, or try to bring down its cost of production, it may lose its traditional EU markets to the cheaper products coming mainly from the Far East.

Signs of overfishing are beginning to show, especially on the side of the coastal fisheries. Restrictions on the fishing of some species such as lobsters, octopus, sea cucumber and other reef fish, have been put in place to prevent overexploitation. The red snapper *(Lutjanus sebae)* inhabiting the relatively shallow waters of the Mahe plateau and other nearby banks is one of the highly commercial species heavily exploited. According to reliable sources, the average size of the majority of fish landed is reducing, which shows that, in general, they are not reaching full adult growth.

4. VALUE ADDITION IN SEAFOOD PRODUCTS IN SEYCHELLES

Value addition in seafood is not new to Seychelles. For quite some time, value added products such as fish fingers, fish burgers and fish balls, have been produced on a rather small scale for the local market. The emphasis is now to produce them on an industrial level mainly for the export market. As a result, a project on Value Addition in Seafood started a couple of years ago and had as its main objectives to increase foreign exchange earning from the export of value-added fishery products and to maximize the use of valuable fish by-products ending as raw material for the manufacturing of animal feed or pet food. Valuable products could be produced from parts of the fish or from species that are not well commercialized if only the processing technology was available and if investment could be cost-effectively justified.

Seychelles government sought assistance from the Centre for Development of Enterprises (CDE) of the EU. Consultants from ID.MER (Institut technique de développement des produits de la mer) based in France were recruited in 2006 to start working on a project identifying several products that could be manufactured from the available resources. Out of twelve potential products identified, five were selected by the local stakeholders and after careful study of these products by ID.MER pilot production commenced in 2008 to 2009. A market trial is to take place both locally and internationally in 2009 and, if the response is positive, industrial production will start late 2009 and 2010. The project involves the government providing the basic infrastructure (main building) which will be partitioned and rented to the processors who, in turn, will provide their processing equipment and other facilities needed. Loan facilities with favourable terms will be made available to assist the processors in procuring equipments.

Assistance is also being given by the Japanese Overseas Fisheries Corporation Foundation (OFCF). This includes the construction of a technical centre for research and development of value-added products. A Japanese consultant in fish processing technology was on mission to design the centre and train the local technicians. The technology is to be disseminated to local processors willing to produce both for the local market and for export. This project is in progress and will be fully operational in mid 2009.

5. CONCLUSIONS

The way forward for the industry remains a considerable challenge considering the many issues that the authorities need to address. Export of fish and fishery products remains the second most important pillar of Seychelles' economy and much of the focus of the industry and government is to maintain access to the EU market. Maximizing the socio-economic benefits obtainable from the industry is also a great priority for the government. Assistance mainly from the EU and the Japanese Government goes a long way in assisting the development of the industry as a whole.

REGULATORY ALTERNATIVES FOR EUROPEAN UNION MARKET ACCESS

[ALTERNATIVES RÉGLEMENTAIRES POUR L'ACCÈS AU MARCHÉ DE L'UNION EUROPÉENNE]

by/par

Francisco Blaha[1]

Abstract

Market access to the European Union (EU) has consistently been a problematic issue for non-EU member countries exporting (*or intending to export*) seafood there. The range of problems faced relate to "*how*" official guarantees are offered, as well as "*what*" are the particulars of these required guarantees. This paper presents and discusses two complementary regulatory strategies to confront these difficulties: an initial strategy of swift application, based on an administrative avenue covering only those commercial operators engaged with the EU destined production chain, plus a further more encompassing regulatory model option, based on a business-like environment, and the application of management theory, including the separation of the provider, the purchaser, and policy, regulatory and service delivery functions within government.

Key words: Seafood, Exports, EU market access, Regulatory models

Résumé

L'accès au marché de l'Union européenne (UE) a été toujours une question problématique pour les pays membres de l'UE non exportateurs (ou ayant l'intention d'exporter) des produits de la pêche. Les problèmes rencontrés se rapportent au "comment" les garanties officielles sont données, de même que "quels" sont les détails de ces garanties requises. Ce papier présente et discute deux stratégies réglementaires complémentaires pour faire face à ces difficultés: une stratégie initiale d'application rapide, basée sur une allée administrative couvrant seulement ces opérateurs commerciaux engagés dans la chaîne de production destinée à l'UE, et une seconde comprenant une option réglementaire modèle, basée sur un environnement de type business, et l'application d'une théorie de gestion, y compris la séparation du fournisseur, acheteur, et les fonctions de politique, réglementaires et de livraison du gouvernement.

Mots clés: Produits de la mer, Exportations, Accès au marché de l'UE, Modèles réglementaires

1. INTRODUCTION

International fish trade has been increasing very rapidly in recent decades. An estimated 45% of the world catch is now traded internationally.

The value of the international fish trade increased from US$15.5 billion in 1980 to over US$71 billion in 2004, according to FAO figures[2].

Developing countries have particularly benefited from this boom, with their net earnings (exports minus imports) increasing from US$3.4 billion to over US$20 billion during the same period. This income exceeds the net foreign exchange revenue they earn from any other food commodity, including coffee and tea.

Currently, around 77% of fish consumed worldwide as food is supplied by developing countries.

The EU is the biggest single market for fish and fishery products worldwide, as a consequence of an increased consumption per capita and its enlargement to 27 member states.

Spain, for example, is the world's third largest single importer (US$5.2 billion), followed by France (US$4.2 billion), Italy (US$3.9 billion), Germany (US$2.8 billion) and the United Kingdom (US$2.8 billion).

[1] FAO, Fish Utilization and Marketing Service (FIIU), Viale delle Terme di Caracalla, 00100 Rome, Italy. francisco.blaha@fao.org

[2] http://www.fao.org/Newsroom/en/news/2006/1000301/index.html

These figures are particularly important, because all EU Member Countries share the same market access rules for seafood products.

2. THE PROBLEM

Exporting to the EU is not an obligation, and it requires an equal amount of effort by the government authorities and by the private sector.

While listing all that the EU requires to accept seafood from a non-member country would be quite difficult, it is safe to say that the local system corresponds (or is equal) to what is established for the EU Member Countries by Regulations (EC) No 178/2002, (EC) No 882/2004, and (EC) No 854/2004[1].

The EU requires that the *official guarantees* in terms of compliance of seafood exports from a third country[2] should be given by a *competent authority (CA)* which means the "*...central authority of a State competent for the organization of official control...*"[3]. This statement has to be read in terms of the *official controls* as required in terms of food safety, production standards and others, as specified for seafood in the relevant EU legislation.

And it emphasizes that..."*The competent authorities for performing official controls should meet a number of operational criteria so as to ensure their impartiality and effectiveness. They should have a sufficient number of suitably qualified and experienced staff and possess adequate facilities and equipment to carry out their duties properly*"[4] ...

The CA is required to comply with a lengthy series of requirements, but roughly summarized, the CA needs to assure compliance with three types of obligations:

- ***Obligations of resources:*** i.e. Instruments of production, Conditions of handling/processing, Hazard Analysis Critical Control Point (HACCP) and Pre-requisite programmes, Traceability, etc.
- ***Obligations of results:*** i.e. Safety levels of the products (i.e. Histamine, Contaminants, Microbiological levels), etc.
- ***Obligations of control:*** i.e. Regulatory verification effectively implemented by the CA, data storage and management, administrative procedures, legal support, strict control of product certification, etc.

As the legislation is made for the EU member countries, many developing countries find that compliance with these obligations is expensive, complicated and requires mobilizations of resources that may not be easily available.

3. THE POTENTIAL SOLUTIONS

This is not a "new" problem for those involved in the EU exporting sector; most countries facing market access problems have identified the constraints in their regulatory framework, and have evaluated some suggested changes for "alignment" with the EU law.

Generally, these proposed changes can be sorted in three options, which we could call for the purpose of this paper:

The Colonial

A total reform of the country's regulatory framework, in order to harmonize it with the EU directives by adopting and transposing the EU legislation.

This is perhaps the most suggested option and while very simple in principle, it does not take into consideration the alternative markets that do not need the same level of controls, hence affecting producers who are not interested in exporting to the EU.

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[1] For a detailed publication on the subject see "How to export seafood to the EU". April 2008. Commissioned by ITC (WTO/UNCTAD) available at http://www.intracen.org/tdc/Export%20Quality%20Bulletins/EQM84eng.pdf

[2] A third country is a *non member* country of the EU.

[3] Regulation (EC) No 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules. *Article 2. Definitions.*

[4] Regulation (EC) No 882/2004. 1.(6).

The Long Term

Redevelopment of the regulatory framework harmonizing with the agreed Codex guidelines under the WTO agreements, to which later add on specific market access requirements (such as the EU, US, etc), and then negotiate with the EU the "equivalence" of regulations.

This is a good option worth pursuing, but it again requires time and resources, which normally are scarce. But let us come to this option later on the paper.

There is, however, a further option seldom proposed which will be discussed further in this paper.

The Practical

This option is based on the setting up of a specific administrative avenue under the present regulatory framework of the CA, but only for those interested to be in the production chain destined for exports to the EU. This approach does not require law changes or "restructuring", and can be swiftly implemented, thus increasing competitiveness as a key condition for trade.

The principle behind this reasoning is that all food producers are required to comply with the present national standards as a legal requirement in the first place. However, as exporting to the EU is a voluntary act on the part of a few operators, the recognized CA can impose (as an administrative measure) additional production and compliance standards, as well as inspection frequency variations, only for those involved in the EU product chain, and so limit the scope of its "EU official assurance capacity" to those able to comply.

The seafood business operators recognize that maintaining registration and certification privileges, as part of the listing of companies allowed to provide raw material or to export directly to the EU, is dependent on regulatory compliance and ongoing performance against standards laid down under the prevalent EU legislation, and controlled by the CA under administrative procedures, in addition to the general national requirements.

If an establishment is not in compliance with the EU requirements, then their EU market access is suspended or removed, as necessary.

Nevertheless, none of the options considers the realities of domestic markets, and the true capacity of monitoring and controlling production with limited governmental resources.

The control plan

The key element for this latest option is the CA's endorsement (at least at administrative level) of a National Control Plan (NCP), which is defined as a *documented description established by the CA containing all the information on the structure and organization of its official control systems*.

The NCP containing all methods, procedures and regulatory instruments to be used for conformity assessment and regulatory verification, is presented in turn to the EU as the legal binding document that represents the "*way*" in which the country deals with exports to its market.

While "technically" only EU member countries are obliged to present an NCP, there are provisions in the legislation that contemplate that the control plans are to be proportionate and technically feasible taking into account the specific situation of the third countries and the nature of the products exported. Common sense says that if this is the way they assess the plans of the member countries, it can be assumed that this is how they expect to see the required information.

An NCP should describe the organization and procedures of the CA with regard (for example) to:

- Formal and legal framework of the CA;
- Listing protocol, including, types of lists, listing mechanisms, suspension and reinstatement of certification by the CA, formal delisting, procedure for updating the EU list, exports to other countries from EU listed establishment, separation and identification of non-EU products;

- Certification protocol, preparation of the EU Health Certificate, additional exporter declarations, endorsements, etc., issue of export certificates, numbering of export certificates, date stamping of export certificates, allocation of signatory stamp, certification of imported products, reissue of export certificates, certification of integrity standards, conditions for certifying officers, language considerations, traceability of certificates, internal auditing;
- Rapid alerts and crisis management protocol, organization of the system's rapid alerts, response procedures;
- Follow-up and crisis management, product withdrawal and recall, traceability guidelines;
- Official controls protocol, monitoring plans, regulatory verification, types of regulatory verification, documentary check, full verification for approval, full verification for renewal of the approval, partial verification, random checks;
- "Checklists" for regulatory verification, infrastructure condition, verification of prerequisites and support programmes, documental verification of HACCP, verification of HACCP plan performance, verification of conditions on ice plants, verification of conditions on cold stores, verification of conditions and systems on offshore vessels, verification of conditions for coastal vessels, verification of conditions of landing sites;
- Verification of conditions for transporters, verification of traceability, corrective actions request, follow-up/closing of corrective actions, frequency of verification;
- Specifications clarification and appeals procedures;
- Approval of official testing laboratories; and
- Public reports protocol.

While an NCP that covers all those issues goes a long way in terms of "*how*" and "*what*" is to be done by the CA, there are other supportive elements that need to be taken into considerations as well.

CA staffing
It is critical that an NCP is effectively implemented and that verifiers are adequately trained and familiar with the processing and products being verified, even if the verification activities are aimed only at a few companies.

Presently the staffing situation of some CAs does not cover the requirements in terms of knowledge or number of inspectors, particularly as regulatory verification needs to include vessels.

Design and implementation of a certification IT database
The process of certification could be greatly improved by the development and use of a very simple certification database.

Such a tool would offer the immediate status in terms of compliance of any establishment listed in the production chain for EU-destined consignments, thereby strengthening the validity of the certificate as well as the traceability of its contents.

An extra benefit, much appreciated by the industry, is that it would enable immediate certification of consignments to be air freighted.

This would make it possible to have certification officers at the airport at weekends and for dispatches at short notice, as long as those officers had web access to the database.

4. THE REGULATORY MODEL

While the presented "split" system can be very "cost effective" and "fast responsive", it takes care of the food safety issues related to the access of one market (even if it is the biggest) leaving the rest of the markets to a system that may also need to be improved. Nevertheless, the practical option can be used as a model to follow in other sectors under the framework of a better overall regulatory model.

In any case, it should be the aim of any organization responsible for seafood safety to look at long-term "effectiveness", and at the generalization of the domestic and export markets under the best international practices.

Although it has been changing over the last decade, this "effectiveness" has been hindered by the philosophy of "command and control" traditionally placed over regulatory activities, where government officers and inspectors deliver the instructions on *what* is to be achieved and, more often than not, *how* it is to be achieved.

This "command and control" form of governmental intervention has fostered an "*us and them"* mentality where food business operators tend to be automatically regarded as not trustworthy; therefore they need to be "controlled". In a parallel sense, customers and consumers come to assume that a "licence" or "approval certificate" on the wall of a business means they are "safe".

Under this form of official controls, enforcement activities have developed into a game of "*catch me if you can*", where regulators need to prove non-compliance, rather than industry being required to demonstrate compliance.

Moreover, the costs of maintaining the inspectorate necessary to ensure compliance across the whole sector and to find prevent and punish non-compliance also falls on government. Thus, the bigger and more complex a sector becomes, the bigger the control system needs to become and the rules and regulations become bigger and more complex, as every eventuality needs to be catered for. Hardly a sustainable approach in today's world of ever-changing standards.

Under this model, government regulations tend to become recipe books, standards or instruction manuals without which businesses cannot operate.

Thus, if a business wants to do something different, new or innovative, it needs to get approval or, in many instances, have the regulations or standards changed. This is often a lengthy process and it can take years before any new product, or variation of an existing product, can be legally marketed.

In synthesis, this traditional model of cluttered, fragmented and protectionist regulatory structure has five key disadvantages:

- It limits the power of recognition for a CA as defined by the authorities in market countries;
- It exposes the regulatory bodies to potential legal challenges by producers;
- It increases compliance costs towards industry, diminishing their international competitiveness;
- It affects government efficiency, transparency and credibility; and
- It burdens innovation, a key component of trade success.

An optimal regulatory model (ORM)

As mentioned, under the long-term option an all-encompassing restructuring of the regulatory framework under internationally recognized principles needs to be considered as well, since better official control methodologies can increase competitiveness if they can reduce the cost to industry and government in complying with regulatory measures.

The real challenge of this option is the need for political commitment to achieve the required change in skills, resources, organizations and policy reform.

Under this option, the role of a CA is to be identified as "*the nation's risk manager*" in respect of the risks related to food in general, more than just giving official assurances to export markets. It needs to be so in two ways:

- By providing a regulatory framework for the management of the risks associated with food safety, pest and disease control, and the welfare of animals; and
- By being accountable for official assurances that food products meet the standards required by domestic law or that of importing countries.

Worldwide, the onus for producing safe food has been shifting to the producer, processor, manufacturer and retailer, while the onus on government is to assure safety, rather than act as the quality controller.

This approach to food safety regulation reduces direct government intervention, and places the responsibility for systems management on industry. As such, it provides greater flexibility and economic control for individual business and allows government to allocate its resources to other development goals.

To further elaborate this concept, we should agree that (in its most general form), there are three key players within any ORM: the regulator, the verifier and the industry operator.

These three participants assume complementary roles and responsibilities which, when combined, enable the Regulatory Model to function as a robust and effective tool to protect and enhance the country' position as a trusted supplier of safe, "fit for purpose" and truthfully-labelled food for domestic and international consumers.

The key roles and responsibilities of the three participants in this type of model can be defined as follows:

The Regulator

- Monitors the overall food safety system for effectiveness and efficiency;
- Develops, negotiates and sets standards (including technical and operational standards for domestic requirements; generic export standards and specific standards relating to bilateral trade access agreements and international standards, such as those set by the Codex Alimentarius Commission);
- Provides official assurances, including export certificates, where these are required as a condition of overseas market access;
- Provides technical and policy inputs to laws and regulations;
- Defines competency criteria for, and approves or recognizes, the verifier. Also approves, recognizes or appoints other essential components in the food safety system, such as laboratories, by using internationally recognized accreditation in assessing conformity with competency criteria;
- Monitors and audits the performance of the verifier;
- May provide advice, and promote or foster initiatives, related to increasing the capability of the verifier. (An example could be the regulator running information or calibration workshops for verifiers);
- Develops resources that may assist the industry operator to develop and to implement risk-based management plans. (Resources can include templates for plans, codes of practice and other guidance material);
- Approves and registers food safety plans or risk-based management programmes adopted by the industry operator;
- Ensures that compliance costs for industry are minimized, by setting standards and other requirements that are commensurate with the risk(s) and robust enough to deliver the appropriate level of control;
- Undertakes compliance, surveillance and enforcement roles to remedy non-compliance issues; and
- Responds to food emergencies and recalls.

The Verifier

The Verifiers' group is made up of individuals or agencies accredited by government to perform specified functions, such as:

- Carry out inspections/audits/analyses and otherwise assess that the requirements set out in standards, specifications, risk-based management and compliance programmes are being met and are still valid;
- Take action under the risk-based management and compliance programmes when legal and/or regulatory requirements are not being met;
- May support authorization for government certification that product is produced in accordance with risk based management plans;
- Reports to the regulator. The verifier has a prime obligation to the regulator;
- Must satisfy competency requirements set by the regulator. It is possible that the regulator may set varying requirements for verifiers working with different risk categories of industry operators or sectors;
- Must also operate independently of industry operators and free from conflicts of interest;
- Wherever possible, verifier services will be provided on a contestable basis. Ideally and in theory, an industry operator would be able to select from a choice of verifiers; and
- If a single entity fulfils the role of both regulator and verifier, it is essential that robust principles and procedures are in place to ensure adequate separation between the regulatory and verification roles.

The Industry Operator

- Industry operators can be defined as those food business operators involved in the value chain of raw materials, products (and sometimes services) destined to be food;
- Has responsibility for developing and/or implementing risk-based management programmes and compliance programmes that meet the requirements of relevant laws, regulations and standards;
- Has input into the selection of methods and processes used to meet regulatory standards;
- Maintains and demonstrates compliance with risk-based management programmes;
- Engages and pays for verifiers;
- Produces food that is safe and fit for domestic and international consumers; and
- Engages in advisory co-participation in the regulatory decision-making process.

Roles and relationships within the ORM

Within the ORM, the government remains in overall control. It retains the right to set the legal framework within which the compliance systems and standards operate. It also retains the right to approve (directly or via the verifiers) the programmes developed by industry to demonstrate their compliance with those standards. Finally, it retains the right to approve or register the independent verifiers or auditors of those programmes.

This government activity also defines the relationships with the other key players in the model.

The independent verifiers or auditors are aligned closer to the regulator than to the various businesses they provide services to. They must be registered or approved by government to undertake their work and the threat of cancellation can be an effective "bonding mechanism". To gain such registration or approval, they must not only be able to demonstrate their technical competence to undertake their work, but they are also bound to remain free of any conflict of interest. They cannot, for example, be the verifier or auditor of a programme that they were commissioned to design.

The independent verifier or auditor may not have any “seizure power” but there should be in-built mechanisms that allow prompt action to be taken to prevent serious risks or hazards going unchecked or being hidden by the unscrupulous operator. Thus, it is the system itself and the legislative requirements, in particular, that give an element of authority to the independent verifier or auditor that an industry self regulated system cannot provide.

The ORM maintains the relationship between consumers and government. The control of the overall regulatory framework by government provides consumers with a baseline assurance that appropriate safety levels are in place through the setting of appropriate outcome specifications or standards.

Consumers, along with other interested parties, are able to participate in the standards-setting process, thus providing a mechanism to increase the acceptability of such standards.

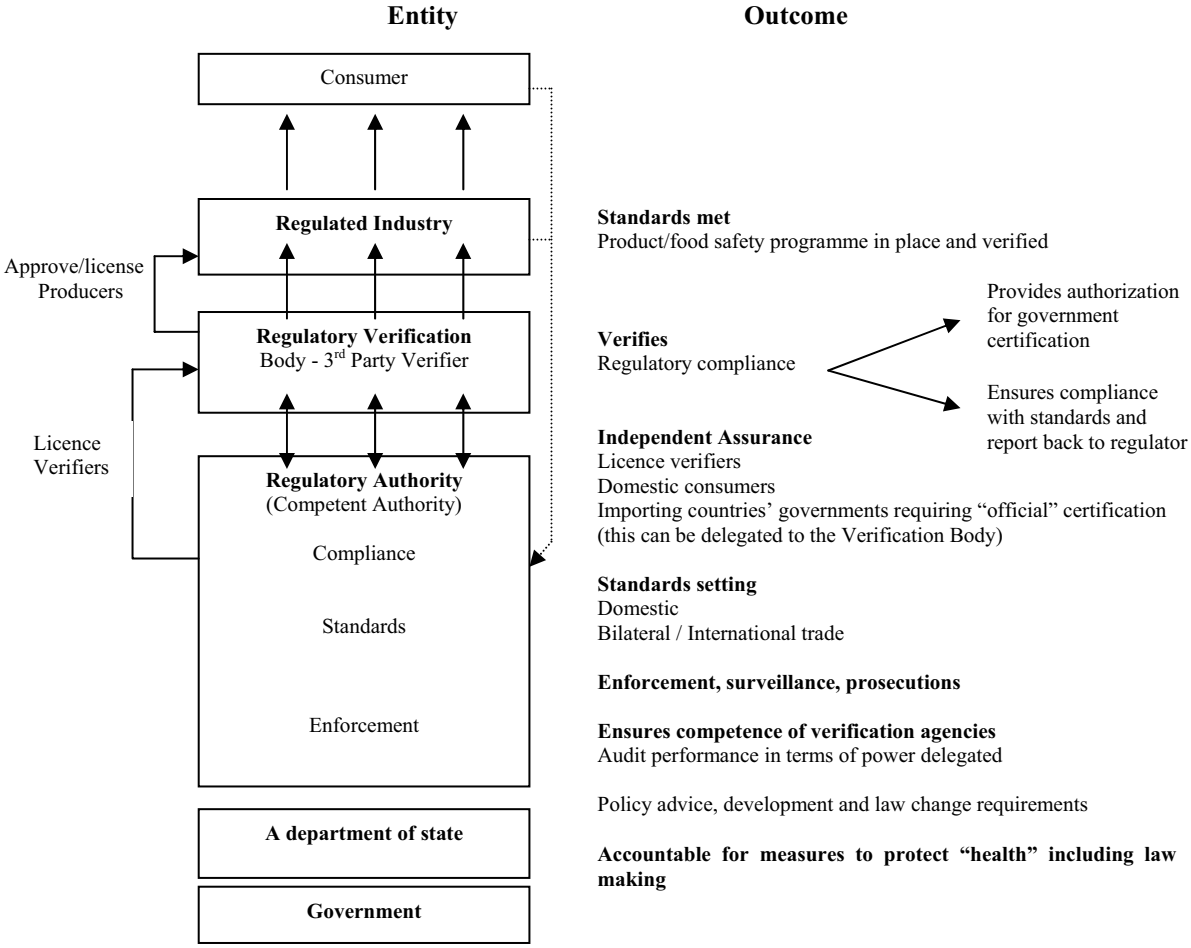
The relationship between industry and consumers continues to be regulated by market forces. However, it is important to note that the market place is not without rules and there are options available to those who believe they have been unfairly dealt with or harmed.

This approach also applies to the way in which the legislative and regulatory framework is set. Standards (or regulations) are no longer detailed prescriptive instructions; rather they are outcome-focused, generic and enabling. For example, in respect of food, the standards for composition and labelling are expected to focus on those aspects necessary to ensure safety, prevent fraud and deception, and allow for consumers to make informed choices in the products they purchase.

The mechanisms used by government and government agencies to arrive at the standards or regulations that will apply to a particular sector encourage industry and consumers to participate in, or contribute to, the development of standards or specifications.

When standards or outcome specifications are set by, or on behalf of, government, judgements about what is an acceptable level of risk will be influenced by the social, economic and political environment as well as the other obligations government has entered into. However, it is also essential that such judgements be based on scientific analysis and the best information available.

The entities, outcomes and interactions in the ORM can be seen in the following figure where solid lines represent regulatory interaction and dotted lines represent consumer and private sector feedback and involvement.



Laboratories

Undoubtedly, in order to effectively implement an official assurances policy, there ***must*** exist adequate laboratory facilities, including trained personnel, who would perform the necessary product testing to determine if it meets the established standards.

For an analytical result to have "official" validity, it must come from a laboratory accredited to an internationally traceable standard, normally done by means of requesting accreditation against ISO/IEC 17025 in the parameters to be determined.

The accreditation is what allows the CA to "trust" the impartiality and accuracy of the results and, thereby, "approve" the laboratory for its results to be considered "official". As a consequence, the status of "approved" can only be maintained as long as the laboratory hold the accreditation.

These requirements apply equally to government and private laboratories: in fact, private sector laboratories are increasingly becoming more used worldwide for regulatory purposes.

There is a need to improve current analytical testing capabilities in many countries. Besides minimizing duplication of testing activities, government faces the daunting task of finding ways to respond to the complex analytical testing requirements of contaminants.

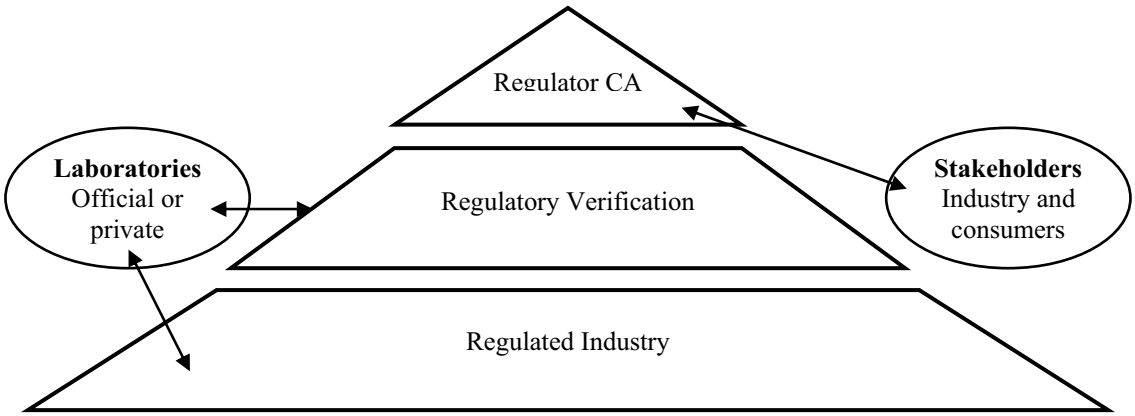
However, the establishment of laboratories requires considerable capital investment as such laboratories are expensive to maintain and operate. Careful planning is therefore necessary to achieve sustainability of the investment. The number and location of the laboratories should be determined in relation to the objectives of the system and the volume of work that exists and is anticipated.

The big picture
To ensure that the full potential of the benefits of the ORM are achieved, it is critical that the various players participate in the system, particularly the standard setting.

Such participation, coupled with the maintenance of transparency of decision making, ensures that all the players feel a sense of ownership and responsibility for the outcomes, both in terms of the standards or regulation set at government level and the "fit for purpose" products produced by the regulated industries.

The government, or more particularly all those agencies and office holders with specific roles or responsibilities in respect of the range of functions undertaken by the government, should make sure that the lines of communication are kept open and that elements of the overall system do not fall into the traps of "client capture" and/or "ivory tower" policy making.

Taking all the players into consideration (regulators, verifiers, industry, laboratories and stakeholders), the overall interactions among them are presented below in a simplified way, in order to strengthen the highly dynamic nature of the model and to show why its best performance requires dialogue and interaction among its participants.



5. CONCLUSIONS

The application of this model is adaptable to the realities of different country scenarios, and can be consistently applied across all sectors of the food industry, regardless of whether products are sold domestically or exported.

It benefits the operations of the food sector by:

Refocusing the role of the regulator: The Model enables the government, as the regulator, to be relieved of the responsibility for delivering inspection services, allowing it instead to focus on managing the overall food safety system, while being more cost-efficient. The Model also enables the regulator to devolve some responsibilities to others and to largely separate its policy and regulatory functions from service delivery.

Giving industry responsibility for food safety: The Model strengthens the capability for industry operators to assume an appropriate level of responsibility for the quality control, safety, suitability and labelling of their products. This is a significant change from the former reliance on government inspection under the old "command and control" regime. This is enhanced substantially when verification frequencies are linked to performance.

Providing clear and transparent delineation of roles: The Model clarifies and makes transparent the roles and accountabilities of each of the participants in the food safety framework. Purchasers and providers of services become distinguishable and independent.

Facilitating the use of HACCP methodologies: Under the Model, standards are outcome-based rather than prescriptive recipe books, and the Model provides for verification systems rather than rely on inspection-based checking. The establishment of a food safety framework compatible with an HACCP-based approach helps to secure the position of a country as a trusted supplier of safe and suitable food on international markets.

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EVALUATING THE OPPORTUNITIES, CONSTRAINTS AND IMPLICATIONS OF ECO AND ETHICAL FISH LABELLING ON THE OCTOPUS VALUE CHAIN IN SENEGAL

[ÉVALUER LES OPPORTUNITÉS, CONTRAINTES ET IMPLICATIONS DE L'ÉTIQUETAGE ÉCO ET ÉTHIQUE DU POISSON SUR LA CHAÎNE DE VALEUR AU SÉNÉGAL]

by/par

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Charlotte Tindall, Moustapha Kébé and Katrien Holvoet

Abstract

This paper provides an overview of ongoing work undertaken in Senegal to understand the implications of fisheries certification on the value chain. The paper analyses the opportunities of increasing social and economic benefits for poorer groups and for more gender sensitivity in the eco labelling through the implementation of upgrading strategies addressing equity gaps. It will describe the octopus value chain and give details on how the introduction of certification, such as an ecolabel and ethical fish labelling, may affect the numbers of people in the chain and their ability to capture benefits. Over the past few years there has been a large increase in the interest for eco and fair trade labelled produce, and while very few developing country fisheries have been certified to date there is increasing interest both by the fisheries themselves to gain market access and by international buyers who are keen to protect their reputation on responsible sourcing. While there are a number of potential benefits of certification including a promotion of sustainable fisheries management and increased investment in development, there are also a number of challenges, potential unintended consequences and elements that will not be addressed by certification. Octopus certification is constrained by the limited number of countries exported to and the interest of buyers to produce certified and ethical labelled octopus. This research provides an analysis of the key issues in Senegal related to the proposed octopus certification. It also proposes responses to encourage a pro-poor and gender sensitive approach to certification through supporting upgrading strategies that will be explored within the ongoing project.

Key Words: Value chain, Senegal, Octopus, Certification, Ecolabels, Ethical procurement, Upgrading

Résumé

Ce papier donne une vue d'ensemble du travail en cours entrepris au Sénégal pour comprendre les implications de la certification des pêches sur la chaîne de valeur. Il analyse les opportunités d'augmenter les bénéfices sociaux et économiques des groupes plus pauvres et pour plus sensibilité genre/parité hommes femmes dans l'étiquetage écologique (éco-étiquetage) à travers la mise en place de stratégies d'amélioration comblant les déficits paritaires. Il décrira la chaîne des valeurs de la poulpe et donnera des détails sur la façon dont l'introduction de la certification, par exemple l'étiquetage éco et éthique du poisson, peut affecter de nombreuses personnes dans la chaîne et leurs habilités à tirer les bénéfices. Au cours des dernières années il y a eu une forte augmentation de l'intérêt d'un étiquetage éco et équitable des produits et quoique un nombre réduit de pays en voie de développement aient été certifiés jusqu'à présent, il y a un intérêt accru et de la part des pêches pour accéder aux marchés et de la part des acheteurs internationaux très portés sur la protection de leur réputation d'un approvisionnement responsable. Bien qu'il y ait une quantité d'avantages potentiels de certification y compris la promotion de la gestion durable des pêches et une augmentation des investissements en développement, il y a aussi beaucoup de défis, des conséquences potentielles imprévues et des éléments qui ne seront pas réglés par la certification. La certification des poulpes est limitée par un nombre réduit de pays importateurs et l'intérêt des acheteurs pour la production de poulpes certifiés et étiquetés éthiques. Cette recherche fait une analyse des questions clés au Sénégal en ce qui concerne la certification proposée du poulpe. Elle propose aussi des réponses qui encouragent une approche pro pauvre et genre sensible pour la certification à travers une amélioration des stratégies qui seront explorées/examinées dans le projet en cours.

Mots clés: Chaîne de valeur, Sénégal, Poulpe, Certification, Éco-étiquetage, Approvisionnement éthique, Amélioration

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1. INTRODUCTION

The intention of certification is to use market power and consumer demand as an economic incentive to introduce more sustainable fishery practices – by rewarding good practices through creation of better and more attractive market access and product valorization. This approach, combined with specific focus on value chain promotion, shall be applied and introduced in the Octopus and Cuttlefish Fishery of the Nianing and Pointe Sarrene area of Senegal. Today, the concept of certification is widely acknowledged as a valuable tool to provide market based incentives for fisheries to improve their management towards more sustainable exploitation practices. Since its establishment in 1997, over 20 fisheries have been certified worldwide by the leading and internationally well accepted certification program of the Marine Stewardship Council (MSC).

However, until today, only few fisheries from developing countries have achieved MSC certification.

Despite the importance of fishery products export revenues for many developing countries and the fact that more than 50% of the world's trade volume in fish and fishery products stems from developing countries' fisheries, ecolabelling in developing countries does remain a challenge that needs to be addressed by both policy makers, institutional and governmental bodies as well as the private industry. The increasing market demand for certified sustainable fish and seafood products in attractive consumer markets in the EU and the US may even impose a threat in the form of market exclusion for some commodities. At the same time, this consumer-awareness driven development also offers an opportunity for higher valorization and better product differentiation on increasingly competitive international markets. There may be many reasons why only few developing countries' fisheries have been applying for certification by the MSC so far; the predominant small-scale multi-gear and multispecies fisheries, the general lack of data and organizational structure, lack of fishery management and regulation and insufficient capacity and capability for efficient enforcement, to name only a few of them.

In order to create learning grounds and practical experiences with ecolabelling in developing countries, specific and well suited fisheries should be identified and guided towards achieving certification.

A feasibility study on ecolabelling of small-scale fisheries in Senegal, elaborated by Blueyou and ENDA/REPAO Senegal in June 2007 for GTZ, has identified the main constraints, opportunities and the most appropriate ways to approach ecolabelling in Senegal.

Based on the study's outcome and in the realm of a workshop on MSC ‑ fishery certification in May 2007 in Dakar, the Senegalese fishery stakeholders decided to establish a Steering Committee for Ecolabelling. This newly created body, consisting of governmental representatives, fishery stakeholders, local NGO's and research institutions, has been appointed to coordinate and lead all activities and initiatives of ecolabelling in Senegal. The Senegalese Steering Committee has then identified and selected the Cephalopod Fisheries of *Nianing* and *Pointe Sarrene* as suitable candidate fisheries for ecolabelling and has decided to develop an implementation plan and a proposal for funding in collaboration with Blueyou. This project proposal is based on the experiences and lessons learned in the realm of MSC certification of small-scale and data-deficient fisheries worldwide. It does, therefore, take into account actual consensus and expertise on how to best approach fisheries of developing countries that do exploit resources mainly destined to export markets such as cephalopods. The Cephalopod Fisheries of Nianing and Pointe Sarrène are such candidates. Octopus and Cuttlefish are exploited by small-scale fishermen using traditional means and gear. Following factors and conditions to favour the proposed programme of MSC-certification of the Cephalopod fishery in Nianing and Pointe Sarrene:

- The two fisheries are geographically limited in their operational range. Therefore, a functional organization structure of the fisheries can be established, and a fishery management plan as well as local enforcement procedures can be implemented within a realistic time frame of 3–5 years;
- Cephalopods are highly reproductive species and, therefore, are less prone to over-exploitation of stocks once a meaningful fishery management is being established and enforced; and
- The cephalopod fisheries are entirely destined to high value export markets and therefore offer market incentives for the introduction of better practices not only in the fishery management, but also for food safety and quality procedures.

A proposal has been developed and elaborated by ENDA/REPAO and WWF (WAMER) with the collaboration of BLUEYOU in Senegal for a pilot programme of ecolabelling Octopus in the area of Pointe Sarrene and Nianing.

This proposal has two main components which are critical for the overall success of the programme:

- First, the proposed objectives and activities are defined in such manner that they do adequately address and above all take into account local realities of the stakeholders and targeted interest groups of the Cephalopod fishery in the Nianing and Pointe Sarrene area; and
- Second, the programme is strongly oriented towards creation of market-based incentives to facilitate and support changes in economic responsibilities, dependencies and performance of job for daily subsistence.

The proposed linking of eco-labelling, as a market-based incentive and practical tool to guide producers towards sustainability, with the methodology of value chain promotion along the products' supply chain has been proven successful in a number of other initiatives in other sectors, such as small-scale aquaculture and organic farming.

The basic underlying question is: How to break the vicious circle of vulnerability and dependency of small scale primary producers towards traders and processing companies that are having complete control on pricing and, therefore, do directly exert pressure on natural resource exploitation? Taking into account the needs of smallholders for daily subsistence, such a combination often leads to resource over-exploitation, especially, as in Senegal's case, if there are no fishery management and enforcement procedures in place.

The ecolabelling proposal programme in Senegal intends to use the organizational capacity and cooperation amongst fishermen not only to provide the required framework for implementation of a fishery management but also to combine fishermen's purchasing power to increase the flow of information amongst group members and to eventually create a strong position for negotiating with traders and factories. In addition, the processing factories will be playing a central role in this programme. The local private industry has the financial means and the capacity to directly support and enable the ecolabelling initiative by implementing a new strategy for procurement of raw material from the fishermen.

Sustainability can only be achieved if all actors along the supply chain start to feel and behave as professional business partners, negotiating and communicating transparently the issues at stake and, therefore, taking and sharing responsibilities for the economic, social and environmental issues at stake. The strong market orientation of the project and the strived direct collaboration with European market actors that are taking the issue of joint responsibility seriously, combined with the pragmatic tools of ecolabelling and fair-trade models, shall be the practical framework that offers incentives for a successful implementation of this programme.

Throughout the world, fisheries stand out as natural resources that remain difficult to manage. New approaches to promote and improve sustainability of fisheries include the implementation of market-oriented certification and eco-labelling schemes for fisheries as well as fisheries co-management efforts. Both these approaches are based on stakeholders' active involvement and participation in fisheries management decisions as well as orientation towards the markets and related supply and value chains. The programme does specifically focus on market-based incentives as valuable tools and practical means for providing incentives to adopt changes along the supply chain of production.

The proposed programme, working with smallholder fisheries' communities along the coast in the Nianing and Pointe Sarrene area, will use the concept of value chain promotion in addition and in combination with all activities related to fisheries co-management, ecolabelling and fair trade models to create synergies and to maximize benefits and long term sustainability of the Cephalopod fishery.

Basically, the value chain approach, as an intervention and participatory management tool for shaping single business sectors, as well as local economies, systematically analyses and takes into consideration all steps of a production process, analyses the links, information and product flows, reveals the strengths and weaknesses of each stakeholder along the supply chain, identifies losses of value in the process and provides a methodical framework to increase the valorization of products along the chain, taking into account the requirements and conditions of international markets that define the overall economic environment.

Since chances of small-scale producers for significant economic benefits increase with the number of value chain operators involved, the formation of fishermen into management sectors and the organization of a fishermen cooperative will be essential elements of the programme. Experiences have shown that the degree of horizontal collaboration and bargaining power within the value chain operators is crucial for income increase.

National Senegalese fisheries authorities have identified a range of measures and defined nationwide programmes that specifically address the countries predominant small-scale fishery sector:

- Organization of the small scale fishery into distinct fishery management sectors;
- Registration of all fishermen and vessels being active in the fishery;
- Improvement of fishery regulation enforcement by local fishery surveillance bodies;
- Introduction of fisheries co-management; and
- Improvement of food-safety and quality measures all along the supply chain.

The proposed programme of eco-labelling and value chain promotion of Nianing and Pointe Sarène Cephalopod fishery does offer a valuable framework of guidance and assistance for all local fishery stakeholders and institutions since it does exactly deal with the issues being promoted by the governmental initiatives mentioned above. It does, therefore, not negatively interfere with governmental measures and processes, but positively enhance and support the successful implementation of the stated national programmes by providing practical incentives and rewards to the stakeholders.

In this regard the proposed programme shall be a practical learning ground for improving sustainability of Senegalese fisheries, securing long term food security for local people as well as safeguarding access to international markets for high-value products. The certification of octopus offers a number of benefits, such as (i) priority market access requiring certified products, (ii) improving the management of the resource, and the possibility of producing more in the future; and (iii) support and investment potential of NGOs and donors (and local government).

Approach to value chain study of Senegal's octopus fishery

This paper provides an example of these issues by drawing on a project that is currently being undertaken in Senegal (in the department of Mbour) by ENDA Repao, MRAG Ltd and SFLP-FAO with support from IDRC (International Development Research Centre) and ODI (Overseas Development Institute), working with the octopus export value chain. The objectives of the project are to: (i) support pro-poor and gender sensitive 'upgrading' strategies to improve the value chain; and (ii) support an approach to certification that addresses social and economic issues within the value chain. The first step of this project has been to understand the current value chain, the inequalities within it, and how it can be improved through upgrading as well as the implications of certification. Upgrading refers to improving the value and efficiency of a supply chain and can refer to: (i) vertical upgrading: which means doing better with the same product through negotiations throughout the chain; or (ii) horizontal upgrading where improvements are made at one level e.g. management capacities at the production level. Fisheries certification of the octopus fishery has been put forward recently by an independently conducted review (Ndiaye *et al*., 2008) which determined that out of all the fisheries in Senegal the octopus fishery had potential given its: (i) orientation towards export; and (ii) relatively simple fishery with a defined production area. There is also potential for Senegal to achieve MSC certification of one of its products through the planned improvements in management of the resource through local fishing committees (Conseils locaux de pêche artisanale, CLPAs). Another review of the World Bank supported fisheries management initiatives (the Girmac project) in four communities along the coast of Senegal (Ndiaye *et al*., 2008) recommended that all cephalopods (i.e. octopus, squid and cuttlefish) within the department of Mbour should form the unit of certification because of the similarity in: i) the artisanal fleets targeting the stocks; (ii) their zone; and (iii) the supply chain to export. However, there are a number of important questions that arise. For instance, can the octopus fishery be considered sustainable, and can a management area be defined when the stock is targeted by both artisanal and industrial fisheries? Further to this, is there sufficient incentive and demand for an ecolabel for octopus products? It is likely that there will be no price premium for certified octopus and without significant demand from buyers there may not be sufficient short-term incentives for actors in the supply chain to invest in certification. There may be other important ways of upgrading the supply chain that will be more effective in adding value for producers, although these will always need to take into account management of the resource for the long-term sustainability of the industry. This paper focuses on the initial results of the project related to the opportunities and constraints of certification and ecolabels. It will also describe how certain upgrading strategies may be effective in providing more benefits to the poor and vulnerable within supply chains, and which ones of these are compatible or mutually reinforcing with certification.

2. OCTOPUS VALUE CHAIN

The octopus fishery in Senegal is one of the important parts of the artisanal fisheries sector which overall employs around 600,000 people and provides more than US$17,000,000 export revenue (Dème, 2002). Octopus contributes to these revenues, since 90% is exported. As well as being important for the national economy, fisheries also provide a livelihood of last resort involving established fishing communities but also new entrants who have left agricultural areas following successive droughts. The largely "open-access" of the artisanal fishery as well as fishing agreements signed with foreign fleets (licenses given in return for budget contributions) have been put forward as key reasons for the over-exploitation of Senegal's coastal resources. The FAO fishery sub-committee for the Eastern Central Atlantic have reported that the status of Octopus and Cuttlefish are critical (FAO, 2005).

Description of the value chain

Octopus production

Production of octopus in Senegal varies from year to year. There were very high quantities of octopus caught in 1999 reaching 37,257 tonnes (seven times higher than during the years 1996–1998) but these quantities have not been seen since. Production declined to 1,795 tonnes in 2001 but reached 8,148 tonnes in 2004, 7,472 in 2005 and 8,814 in 2006 (See Table 1). This is approximately 2.4% of global production. However, there is a discrepancy between declared catches and declared exports, with exports exceeding catches in recent years apart from 2006. Octopus forms 65–75% of the overall cephalopod catch, which also includes squid and cuttlefish.

Table 1: Octopus production and export provided from different data sources

Years	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Octopus production (tonnes)	37,257	6,057	1,795	12,796	10,861	8,148	7,472	8,814
Octopus export (tonnes)	32,180	12,567	4,351	14,237	13,010	10,039	8,560	6,030
Commercial value (million FCFA)	no data	no data	no data	19,206	20,377	13,805	9,332	10,504
Euros (million)				29.28	31.06	21.05	14.23	16.01

Source: DPM (Direction des Pêches Maritimes)

This production is relatively small compared to that within other countries of the region such as Mauritania and Morocco. For example, Morocco catches were 20,840 tonnes in 2007 (Josupeit, 2008). Around 25,297 tonnes of octopus are landed in Mauritania per year, although this does not include octopus caught in Mauritanian waters by foreign fleets which may not be landed in-country. Octopus production is concentrated around the regions of Dakar (42%) and Thies (56%). Production takes place all year round, although there is a peak in production during the rainy season from July to October. There are three important ports for octopus landings: Mbour, Joal and Kayar. The value chain described below focuses on the trade surrounding Mbour. This area accounts for around 12–30% of national production depending on the year.

Octopus value chain

A simple view of the value chain involves the fishers, traders and the factories that process and export the product. A more detailed view of the value chain reveals that there are a number of actors at each level (Figure 1). For instance, at the fishery level there is a distinction between boat owners who own the catch and engage in trade; and the boat crew, porters and boat haulers who receive a wage or a proportion of the catch for their work. There is also an important distinction between the artisanal fishers that target octopus and the industrial fishery. Both of these categories of fishers will also target other fish species, including other cephalopods (such as squid and cuttlefish). The artisanal fleet generally fish up to 400m, while the industrial fleet fishes at depths of more than 500m and are restricted by law to fish beyond 12nautical miles of the coast.

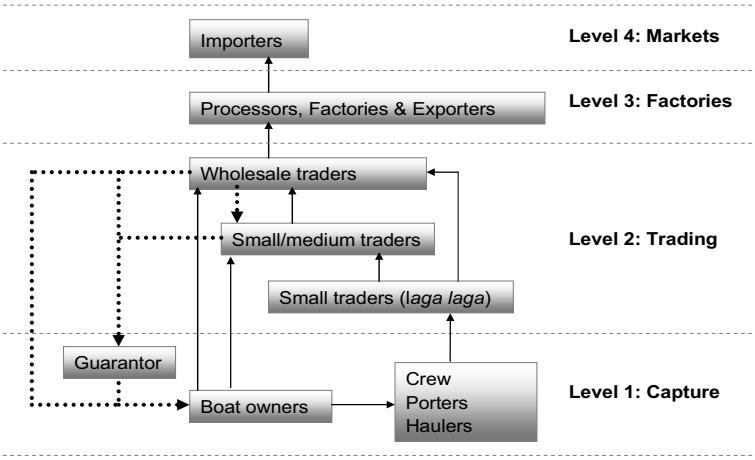

Figure 1. Schematic diagram of the octopus value chain in Senegal

The main export countries are Italy, Spain and Greece in Europe and Japan. Historically Italy has been the main destination and Senegal exported around 3,700 tonnes and 4,200 tonnes here in 2006 and 2007, respectively. Japan has been a regular export market with around 1,800 tonnes exported in 2005 and 1,000 tonnes in 2006. Exports to Spain were around 500 tonnes in both 2006 and 2007 (Table 2) (Josupeit, 2008).

Table 2. Quantities of exports of octopus from Senegal to different countries

Years	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Italy	22027.5	7029.5	2639.3	10189.3	8299.0	5855.5	4744.1	3666.5	4200
Japan	1174.8	1216.1	324.7	1787.1	1558.4	1905.2	1776.8	930.8	nd
Spain	5130.4	100.5	769.5	1255.1	1979.9	1447.4	738.6	522.5	500
Greece	1765.8	1539.7	87.0	423.5	711.5	255.9	730.0	336.3	nd
Thailand	664.4	606.6	213.7	133.8	70.3	85.8	116.0	172.5	nd
China	0.0	307.6	0.0	115.9	219.5	299.5	103.9	142.7	nd
Others	1417.5	867.0	316.6	332.1	171.6	190.5	350.1	258.1	nd
Grand Total	**32180.4**	**12566.9**	**4350.8**	**12436.6**	**13010.2**	**10039.7**	**8559.6**	**6029.5**	

Source: COMTRADE plus national statistics for 2006, as cited in the GRP 94: The World Octopus Market, 2008. Note: Nd = no data available

The most important factories for octopus include Ikagel (based in Mbour), Africa Fish and Blue Fish (all based in Dakar). There are a number of other factories that deal in a range of different fish species but also deal with octopus. Different factories sell to different markets, for example Ikagel has links to importers in France (Ikagel-France), while Blue Fish sells mainly to the Italian market. Other factories such as Senegal Pêche export to Japan and have Japanese investment.

Between the fishery level and the factories, there are a number of different categories of traders: The wholesale traders (often based in regional centres such as Mbour) often have contracts directly with factories and either buy directly from fishermen (that they often finance at the beginning of the season), other large traders, or from smaller traders either based at the fish landing sites or in town. In addition to the wholesale traders, there are also large traders that will also buy from fishermen and sell on to factories. In some cases traders are employed directly by the factories. Lastly there are the small traders (often women) known as '*laga laga*' that buy small quantities of octopus from fishers or porters and haulers and sell these on to the larger traders. The traders are instrumental in financing the fishing activities, and will often give credit at the beginning of the fishing season and maintain an outstanding credit in order to assure regularity of supply. Often these funds are managed by an independent guarantor (e.g. a retired fisher) who assures that the fisher will honour their agreements to exclusively supply the trader. The distinctions between these different categories and the value chain can often be blurred, for instance, some boat owners also take part in trading if they have the financial means and while it is mainly the larger traders based in the regional centre (Mbour) that have contracts with the factory, some traders based at smaller landing sites (e.g. Pointe Sarene) have also negotiated contracts. The trade in octopus in Senegal is not independent from that taking place in Mauritania and Morocco. In some cases Senegalese factories may buy product from Mauritania to process, or Mauritanian traders may buy in Senegal and process

and export this in Mauritania. The quantities produced in these other two important countries also affect the price on the European and Japanese markets.

Octopus price

The price of octopus in Senegal is partly a function of the supply and demand. While current factory purchase prices are between FCFA 1,000–2,000/kg (€1.5–3/US$2.4–3.8), the amount paid to fishers dropped to FCFA 100/kg (€0.15/US$0.2) in 1999 during the explosion of octopus production. However, it is also a function of the size and the final market where it is sold (Table 3). Sizes of 300–500 g per piece fetch around US$10–12/kg (€6.4–7.7/kg) in the Japanese market, whereas sizes of 2–3 kg are sold for US$6–8/kg (€3.8–5.1/kg). In Europe (Italy and France) prices are around €8/kg for pieces between 800 g and 2 kg. The type of processing will also affect the price, for example 'hand-flowered' octopus where the tentacles are arranged around the body fetch very good prices on the European market.

Table 3. Examples of prices for different sizes on different markets (for 2006)

Country	Size kg/pc	Price/kg	
		US$	€
Italy	Average	5	3.2
Spain	1–1.5	11	7
	3–4	19	12
Japan	Average	5	3.2
	0.3–0.5	10–12	6.4–7.7
	2–3	7	3.8–5.1
France	0.8–2.0	12.6	8

***Source*:** 2007–2008 from Globefish website Octopus Market Report – June 2008 (Josupeit, 2008), and interviews with importers

In Senegal, the factories have a monopoly over the price because there is no local market for the product and only a few fish exporters trade in octopus. If the factories fix the price at FCFA 1,000/kg, larger traders will buy from the smaller traders for FCFA 900/kg and pay FCFA 800 to the *"laga laga"* who may offer FCFA 750 to the fisherman (Table 4). This practice often causes problems for the traders if the factories change the price they will buy at towards the end of the day after trading at the beach level has already taken place. This situation also illustrates the lack of negotiating power of the traders, which equally translates into the low negotiating power of fishermen.

Table 4. Average price of octopus as it moves along the value chain

	Fishers	Traders	Processors/Export	EU market
FCFA/kg	750	800–900	1,000	-
€/kg	1.1	1.2–1.4	1.5	3–12 (depending on size and market)

Current inequalities within the value chain

There are a number of existing inequalities and social issues within the value chain. One of the key aspects that determine the benefits reaped by producers and the poor in the chain is the ability of the processing and exporting factories to fix the price at which they buy the octopus. As discussed earlier, one of the reasons for this is the lack of competition between exporting companies, but it also reflects the low negotiating capacity of actors lower in the chain which is likely to be related to lack of information on international markets and prices. Access to independent credit is likely to affect the negotiating capacity of fishers, and this is often reported to be difficult given the centralization of credit organizations, the rigid criteria for accessing credit, and lack of flexibility in repayments as well as the modest amounts loaned (Coulibaly, Dème, Diop and Kane, 2003). The fact that exclusively "day caught octopus" is bought also limits the fishermen's negotiating capacity. Another key concern for the value chain is related to quality issues. The quality of octopus from Senegal and reaching European markets is considered to be relatively high and it is possible for factories to use specific processing techniques to improve the texture of poorer quality produce. However, traders will receive lower prices for poorer quality octopus. In many cases the factories will collect directly from landing sites with their own lorries thereby assuring the quality, but octopus that goes via other routes (e.g. via fishermen to *"laga lagas"* to traders and then to factories) has more potential for deterioration. The actors in the value chain that are considered to be the poorest and most vulnerable include the fisher crew, artisanal processors (women), small-scale traders (women), and a large number of migrants. Medium poor groups include fishers that own some fishing equipment, traders that have some means of transport, traders and processors that benefit from family support or credit, and fishers involved in the industrial fishery; while well-off groups include boat owners (owning many

units), traders and processors that have financial support of partners (e.g. factories or foreign exporters) or their own significant fund (Coulibaly, Dème, Diop and Kane, 2003).

3. IMPLICATION OF CERTIFICATION

Opportunities of certification

As discussed above, there are a number of different options for certification schemes. Awareness-building workshops on the MSC scheme have already taken place in Senegal, and recent review reports (BlueYou, ENDA/REPAO and WWF, 2007) have recommended MSC certification. Other options include Friends of the Sea, which at first glace looks like an attractive proposition given its strengths in markets such as Italy and Spain where a high proportion of Senegalese octopus is destined. However, the Friend of the Sea scheme does not have the additional benefits of NGO support (e.g. WWF and Greenpeace) or criteria on fisheries management that ensure sustainability of the stock into the future. While Fair-Fish proved to be an interesting approach when trialled in Southern Senegal, it lacks the market presence of other labels. Naturland may also be an interesting approach in the future although the market is currently focused on Switzerland and Germany where octopus is not consumed in large quantities, and there are still issues related to the draft criteria to iron out. Fairtrade certification, possibly in partnership with MSC, could be an option in the future as it provides for direct benefits to the producers. One of the main benefits of certification is securing market access. However, while this is true for some products such as white fish (where there is a very high demand for certified produce) this is not yet currently the case for Octopus where market access to Spain and Italy is governed more by the quality and price than environmental or social issues. There may, however, be increasing interest in MSC certification of octopus in Japan where the use of MSC is growing in popularity. Current estimates suggest that up to 20% of Japanese fish imports are from fisheries certified under the MSC standard or fisheries currently in assessment. It is still important to bear in mind that octopus imports into Japan have been declining over recent years, which could affect demand for certified product. Price premiums for the product are not guaranteed, although this was achieved briefly under the fair-fish pilot and would be a characteristic of any fairtrade labelling. Another key benefit of certification, such as MSC, is the requirement to have effective or improved fisheries management in place. It is clear that there is a need to improve the management of the octopus fishery, and a potential for improved yields if certain management measures such as biological rest periods and minimum landing sizes were effectively implemented. The strengthening of co-management bodies (i.e. the CLPAs) to achieve effective fisheries management could also have a number of knock-on benefits of a better organization of actors in the value chain. Lastly, it may be possible for Senegal to benefit from investment of donors into the fishery in preparation for certification. There has already been interest from GTZ and the World Bank in strengthening management capacity to support the certification process, but as of July 2008 neither of these programmes has yet been approved.

Constraints of certification

Despite the potential benefits of fisheries certification, there are a number of constraints. One of the key issues is the high cost and time required to improve management and achieve certification. For instance, a proposal to the GTZ to support the certification process estimated a four-year programme costing €682,631 which would in the first two years build up and establish co-management structures and in the second phase implement certification as well as improving the produce valorization along the value chain (BlueYou, ENDA/REPAO and WWF, 2007). The challenge in Senegal is the currently low capacity for management. For instance, co-management structures are not yet fully established and those that have been supported by JICA and Girmac funding have key differences in structure. There are also a number of on-going policy initiatives that need to be coordinated, such as the revision of the Fisheries Code, and the management plan for octopus. Current estimates consider that the octopus is already over-exploited and there would, therefore, need to be a dramatic improvement in management to turn this situation around. The “unit of certification” is also problematic, as both artisanal and industrial fleets target the same stock, and the octopus fishery is spread down a significant proportion of the Senegalese coast. While it is possible to define a unit of certification that only targets a proportion of the overall stock, it is necessary for the status of the overall stock to be sustainable. This allows for only the artisanal fishery (and possibly only specific areas) to be targeted for certification, but means that they will be reliant on responsible fishing practices of those outside of the scheme and over which they may have limited control. This also presents challenges for traceability, where it would be necessary to guarantee that the octopus could be traced back to the artisanal fishery rather than being a produce from industrial vessels or from Mauritania. However, the main economic constraint for certification of the Senegalese octopus is the current lack of interest by European buyers in Italy, Spain and France. While there is some consciousness on the importance of sustainability, buyers in France are not familiar with MSC certification and do not find that customers are asking

for this type of product differentiation. There is similarly a lack of interest in certification among the actors in the value chain within Senegal, unless it can guarantee a price premium. This looks unlikely in the current market, although it could be possible in the future.

Specific social issues associated with certification

The main 'social impact' of certification is related to the need to define access rights to the fishery and then restrict access (i.e. issue and enforce permits). Although this is likely to provide benefits into the future increasing value of the resource, improving management and securing livelihoods, there is a short-term social cost where some actors will not receive permits and will be excluded from the fishery. The extent of the social cost will depend on how equitably and transparent the process is. It is obviously a difficult and political process illustrated by the delay already experienced in introducing such a system. It is also clear that certification will not address a number of current inequality issues, such as the ability of factories to fix prices, the low negotiating power of traders with factories and also of fishers with traders, and the lower quality of some octopus that gives producers or traders a lower price. Pro-poor upgrading strategies (where the value of the product is increased throughout the value chain) have the potential to: a) address current inequalities in the chain; b) mitigate social impacts of certification; and c) reinforce environmental or social objectives of certification (Figure 3). Some of these can be addressed at the same time, for instance improving the organization of community groups can promote the negotiation power of producers, give them a greater voice in resource allocations and assist in improved resource management. However, other upgrading strategies may be more orientated towards providing addressing current inequalities or moving towards the objectives of social certification (such as Fairtrade). For example, improving the quality of the product can improve the price paid to producers and traders, and increasing the transparency of the market can prevent factories fixing prices.

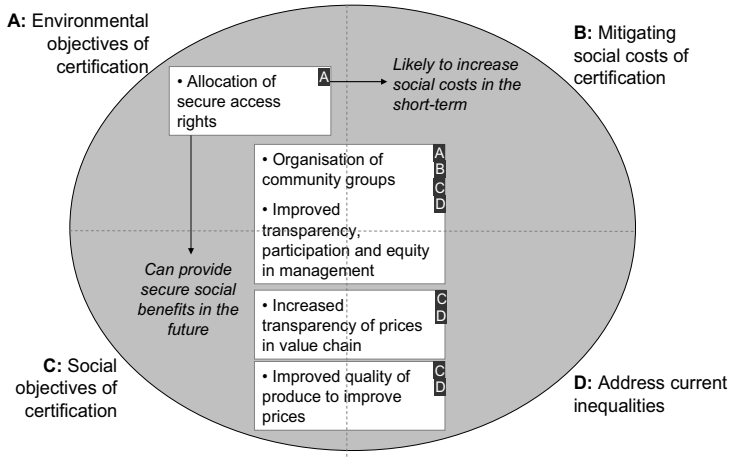

Figure 2. An illustration of upgrading actions and their contributions to different outcomes (A, B, C and D)

4. CONCLUSIONS

Before considering benefits or constraints of certification for developing countries it is necessary to consider whether importing countries are demanding certified product or are likely to in the future. If there is limited demand from the market, it is important to consider what the motivations for certification are (and by who) and whether these are likely to be realized. This also includes a consideration of the cost of certification and how it will be covered and by whom in the long term (as most of the certification schemes in developing countries are donor supported during the set up period). It is important to analyse the required functions that need to be taken up by government institutions and to understand if the willingness and commitment is there to sustain the initiative. A value chain analysis is instructive as it allows the implications for different actors (and relations between them) to be assessed, rather than focusing only on the implications of certification on the state of the resource.

In the case of the Senegal octopus export value chain, there is no immediate demand for certified product from importing countries, although this may change in the future. There are also relatively high costs of achieving certification and an effective management regime, which is one of the reasons why donor agencies have been involved in discussions to assist with covering the costs. There are a number of longer-term benefits of achieving environmental certification, including improved management and a more sustainable fishery.

However, in the short-term there may be social costs including the need to reduce access to the fishery and set up a system of permits. Actors in the value chain appear to be more aware of the short-term costs than the long-term benefits, and want to see short-term incentives such as a price premium to make it worth their while. Social certification (such as fairtrade) could deliver such a premium but current developments are moving towards dual certification with an environmental standard to ensure that the stock sustainability is not undermined.

Certification schemes can have a number of benefits, but also constraints and potential social impacts as discussed above. They may also be unable to address all the current inequalities in the value chain but should at least not increase them. For instance, environmental certification would not be able to address value chain issues such as fairness of the pricing system. Social standards (such as Fairtrade) could address pricing issues, but would not be able to address quality issues and may not be able to directly influence the allocation of access rights. It is clear, however, that a combination of social and environmental certification could have the most overall benefits, although there may be additional areas that have to be considered that still fall out of the remit of both, such as the equitable distribution of access rights and potential short-term compensation for those negatively affected. Issues still remain however, such as limiting the burden of certification (which could become more complex with the introduction of social issues) and determining whether certification is in fact the best route for tackling these issues.

Certification can be considered as one type of upgrading strategy, but there are other strategies that can also be used to improve the value chain and provide more benefits to poorer groups. Some of these strategies can be in line with certification requirements, but others, such as quality upgrading and organization capacity of actors, are worthwhile achieving, even without certification, and can be used to address current inequalities and inefficiencies within the chain. Examples have been given here, and through the case study in Senegal selected strategies will be piloted following the full analysis of the value chain.

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APPROCHE PLATEFORME TECHNOLOGIQUE POST-CAPTURE DU POISSON: POINT D'ENTRÉE POUR LA RÉSOLUTION DES QUESTIONS TECHNOLOGIQUES ET SOCIOCULTURELLES EN PÊCHE ARTISANALE

[POST-HARVEST FISHERIES TECHNOLOGICAL PLATFORM APPROACH: ENTRY POINT TO ADDRESSING TECHNOLOGICAL AND SOCIOCULTURAL ISSUES IN ARTISANAL FISHERIES]

by/par

Oumoulkhairy Ndiaye[1] and Yvette Diei-Ouadi

Résumé

Cette contribution porte sur l'approche "Plateforme technologique" mise en œuvre de 2005 à 2006 le long du lac Tchad et du fleuve Chari Logone en République du Tchad, dans le cadre du Programme de Coopération Technique de la FAO, TCP/CHD/3003 (A) "*Renforcement des capacités nationales en inspection et amélioration de la qualité des produits halieutiques du lac Tchad et du fleuve Chari*".

Une plateforme technologique est avant tout un concept, matérialisé par une aire aménagée et équipée en technologies améliorées post capture. C'est un point d'entrée, un cadre favorisant des échanges, un forum où sont traités tant les obstacles d'ordre technique/technologique post capture que sociaux et économique au développement des communautés de pêche.

L'approche pluridisciplinaire appliquée est spécifique, elle diffère du schéma classique d'acquisition d'équipements techniques où les populations ne sont pas associées et leur environnement socioculturel souvent ignoré lors de la conception de solutions aux problèmes rencontrés dans leurs activités.

La conception et la mise en œuvre de la plateforme varient d'un site d'intervention à l'autre selon le type d'opérations post-capture, les problèmes de technologies, les aspects socioculturels et, les enjeux économiques.

Les bénéficiaires, en majorité des femmes, organisés en groupement d'intérêt économique se sont appropriés la plateforme et ont démontré leurs capacités à assurer la poursuite des activités ainsi que la gestion, la maintenance des installations et des équipements réalisés avec la mise en place d'un organe de gestion.

L'ancrage de l'approche plateforme technologique contribuera significativement à la réduction des pertes post-capture, à l'amélioration de la qualité, au renforcement de la cohésion sociale et à la protection de l'environnement. Par conséquent, cette approche holistique, de par sa pertinence devrait être disséminée dans les autres communautés de pêche en Afrique.

Mots clés: Pêche à petite échelle, Plateforme technologique post-capture du poisson, Qualité

Abstract

This contribution deals with technological platform approach which took place from 2005 to 2006 along Lake Chad and river Chari Logone in the Republic of Chad, within the framework of FAO Technical Cooperation project, TCP/CHD/3003(A) "Strengthening national capacity in inspection, quality improvement of fish products of Lake Chad and river Chari".

A technological platform is, above all, a concept materialized in a laid out area and equipped with improved post-harvest technologies. It is an entry point, a framework where exchanges are made, a forum where technological and technical post-harvest as well as socio-economic obstacles to the development of fishing communities are addressed.

The multi-disciplinary approach applied is specific, different from the classic scheme of acquisition of technical equipment in which the population was not involved and their sociocultural environment often ignored in the design of solutions of the problems encountered in their activities.

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The design and implementation of a platform vary from one intervention site to another according to the type of post-harvest operations, technological problems, sociocultural aspects and economic challenges.

The beneficiaries, in great majority women organized in economic interest groups with the establishment of a management body or committee, developed a sense of ownership of the platform and demonstrated their capacity to assure the follow-up, as well as the management and maintenance of the facilities and equipment.

The anchorage of the technological platform approach will contribute significantly to the reduction of post-capture losses, to improve quality, to strengthen social cohesion and to protect the environment. Hence, this holistic approach by virtue of its pertinence should be disseminated in other fishing communities in Africa.

Keywords: Small-scale fisheries, Post-harvest fisheries technological platform, Quality

1. INTRODUCTION

L'approche plateforme technologique développée dans le cadre du projet TCP/CHD/3003(A) a été guidée par l'étude sur le profil de pauvreté menée en 2003 par la FAO, dans le cadre des activités du Programme pour des moyens d'existence durables dans la pêche (PMEDP).

L'étude a montré que 80-95% des communautés de pêche du lac Tchad et du fleuve Chari en majorité des femmes, sont frappés par la pauvreté. Des pertes importantes liées à l'insuffisance des connaissances et des moyens appropriés de conservation, de transformation, de transport et de commercialisation sont enregistrées depuis la capture jusqu'au stockage des produits finis.

Aussi une faiblesse voire un manque d'organisation des populations riveraines, la non prise en compte des préoccupations des femmes et leur faible participation dans les activités communautaires ont été notées du fait de barrières socioculturelles.

Les difficultés d'accès et d'approvisionnement en matières premières des groupes défavorisés, la discrimination des sexes et la domination des groupes plus nantis sur le plan socioéconomique constituent des obstacles qui freinent l'élan de solidarité et de développement tant souhaité dans ces communautés.

L'étude a permis également de mettre en évidence des zones potentielles d'intervention pour mener des actions visant à réduire la pauvreté et à améliorer les moyens d'existence des communautés de pêche riveraines du lac Tchad et du Chari.

Cette analyse de la pauvreté a servi à consulter un large éventail d'institutions travaillant avec ou pour ces communautés de pêche dans le but de comprendre les succès et les échecs des tentatives précédentes, les leçons tirées et les meilleures pratiques qui peuvent être adoptées ou améliorées afin de profiter à un grand nombre de personnes.

Les démonstrations ont été menées dans les communautés où le Projet pilote post-capture (PPPC) du PMEDP a préalablement développé les capacités organisationnelles et elles ont permis aux bénéficiaires de comparer les avantages des techniques améliorées par rapport aux techniques traditionnelles, facilitant ainsi l'appropriation des technologies améliorées.

Cette contribution met l'accent sur la conception, la réalisation, le fonctionnement et la spécificité de l'approche plateforme technologique expérimentée au Tchad. L'impact des améliorations technologiques dans le secteur post-capture et les mutations sociologiques notées sont aussi abordés. Les recommandations formulées portent sur les perspectives pour la filière et les actions à mener pour pérenniser les acquis.

2. CONCEPTION ET RÉALISATION DE LA PLATEFORME

La première étape a consisté à sensibiliser, informer et impliquer les autorités locales, administratives et les communautés ciblées.

La seconde étape a porté sur l'identification et la sélection des sites d'intervention devant abriter les plateformes dans les zones potentielles présélectionnées par le projet PMEPD sur la base des données de l'étude du profil de pauvreté.

Le choix des sites d'intervention repose sur les critères suivants:

- disponibilité des ressources (plans d'eau, ressources halieutiques);
- sédentarisation des acteurs;
- accès à l'espace (construction de plateforme de démonstration);
- existence de groupements structurés (reconnaissance juridique, patrimoine du groupement, dynamisme des acteurs);
- approche genre pour plus d'équité dans l'assistance et le renforcement des capacités.

La troisième étape a concerné la construction de la plateforme.

Les réalisations et les constructions sont matérialisées sur des plans de masse et les principes d'aménagement technique et sanitaire ont été respectés.

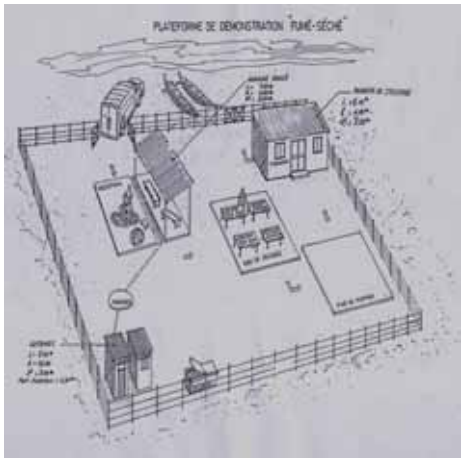

Figure 1. Agencement des opérations de manutention et traitement de poisson sur une plateforme spécifique

Figure 2. Halle de réception de la matière première (poisson frais) lors du débarquement

Pour construire la plateforme, le projet a assuré l'approvisionnement en matériaux de construction. Les bénéficiaires ont contribué en apport en sable, au stockage et à la surveillance des matériaux de construction et à l'hébergement des ouvriers étrangers. Leur participation avec l'instauration d'un système de suivi a permis en permanence d'effectuer les ajustements nécessaires.

Le four banda trouvé sur l'un des sites a été amélioré. Le prototype proposé est construit en briques réfractaires et des chaînages au niveau de la fondation et à la partie supérieure permettent d'augmenter sa durée de vie de 1 an à 10 ans. Les dimensions ont été révisées et la capacité est passée de 50 kg à 200 kg. Les accessoires (portillon, couvercle) inexistants du four traditionnel et la matérialisation des foyers pour le combustible ont permis de réguler les paramètres de fumage (température, densité et vitesse de la fumée, humidité).

Un prototype de claie de séchage démontable horizontale surélevé à 1,50 m du sol avec des supports métalliques a été proposé par rapport aux claies de séchage de fortune à même le sol. Chaque support peut recevoir 4 claies démontables facilement empilables de 1,20 m de longueur, 1,12 m de largeur et de 8 cm la hauteur de la latte. La capacité de la claie est en moyenne 20 kg.

Trois prototypes de conteneurs isothermes ont été confectionnés (Figures 3 et 4). Le conteneur de capacités 1500 kg est utilisé pour le stockage de la glace, celui de 1000 kg pour le glaçage et la conservation du poisson frais et celui de 200 kg pour la conservation du poisson à bord des pirogues ciblées. Ce dernier modèle est aussi utilisé pour l'achat et le transport de la glace.

Figure 3. Conteneurs isothermes de stockage de poisson frais

Figure 4. Intérieur d'un conteneur adéquatement isolé

Après les constructions, la plateforme est équipée en matériel de manutention, de préparation et de traitement, de conditionnement, de stockage du poisson, de tenues vestimentaires et des récipients pour la conservation de l'eau potable. Du matériel et des produits de nettoyage et de désinfection ont été mis à disposition pour l'entretien et l'hygiène des opérations et des équipements.

3. FONCTIONNEMENT DE LA PLATEFORME

Les bénéficiaires (Figure 6) en majorité de femmes et des facilitateurs de l'administration des pêches ont participé aux sessions de formations et de démonstrations en technologie post capture, en gestion et en comptabilité au niveau de la plateforme.

Figure 5. Four amélioré de fumage du poisson issue d'un prototype traditionnel

Figure 6. Des opérateurs post-capture à la fin d'une session de travail, autour du poste de parage du poisson

Afin de permettre une meilleure utilisation des infrastructures, des équipements et du matériel et viabiliser l'exploitation, la gestion des infrastructures et la pérennisation des acquis du projet, un comité de gestion a été mis en place au niveau de la plateforme.

Les membres sont désignés par les adhérents des groupements bénéficiaires. En assemblée générale avec l'appui des agents de l'administration des pêches, les conditions et les critères de gestion de ces infrastructures ont été définis (redevances provenant de l'utilisation des fours, des claies de séchage, des caisses isothermes, du magasin de stockage, de l'aire de prétraitement et du petit matériel, ainsi que de la vente de glace).

L'utilisation de la redevance a été allouée en priorité à:

- l'achat de matériel et de produits de nettoyage et d'entretien des équipements;
- la réparation et la maintenance des équipements;

- la construction ou l'achat éventuel de nouveaux équipements;
- la motivation des membres du comité de gestion.

Les fonds issus de la vente des produits frais et/ou transformés obtenus lors des expérimentations et des démonstrations durant les activités du projet ont permis d'alimenter au départ la caisse du comité de gestion de la plateforme.

Des cotisations sont aussi prévues pour renforcer les moyens financiers de l'organe de gestion. Le montant est arrêté en assemblée générale, notamment en cas de besoin d'un fonds d'investissement lorsque le montant épargné est insuffisant ou encore en cas d'urgence, pour assurer la continuité du fonctionnement des installations et équipements de la plateforme.

4. SPÉCIFICITÉ DE L'APPROCHE PLATEFORME TECHNOLOGIQUE

Le choix des groupements structurés opérationnels et bien organisés par le projet pilote PPPC du PMEDP et la participation effective des communautés ciblées ont été déterminants pour la réussite de l'approche.

La méthodologie de proximité du projet avec la traduction en actes concrets des préoccupations des communautés cibles en construisant la plateforme ont permis d'initier une dynamique de développement local autour des activités post-capture.

La plateforme a été une initiative innovatrice pour ces communautés de pêche et a servi de lieu de ralliement des populations, de cadre d'échanges et d'entraide, de forum pour discuter et traiter toutes les questions sans discrimination et de manière holistique. Elle a par conséquent favorisé le renforcement de la cohésion sociale.

L'approche pluridisciplinaire appliquée est particulière, en ce sens qu'elle va au delà des schémas classiques d'assistance technique qui mettent davantage d'accent sur l'acquisition d'équipements techniques.

Le succès enregistré est surtout dû à la participation des bénéficiaires, les efforts d'information et de sensibilisation des agents de vulgarisation du Ministère en charge de la pêche et à l'implication des ONG de développement.

5. CONSTATS

Ponts forts

L'approche mise en œuvre semble avoir répondu aux attentes des communautés de pêche. La plateforme a servi de courroie de transmission des connaissances technologiques et sociologiques et a ainsi facilité l'encadrement et le renforcement des capacités des opérateurs; de nouvelles capacités techniques, managériales et de gestion ont été acquises.

La participation et l'intégration des bénéficiaires, en majorité des femmes, ont été réellement positives et ont permis des changements quantifiables avec cette approche.

L'utilisation des conteneurs isothermes a permis de mettre à la disposition des pêcheurs et des populations une tonne de glace en barre pendant 10 jours et les durées sur l'eau sont passées de quelques heures à 3 jours augmentant du coût la quantité et la qualité des captures. Le poisson frais sous glace est conservé dans le conteneur isotherme pendant une semaine contre un jour dans les caisses traditionnelles en bois. Les pertes sont réduites et le gain peut s'élever à plus de 50%. La caisse de transport a facilité la commercialisation du poisson frais vers les marchés urbains.

Les essais effectués avec le prototype de four type parpaing ont donné des produits avec un lustre très apprécié (Figure 7), une texture ferme, une odeur caractéristique très bonne, un fumage homogène et une cuisson très bonne.

Figure 7. Poissons en cours de fumage dans un four amélioré

Le bénéfice tiré de la vente de ces produits est 2 fois plus important. La durée de fumage est réduite, elle est passée de 24 à 8 heures. La consommation en bois de combustible est passée de 3 à 1 fagot (un fagot pèse100 kg) pour 300 kg de poisson frais.

Le rendement en moyenne de 40% est plus important que les produits traditionnels souvent calcinés (25%). Sur le plan de la gestion de l'environnement, comparé à la méthode traditionnelle, l'usage du four Parpaing réduit très sensiblement la pollution par la fumée et expose moins les transformateurs à la chaleur et l'inhalation de la fumée.

Le séchage sur claies améliorées (Figures 8 et 9) ayant facilité le drainage des eaux d'exsudation, la durée de séchage se trouve réduite de 48 heures à 10 heures pour les gros poissons et 24 heures à 6 heures pour les petits poissons à une température ambiante de 42 °C. Les conditions d'hygiène et de stockage sont nettement améliorées.

Figure 8. Prototypes de claies de séchage améliorées

Figure 9. Prototypes de claies de séchage améliorées inclinées

Le poisson est à l'abri des contaminants et des prédateurs. Il peut être protégé de l'humidité nocturne et de la pluie en le couvrant avec un matériel imperméable (par exemple une bâche). La qualité du poisson séché est nettement améliorée, la couleur ambrée, sans aucune brûlure par le soleil, la bonne odeur de début de fermentation et la souplesse de la texture font que le produit est très apprécié, plus facile à empiler et se conserve mieux.

Le rendement après séchage est de 20 à 25%. Le bénéfice tiré du séchage amélioré est 2 à 2,5 fois plus important que celui du séchage traditionnel du poisson.

Le partenariat entre les bénéficiaires et ONGs a été d'un apport salutaire pour la pérennisation des actions déjà initiées.

Les médias publics et privés en synergie avec l'équipe IEC (Information, Education et Communication) ont joué un rôle important dans l'information et la sensibilisation des populations sur la spécificité de l'approche et les réalisations concrètes.

Faiblesses

Malgré les impacts positifs notés, il existe néanmoins des aspects qui pourraient limiter considérablement l'engouement que devrait susciter cette approche, parmi lesquels:

- les opérateurs les plus nantis, particulièrement les hommes au sein des communautés qui, en monopolisant la location des infrastructures des plateformes deviennent les utilisateurs exclusifs, au détriment des bénéficiaires réels, surtout les femmes. Ceci pourrait décourager voire pousser à l'abandon les opérateurs les plus pauvres.
- le manque d'équipements adéquats de transport du poisson (notamment camion isotherme, réfrigéré) constitue un handicap pour une continuité de la chaîne de froid;
- Le manque d'équipements de froid sur les marchés destinataires affecte les efforts de préservation du poisson consentis au niveau des plateformes technologiques depuis la capture.

6. CONCLUSIONS ET RECOMMANDATIONS

L'approche plateforme technologique développée au Tchad est salutaire pour les communautés de pêche ciblées. Dans un environnement où les problèmes au développement de la post-capture sont de nature complexe, elle constitue un cadre efficace, sinon un point d'entrée idéal pour aborder de manière holistique les obstacles identifiés dans les communautés de pêche. Elle a contribué au renforcement des capacités des opérateurs organisés, à accroître la compétitivité des produits halieutiques sur les marchés et à poser les conditions de base pour l'amélioration des revenus des producteurs, des transformateurs et des distributeurs.

Les bénéficiaires ont démontré leurs capacités à assurer la poursuite des nouvelles innovations simples introduites ainsi que la gestion et la maintenance des installations et des équipements réalisés.

Dans la perspective d'une meilleure vulgarisation de cette approche dans nos pays, il est recommandé de:

- partager les expériences acquises par les communautés ciblées par le biais de la diffusion d'une documentation appropriée dans les pays ayant des problèmes similaires;
- assurer l'ancrage institutionnel de l'approche plateforme de manière à assurer un impact économique et social visible, s'inscrivant ainsi dans le cadre de la lutte contre l'insécurité alimentaire et la pauvreté;
- fournir un environnement favorable pour les bénéficiaires afin d'éviter le monopole des individus dominants au sein des communautés;
- mettre en réseau tous les groupements concernés à travers un dispositif et des outils de communication/information adaptés;
- assurer la mise en relation des groupements concernés avec une structure d'épargne et de crédit adaptés aux besoins de la filière; et
- améliorer les conditions des marchés au poisson avec l'implication des autorités locales et centrales pour que les efforts fournis au niveau des plateformes soient optimisés.

SITUATION ANALYSIS OF LONG-DISTANCE FRESH FISH DISTRIBUTION ALONG THE COAST OF TANZANIA

[ANALYSE DE LA SITUATION DE LA DISTRIBUTION À LONGUE DISTANCE DU POISSON FRAIS LE LONG DE LA CÔTE TANZANIENNE]

by/par

Yahya I. Mgawe[1]

Abstract

The distribution of fresh fish from rural fishing areas to urban centres in Tanzania has increased over the past ten years. This tide has been driven by urbanization, increased preference for fresh fish among local consumers and high price tags on fresh fish compared to traditional cured products. Currently, fishers in remote places are struggling to sell their products in major urban markets, even to those located in distant places.

Long-distance fresh fish distribution, however, faces a host of technical problems. A large proportion of fish, about 5% to 10%, gets to the market already spoiled or in poor quality condition. Consequently, fishers get low prices for their produce and fail to secure greater benefits from the trade.

The situation analysis study conducted along two of the major fish supply chains (Mafia Island to Dar es Salaam and Kilwa to Dar es Salaam) has identified major problems affecting fresh fish trade. It includes delay in handling and distribution of fish, poor supply, use of ice and failure to apply Good Hygienic Practices (GHP). Likewise, the use of poorly designed local fish containers increases the cost of using ice as a result of high melting rate in the tropics and reduces the shelf life of fish.

The study has found that, on average, long-distance fish traders incur about 8% or 250 kg of fish per canoe/trip as physical loss during the South Monsoon (kusi). High losses occur during the North Monsoon period (kaskazi) when about 16% of the fish is found to be of poor quality. This paper outlines technical problems found at each stage along the fresh fish supply chain, with recommendations that could contribute to reducing post-harvest quality loss and waste and, more importantly, the findings could help in setting minimum standards for safety and quality assurance in fresh fish distribution.

Keywords: Fish trade, losses, fresh fish

Résumé

La distribution de poisson frais des zones de pêche rurales aux centres urbains en Tanzanie a augmenté au cours des dix dernières années. Ce courant a été provoqué par l'urbanisation, la préférence des consommateurs locaux pour le poisson frais et le prix élevé du poisson frais par rapport aux produits traditionnels transformés. Actuellement les pêcheurs dans les endroits isolés s'efforcent de vendre leurs produits dans les marchés urbains importants, même ceux situés dans les endroits éloignés.

Cependant, la distribution à distance de poisson frais fait face à de nombreux problèmes techniques. Une grande proportion de poisson, environ 5 à 10%, arrive dans le marché déjà altérée ou en mauvais état. Par conséquent, les pêcheurs obtiennent des prix bas pour leurs produits et ne tirent pas de grands profits du commerce.

L'étude sur l'analyse de la situation menée le long de deux chaînes principales d'approvisionnements de poisson (Île de Mafia à Dar es Salaam et Kilwa à Dar es Salaam) a identifié des problèmes majeurs qui affectent le commerce du poisson frais, notamment: le retard dans la manutention et la distribution du poisson, le mauvais approvisionnement, l'emploi de la glace et l'échec d'application des bonnes pratiques d'hygiène (BPH). Également, les conteneurs locaux de poissons mal conçus qui sont utilisés augmentent le coût de l'utilisation de la glace du fait du taux de fonte élevé sous les tropiques et réduisent la durée de la conservation du poisson.

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L'étude a montré que, en moyenne, les commerçants de poisson enregistrent environ 8% ou 250 kg de perte physique de poisson par pirogue/voyage pendant la mousson du sud (kusi). Les pertes élevées se produisent au cours de la période de mousson du nord (kaskazi) quand environ 16% des poissons s'avèrent de qualité inférieure. Ce document décrit les problèmes techniques remontrés à chaque étape le long de la chaîne d'approvisionnement de poisson frais, ainsi que les recommandations qui pourraient contribuer à réduire les pertes post-capture de qualité et le gaspillage et, de façon plus importante, les résultats pourraient aider à établir des normes pour l'assurance de la sécurité sanitaire et la qualité dans la distribution du poisson frais.

Mots clés: Le commerce du poisson, Pertes, Poisson frais

1. INTRODUCTION

The inshore marine fishery in Tanzania is dominated by small-scale fishery carried out by over 36,000 fishermen using about 7,300 fishing canoes and an assortment of fishing gear and techniques (URT, 2008). The industrial fishery is limited to shallow-water shrimp fishing, engaging about 20 trawlers licensed on an annual basis. Currently, there is a moratorium imposed on inshore shrimp trawling, which has left the area under the exclusive use of small-scale fishers.

Regarding catches, it is estimated that between 60,000–90,000 tonnes of fish are being harvested annually (URT 2007, Jacquet *et al*., 2008). The catches are consistently dominated in weight and numbers by the small-bodied Leiognathidae, Mullidae, Gerreidae, Nemipteridae and Carangidae in that order. Large fish makes up a relatively small proportion of the total catch.

Fish traders are found in all of the 230 landing sites spreading along the 1,400 km shoreline. Most of them purchase fish from fishermen to sell it within their vicinities or process it before selling to hinterland markets. There are others who take the fish to distant markets where prices are relatively higher. Different means of transport, to include bicycles, transport canoe and trucks, are used in fish distribution, depending on the type of fish and market destination.

Traditional fish processing methods such as smoking, sun drying and salting are still popular in fishing villages and among Tanzanian consumers. The curing methods are predominantly in remote areas located far from urban centres. Generally small-sized sardines (*<10 g*) locally known as *dagaa* are mostly sun dried whereas most of the table-sized bony fish are hot-smoked or fried. Cartilaginous fish, such as sharks and rays, are traditionally dry-salted to meet consumer preference and to attain longer shelf life.

The local fish processors are well experienced in dealing with their business though they still use inefficient technology and quite often encounter unfavourable weather conditions, especially during the rainy season. Over the past few years, however, consumer preference has shifted from cured to fresh fish. The economics of selling fish in its fresh condition become apparent even when production costs and outputs with traditional processing are taken into consideration.

The change in consumer preference has compelled fish traders to venture into the fresh fish trade. They purchase fish from fishing villages to sell in urban centres especially Dar es Salaam, where the price is relatively higher compared to other fish markets. The initiative is faced with formidable challenges in terms of safety, quality issues and losses.

In view of this situation, it was important to conduct a situation analysis study in order to identify and analyse technical problems occurring throughout the upstream fresh fish supply chain; fishing, handling and transportation stages. Hence, the decision to conduct the study along two major supply chains; the Kilwa – Dar es Salaam chain and the Mafia – Dar es Salaam fresh fish supply chain (Figure 1).

Fishing practice and distribution pattern in the two districts are more or less similar. Generally, there are two modes of collection and transportation of fish from the two places to the Dar es Salaam market. The first option is to fish or purchase fish right at sea, store it with ice in locally-made onboard containers known as *friji*. The same canoe is often used in transporting the fish to Dar es Salaam market by sea.

An alternative method involves landing of fish at a nearby landing site, where fish traders will purchase and store it in locally-insulated boxes known as *koki*. Traders under this category transport their produce by using trucks as in the case of Kilwa or a combination of canoe and truck as in the case of Mafia Island, where one has to board a canoe to the closest mainland small port before taking up a truck to Dar es Salaam.

2. OBJECTIVE

The main objective of the situation analysis study was to identify technical problems that affect fresh fish distribution along the upstream supply chain and interventions that are being made, and to recommend areas for quality and safety improvement, as well as loss reduction intervention.

3. METHODS

The study used different methods to include review of literature, historical data analysis, Semi-Structured Interview, physical observation and inspection by using general check-lists for the upstream control chain. The checklists were filled in at each stage along the chain by a panel of four students from Mbegani Fisheries Development Centre.

The sample group was divided into traders using the sea and those using a combination of sea and road transport. Fish price differential between good and bad quality fish at the Dar es Salaam fish market was used as a yardstick in determining quality loss.

Study areas

Mafia Island is located adjacent to *Rufiji* river mouth (Figure 1), where silts flowing from up-country enrich the food chain and support a good fish stock in the area. This has made Mafia fishery one of the most important inshore marine fisheries in Tanzania in terms of both the Catch Per Unit Effort (CPUE) and size of individual fish landed. It is being estimated that there is more than 5,700 fishermen in Mafia (URT 2008) producing about 300–400 tonnes per month. The fish caught in Mafia is sold within the district and to distant markets especially Dar es Salaam.

On the other hand, the historical district of Kilwa has about 2,300 fishermen (URT 2008). Most of fish in Kilwa is caught by seine nets and gill nets. The fish landing is estimated to range between 100 to 200 tonnes per month (URT 2008). Medium and large-sized fish is sold to fish collectors for the Dar es Salaam market whereas small-sized is barbecued for distribution to land-locked districts.

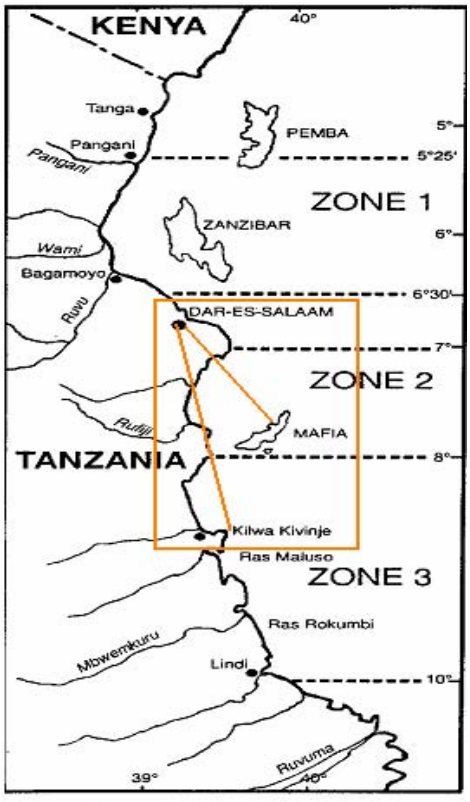

Fig. 1: The study site

Figure 1. The study site

Regarding Dar es Salaam, this is the commercial capital of Tanzania with an estimated population of about four million. The city is the largest consumer market with a very strong preference for fresh fish and it is the most active fresh fish outlet in the country, where over 20,000 tonnes per year are landed by fishing fleets and fish collection boats from nearby and distant coastal districts, such as Mafia and Kilwa located 180 km and 320 km from Dar es Salaam, respectively.

4. RESULT AND DISCUSSION

The distribution channel

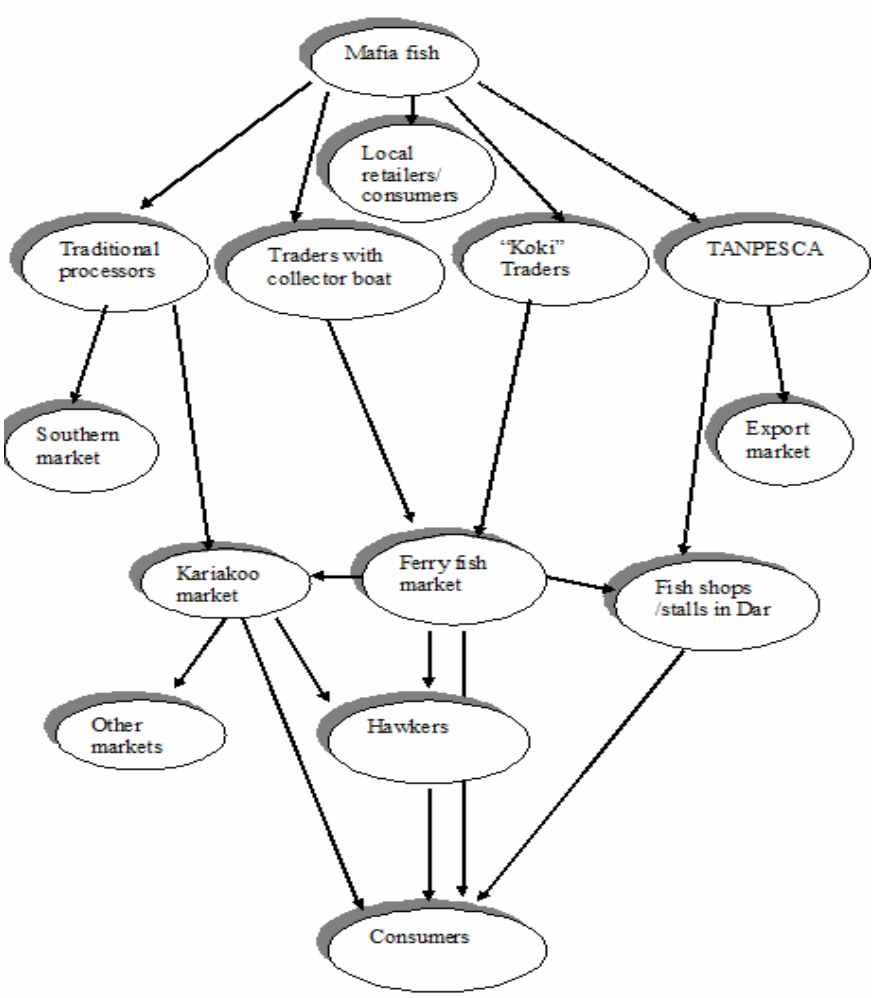

Fig.2 Distribution channel of fish from Mafia fishery

Figure 2. Distribution channel of fish from Mafia fishery

The distribution channel of fish in Mafia (Figure 2) and Kilwa district follows a common pattern whereby low-value fish, especially the anchovy and sardine are processed for the remote markets in landlocked districts, while high-value fish is stored in ice before being transported to urban markets, mainly Dar es Salaam.

Fishing

Fishers in the two districts use a variety of fishing gear which includes purse seines, gill nets, shark nets, scoop nets, traps and lines. The catch is generally composed of various species dominated by: snapper *Lutjanus* spp., (changu), spinefoot *Siganus* spp. (tasi), trevally *Carangoides* spp. (kolekole) and mackerel *Rastrelliger kanagurta* (kibua). Sardines, anchovies, sharks, rays, lobsters and octopus are also being caught.

Regarding post-harvest fish loss during the fishing stage, the results suggest that an average of 5% physical loss occurs when using passive gear, such as gill nets, due to the prolonged setting time of up to ten hours. However, the losses are less than 2% when using active gear, such as surrounding nets, because the setting and hauling operation takes less than one hour. There is almost no loss at this stage for those using traps, locally known as *malema*, because the fish remains alive up to the time of hauling.

Table 1 shows that the use of dirty fishing gear, failure to separate fish from potential onboard contaminants and low-level personal hygiene are the major safety and quality problems that could be the source of microbial contamination and Post-Harvest Fish Loss (PHFL) at the fishing stage.

Table 1. Sanitary conditions related to the fishing operations

Elements to verify	Yes	None	Comments
Fishing gear easy to clean Well maintained		V	Fishing gear are seldom cleaned
Are fish isolated from products/objects that might contaminate or damage them?		V	The boats are small to have effective separation
Are the fish protected from the sun?	V		60% kept in containers
Has the fish been iced at sea	V		No problem for fish iced at sea
Are the fish stored in an insulated hold?	V		Locally insulated containers
Are the fish iced?	V		Though not adequately
Crew health and hygiene monitored Medical checks practiced Adequate personal hygiene		V	Low level of personal hygiene

Holding onboard

Handling and storage of fish onboard fishing canoes is done by crew members. Those with insulated containers apply ice at sea, which enables them to continue fishing for a number of days, maximizing fishing efficiency. The time taken to collect fish depends on whether it is a lean or peak season. It takes more days, up to 10, to fill in the 3–tonne container (Figure 3) during the lean season whereas it could take 6–8 days during the peak season between November and March. In addition, traders need 1–2 days to get to the market by using 40 HP motorized canoes. The handling practice on board the canoe has a number of weaknesses as outlined below (Table 2).

Table 2. Sanitary conditions related to the construction of containers and hygienic handling of fish

Elements to verify	Yes	None	Comments
Fish gutted, washed and cooled immediately		V	No gutting is done
Protection of products (from sun and contaminants) Fish boxes adapted (insulated, easy to clean) clean, in good condition with drainage.		V	Only a few meet the minimum requirement
Rapid and hygienic fish landing (not more than 8hrs) Allowing drainage of melted water		V	No drainage system
Hygiene maintenance Boat cleaning after landing Fish boxed, cleaned after each use Fish boxes used for landing clean		V	Very partial cleaning
Oil and fuel kept separate		V	Poorly separated
Crew health and hygiene monitored Medical checks practiced Adequate personal hygiene		V	Low level of personal hygiene
Quantity of ice utilized is sufficient for the journey		V	Less than 1:1 ratio
Ice made of potable water?		V	Questionable
Ice handled hygienically		V	Not much
Ice stored in a container that protects it from external contamination?	V		Most of the time closed
Container in which fish are stored clean and lined with material that is durable, waterproof and easy to clean?		V	Hardly the case
Fish handled carefully to avoid damage?	V		Reasonable care is taken
Fish handlers clean and wearing clean clothing?		V	Poor personal hygiene
All surfaces and equipment that fish come into contact with are cleaned with potable water or clean seawater?		V	Cleaning is done using unclean sea water
Equipment used to land fish made of material that is easy to clean and in a good state of repair and cleanliness?		V	

Storage ashore

Fishermen fishing without insulated on-board containers land their daily catch in designated landing sites, where Dar es Salaam fish traders have established makeshift camps. These traders will purchase fish and store it in fish boxes locally known as "*koki*". A koki is a locally insulated fish box with a capacity for carrying about

200–300 kg (Figure 4) of fish. They are made in such a way that insulation is only applied to the main body or the base. Otherwise, the boxes are covered by polyethylene sheeting on top to allow for flexibility in over-filling the koki for the sake of reducing transport costs charged per koki.

Figure 3. On board container "friji"

Figure 4. Fish box for storage at shore "koki"

Although it was not quantified, there is every reason to believe that failure to use insulated covers is costing the traders a lot in terms of the increased cost of ice led by a high ice melting rate and rapid fish spoilage.

In addition, failure to observe basic principles of Good Hygienic Practice (GHP), delays in sales negotiation and poor design of most of the fish boxes allow for massive microbiological contamination. It all results in accelerated spoilage and increased quality loss. In view of this situation, one would not be wrong to suggest that effective training of fishers in fish handling, including proper application of ice, seems to be an ideal intervention to reduce the loss and increase the income of stakeholders. Likewise, it is important to promote the use of properly designed and constructed containers for both on board and onshore storage, such as the ones being used in areas where traders have been successful (Figures 5 and 6).

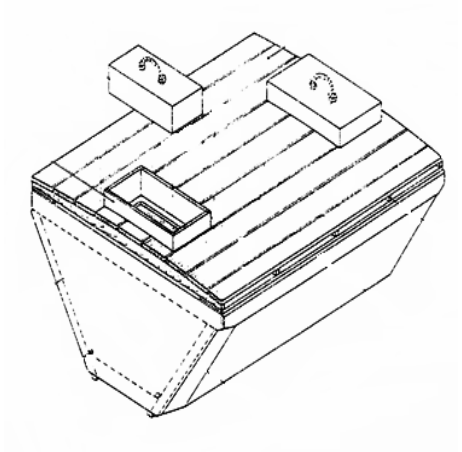

Figure 5. Sketch of Senegalese onboard insulated container

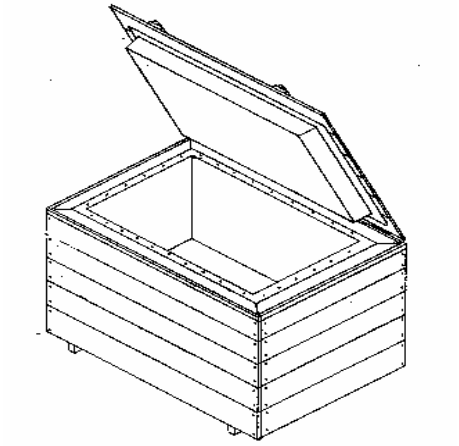

Figure 6. Sketch for an ideal design for storage and transportation

Transportation

There are two strategies that are used in the transportation of fish from Kilwa and Mafia to Dar es Salaam market. One option is to purchase the fish right at sea, and store it with ice in locally-made insulated containers placed on board a collection boat. After collecting about 3 tonnes of fish, an exercise which can take up to 10 days, the fish is taken to Dar es Salaam by using transport canoes. The other option is to land the fish on shore, where traders will purchase and store it in *koki*. After 3–4 days the fish is taken to Dar es Salaam Integrated Fish Market Complex (DIFMC), first by a transport canoe to small ports on the mainland especially Nyamisati or Kisiju. A fish trader may spend a day at the transit point before boarding a truck to the final destination in Dar es Salaam.

Keeping the fish for prolonged time causes quality degradation, which lowers the price at the market. Again, sea transport takes longer compared to road transport. The delay causes quality loss, especially when weather conditions are not favourable.

The use of old trucks in transporting fish has its own problems including poor sanitary conditions and frequent mechanical breakdowns. As a matter of fact, there is a very clear contrast between the quality of trucks used in transporting fish for export in Lake Victoria area and those used along the coast for the domestic market (Figures 7 and 8). Nevertheless the use of trucks is considered to be a quicker option compared to the sea option given the improved condition of roads.

Figure 7. A typical fish truck on Lake Victoria Export fishery

Figure 8. A typical fish truck carrying koki along the coast

The general situation regarding the transportation aspect (Table 3) suggests that there is an urgent need for improvement to bring up the practice to a minimum standard required for ensuring safety and quality of fresh fish supplied for the domestic market.

Table 3. Road transport sanitary conditions related to the construction and hygienic operation

Elements to verify	Yes	None	Comments
Fish container, box or lorry closed: Easy to clean Hygienic and adapted to the purpose Clean and well maintained, with drainage Space for the ice sufficient		V	Trucks being used are open, not meant for transporting fish
For refrigerated trucks Temperature under regime below -18 °C Recorded and readable temperature (from outside)		V	Not applicable
Loading / unloading Quick and hygienic Fish contained in cases of proper material		V	The operation is slow
Hygiene control Cleaning of lorry after and before use Vehicle periodically subject to general cleaning		V	General cleaning, not thorough as required by sanitary standards in handling fish
Oil and fuel kept separate	V		Certain degree of separation
Health and hygiene of crew monitored Medical checks up to date General hygiene adequate		V	No such initiative
Temperature under control Lorry temperature Product temperature		V	Not much of the control

The situation at DIFMC

Unloading of fish at DIFMC is done by experienced labourers who are paid in relation to the amount of fish handled per man. However, their level of personal hygiene is low, which could be a source of contamination.

Likewise, they use highly contaminated beach water for washing fish, which increases microbial contamination and spoilage. The same applies to the habit of throwing fish on dirty ground and the slow auctioning process.

Experienced buyers at the DIFMC determine the quality of fish by using organoleptic or sensory assessment. They look at the skin of fish (whether it is shiny) to indicate freshness or not. The sunken eyes will surely suggest that the fish has deteriorated. Sometimes they open the operculum to check whether the fish has heavy mucus on its gills, a sign of bad quality fish. The off-odour as opposed to seaweed smell will tell with certainty that the fish has spoiled.

These factors determine the price of fish that buyers would pay *ceterus paribus* (assuming other things are equal). Physical observation and weight measurement taken at DIFMC suggest that, using the same yardstick, the long-distance traders incur about 8% or 250 kg of fish as physical loss per canoe/trip during the South Monsoon (kusi). Higher losses occur during the North Monsoon period (kaskazi), when about 16% of the fish is discarded. On the other hand, losses are relatively lower, 3–4%, for those using koki.

Getting to DIFMC at odd hours, say in the evening, is another problem causing losses to traders since the market itself is lacking in many facets (Table 4).

Table 4. Landing site sanitary conditions related to the construction and hygienic operation

Elements to verify	**Yes**	**None**	**Comments**
Contamination of fish must be avoided		V	Lack of awareness prevails
Operations should proceed rapidly		V	Very slow process
Fish should be placed in a protected, temperature controlled environment as soon as possible		V	Process takes place slowly in the open
Equipment and handling practices that damage the fish should not be used	V		Mostly use edgeless baskets
Fish should not be placed on the ground or auction room floor		V	Fish is placed on the ground and on floor during auctioning
Auction hall should be covered and have walls that are easy to clean	V		Walls have tiles but cleaning is inadequate
Floor should be raised above ground level, waterproof, easy to clean and facilitate drainage of water	V		The auctioning floor is raised
Landing site should have a hygienic waste-water system		V	Not adequate
Sanitary facilities with adequate flushing toilets and wash basins should be provided		V	Not adequate
Premises should not be used for other purposes		V	Several other activities are carried out potential for cross contamination
Undesirable animals must not be admitted		V	No such protection
Premises should be regularly cleaned, at least after each sale, with potable water or clean seawater	V		Premises not cleaned thoroughly
Signs prohibiting smoking, spitting, eating and drinking must be displayed in areas where fish is handled		V	No such signs are available
Premises should have adequate water supplies		V	No adequate water supply
Water-tight containers made of corrosion resistant materials should be available for storage of fish that is unfit for human consumption		V	Not available
After landing or first sale, fish should be transported without delay to their destination		V	They use public transport system, which is not efficient
Where it is not possible to promptly transport fish they should be stored in chill rooms that approach the temperature of melting ice		V	Very limited cooling facilities and storage
Ice available produced on the spot Storage condition/containers		V	Ice supply at DIFMC is inadequate

Based on the results presented in Table 4, there are reasons to believe that failure to adhere to GHP at the market increases blowfly infestation, microbial contamination and generates high loss of quality and physical fish. These weaknesses have to be addressed in order to secure greater benefits from the fresh fish trade.

5. CONCLUSIONS AND RECOMMENDATIONS

The long-distance fresh fish trade has a potential for increasing benefits to operators. However, there is an urgent need for technical intervention especially in terms of Good Hygienic Practice and introduction of properly designed local insulated containers. Again, there is a need to put in place minimum safety and quality standards to improve the practice throughout the upstream supply chain.

Regarding the two types of containers used in the transportation of fish, *friji* and *koki,* it seems the later offers an ideal solution compared to the former. Its small size makes it possible to reduce the number of collection days compared to the friji. Again, road transportation is relatively cheap and quicker. It is cheaper to buy a koki and more important easier to assign a few fishers to send the combined cargo to the market, reducing the opportunity costs. Also, with Koki traders could expand their business and secure greater benefits by capturing the fish-stalls market, which is expanding very fast in major towns.

Fish supply at DIFMC is greater than demand during the dark-moon period of the month. At this time the market-force losses become more pronounced. One option could be to expand the distribution of fish to the growing regional market. However, such intervention requires increased government effort in harmonizing the trade.

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TRADING THE SHRIMP TRAWLING BYCATCH IN THE CENTRAL GULF OF GUINEA: A DILEMMA FOR ITS NEGATIVE/POSITIVE IMPACT

[VENDRE LES CAPTURES ACCESSOIRES DES CHALUTIERS CREVETTIERS DANS LE GOLFE DE GUINÉE CENTRE: UN DILEMME POUR SON IMPACT NÉGATIF/POSITIF]

by/par

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Abstract

The study characterizes the trade of bycatch in shrimp fisheries in Cameroon and Nigeria in the context of the FAO-REBYC project. Following the introduction of the Bycatch Reduction Device (BRD) and the Turtle Excluder Device (TED) in Cameroon, sea trips undertaken on board commercial vessels to test and demonstrate the different devices show a ratio of shrimp to bycatch of 1:24. Samples of the discarded component of the catch present five components: marine debris (21%), hairtails (16%), crabs (13%), shad (8%) and juveniles of many species (42%). In Cameroon and Nigeria nearly all the bycatch species are retained, transferred to shore and sold. In a recent study carried out in Dockyard Limbe, one of the big bycatch landing site in Cameroon, 231 persons are involved to this transfer using 2 categories of boat collectors, big and small ones. A group of 70 wholesalers, mainly women, also operate in a situation of monopoly. An average monthly landing of 2,056 bags per big boat and 681 bags per small boat are given, for a total annual bycatch landings of around 9,350 tonnes, from all the 35 active boats, sold fresh or smoked and distributed to the main markets. Considering the production of two other big Jabru landing sites in Douala and Kribi and that of many other small ones along the coast, one can estimate the total bycatch produced in Cameroon to be around 20,000 tonnes. The study analyses the food security dilemma and prescribes the general use of BRDs but each country in its own way. The official legalization and regulation of bycatch trade, as well as the organization of the business, are highly recommended.

Key words: Trading, Cameroon and Nigeria, Bycatch, REBYC project, Shrimp trawling, Food security

Résumé

L'étude caractérise le commerce des captures accessoires de la pêche crevettière au Cameroun et au Nigeria, dans le contexte du projet FAO-REBYC. Les sorties en mer à bord des bateaux de pêche pour tester et faire une démonstration du Dispositif de réduction des prises accessoires (BRD) et du Dispositif d'exclusion des tortues (TED) après l'introduction de ces différents dispositifs au Cameroun, montrent une proportion crevettes-captures accessoires de 1:24. Les échantillons prélevés des rejets des captures présentent quatre composantes: les débris marins (21%), les hairtails (16%), les crabes (13%), les requins (8%) et les juvéniles de plusieurs espèces de poissons (42%). Au Cameroun et au Nigeria, presque toutes les captures accessoires sont retenues à bord, débarquées puis vendues. Dans une étude menée récemment à Dockyard Limbe, un des grands centres de débarquement des captures accessoires au Cameroun, il ressort que 231 personnes sont impliquées dans ces transferts avec l'aide de deux types de bateaux collecteurs, grands et petits. Un groupe de 70 grossistes dominés par les femmes, opèrent également dans ce secteur en situation de monopole. Les grands bateaux débarquent en moyenne par mois 2.056 sacs de poissons par bateau et les petits 681 sacs par bateau, ce qui donne pour les 35 bateaux en activité, un débarquement total annuel de près de 9.350 tonnes de captures accessoires, vendues à l'état frais ou fumé dans les principaux marchés. En prenant en compte la production de deux autres centres importants de débarquement de Jabru à Douala et Kribi et celle de plusieurs autres petits centres le long de la côte, l'on estime à environ 20.000 tonnes la production totale des captures accessoires au Cameroun. L'étude analyse le dilemme de la sécurité alimentaire et prescrit une utilisation générale des BRDs, mais chaque pays dans son contexte. La légalisation officielle et la réglementation du commerce des captures accessoires, tout comme l'organisation de ce secteur d'activité, sont fortement recommandées.

Mots clés: Commercialisation, Cameroun et Nigeria, Captures accessoires, Projet REBYC, Pêche crevettière, Sécurité alimentaire

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1. INTRODUCTION

Many authors (Clucas and Teutscher, 1998, Eayrs, 2005) define bycatch as the unwanted or non-target part of the catch taken by fishermen. This component of the catch is either discarded at sea or landed to be used for human or animal consumption. The capture of excessive amounts of bycatch may pose a threat to species diversity and ecosystem health because this part of the catch is usually unregulated. In Tropical shrimp trawl fisheries bycatch often consists of juvenile food-fish species and may threaten food security and sustainable fisheries production if excessive amounts are removed. Bycatch is a global problem that must be addressed. FAO has recently estimated that nearly seven million tonnes of fish bycatch are discarded globally by commercial fishermen every year. To address this problem, FAO is executing since 2002 a GEF funded global project entitled "*Reduction of Environmental Impact from Tropical Shrimp Trawling, through the introduction of Bycatch Reduction Technologies and Change of Management (EP/GLO/201/GEF)* named as the REBYC project.

The main objective of the project is to reduce unwanted bycatch and discards in tropical shrimp trawl fisheries by introducing appropriate fishing technologies, mainly BRD (bycatch reduction device). Discards here means all what the fisherman returns to the sea, mainly constituted of marine debris, juveniles food fish and other bycatch not transferred to shore. The project objectives also include the reduction of unwanted bycatch by shrimp trawlers, in particular the capture of juveniles of commercially valuable and ecologically important species, and a better understanding of the impact of shrimp trawling on different marine habitats. Twelve countries from Latin America, the Caribbean, Southeast Asia, the Gulf region, West Africa and the NGO SEAFDEC (Southeast Asian Fisheries Development Centre) are participating in the project. Cameroon and Nigeria are the two project participants from Africa.

Situated in the Central Gulf of Guinea, Cameroon and Nigeria operate together about 300 vessels, mostly shrimp trawlers fishing in the same area. The trawling activities in the area occur very close to river mouths and shallow waters which are breeding and nursery grounds of many fish species; this inevitably results in large quantities of juveniles caught. Some species are already disappearing from trawler landings while juvenile fishes (less than 10 cm in total length) now constitute over 80% (in weight) of overall trawler landings in both countries. However, much of the bycatch is not discarded but collected by artisanal canoes and sold to local processors (smokers) on shore, for human consumption and this constitutes a source of income giving employment opportunities in the coastal area.

With regard to the objective of the project and considering the present situation faced by Nigeria and Cameroon, the project work plan included to conduct a socio-economic survey of bycatch trades in order to better address the problem of bycatch utilization.

From the case study carried out in Dockyard landing site in Cameroon, this paper characterizes the trade of the shrimp bycatch and discards in the context of the REBYC project, and analyses the project food security dilemma as faced by some of the participant countries.

2. DATA AND METHODS

The study uses data from 2 sources:

Information from sea trips undertaken on board commercial vessels for experimental trials of BRDs during 2005–2006

These experimental and demonstration trials were made onboard stern trawlers that are shrimpers rigged with four nets, a quad rig, fishing simultaneously. This permitted comparative testing for the TED (Turtle excluder device) and BRDs (bycatch reduction device) at the same time. The four traditional trawls were modified from left to right as TED only outside, T 90 codend inside for the port side, and for the starboard side, square mesh window inside and traditional codend outside. A total of 21 hauls each of two hours trawling were made during 7 trips and catches composition from different codends sorted into three major categories (shrimps, fish of commercial value and trash fish) and compared.

During each trip a sample of 50 kg of discards was retained onboard and taken to the SRHOL-IRAD laboratory for analysis: composition, identification of different species and length frequency distribution.

A socio-economic study undertaken on bycatch utilization and trade during 2005

Data necessary for this study were collected from questionnaires during interviews of collectors, processors and sellers. The main trash fish landing site in Limbe is Dockyard, with around 35 Boat collectors including 11 big canoes (category big) and 24 small and medium size ones (category small). A representative sample of 12 canoes (6 big and 6 small) was selected to be monitored for a year. Information on landings, buying and selling price, processing, operating costs, earnings and destination markets was collected twice a week during twelve months.

3. RESULTS AND DISCUSSION

Catch composition from different codends

The species here included mainly the croakers (Scianidae), sole (Cynoglossidae), thread-fins (Polymenidae), shad, ethmalosa (Clupeidae), silver fish (Trichiuridae), and shrimps (Penaeidae) notably *Penaeus notialis*, *P. kerathurus* and *Parapenaeus atlanticus*.

Table 1 below shows the catch composition sorted into Shrimps, Fish of commercial value and Trash fish (constituted mainly of juveniles, immature fish species and small pelagic). The more important finding is the ratio of shrimp to bycatch in general and to different categories represented here. It shows clearly that the figure here is 1:24, meaning that the production of one kg of shrimp involves catching 24 kg of bycatch. The comparison between different codends of the stern trawler is not considered in this paper. One can just observe that the weight of shrimps of commercial value was similar in both traditional and BRD codends. BRD codends caught more commercial fish species than the traditional diagonal codend and Traditional diagonal codend caught more thrash fish than BRD codends.

Table1. Fish composition and rate of shrimp to landed bycatch by categories

Catch per weight (kg)						
Rig	**TED only**	**T 90**	**Square window**	**Traditional**	**Total**	**For 1 kg of shrimp**
Shrimp	120	193	165	161	639	-
Fish of commercial value	1 714	1 661	1 736	1 594	6 705	10
Trash fish	2 046	1 161	1 970	2 698	7 875	12
Total landed (Fish and trash fish)	3 880	3 015	3 871	4 453	15 219	24

Composition of discards' samples

The samples of discards collected by SRHOL-IRAD laboratory present five components including Marin debris (21%), Hairtails (*Trichurus lepturus)* (16%), Crabs (13%), Shad (*Illisha africana*) (8%) and many other juvenile food fish (42%). As shown in Annex I, the specific composition of the samples shows more than 40 different species, mostly juveniles.

Size and weight frequencies of species found in discards

The size and weight measurements of each fish found in the discards were taken. Results of the analysis of these measurements are presented in Table 2, showing minimum and maximum weights and lengths by species. Weight of the individual fish ranges from 1.6 g to 127.8 g, while their size distribution ranges from 4.5 cm to 23 cm according to the species.

Table 2. Minimum and maximum weight (g) and length of fish discarded

Total length	***Brachydeuterus auritus***	***P. typus***	***P. senegalensis***	***Cynoglossus* spp.**	***Drepana africana***	***Pentanemus quinquarius***	***Polydactylus quadrifilis***	***Chloroscombrus chrysurus***	**Turbot**	***Selene dorsalis***
Smallest fish	5,5 g	4 g	10,3 g	7,2 g	8,3 g	8,9 g	7,9 g	21,1 g	8,3 g	1,6 g
	8 cm	8 cm	11 cm	9,5 cm	7,5 cm	12 cm	9,5 cm	12 cm	10 cm	4,5 cm
Biggest fish	37,1 g	42,2 g	25,5 g	104,2 g	54,6 g	39,9 g	38,5 g	34,9	35,9g	127,8 g
	16 cm	20 cm	15 cm	23,5 cm	13 cm	18 cm	16,5 cm	15,5 cm	16 cm	23 cm

Estimates and quality of bycatch in Limbe

In Cameroon particularly in Limbe, bycatch products are known as "Jabru fishing". The main Jabru fish landing site in Limbe is Dockyard. After data analysis, about 35 boats collectors of different sizes (11 big canoes and 24 small and medium-sized canoes) are involved in the business. As in Nigeria (Akande, 1998), big boats have a crew of 11 people and are equipped with high horsepower engine (40 and 75). The medium size canoes have a crew of 5 members. This gives around 231 persons who undertake a full-time business of transferring bycatch to shore. This number can increase, as fishermen who normally target small pelagic (*bonga* and *sardinella*) during the peak season, opt for the bycatch transfer trade during the low season. In Limbe, these collectors operate mostly during night time and return to the landing site in the morning where buyers, mostly women are already waiting for them.

Before, only trash fish could be given to the collectors onboard. The apparent depletion of the resources and the need for more food, especially proteins sources to meet the requirements of the fast-growing population have motivated the trawl operators and crew to focus their activities on fish bycatch. They are now retaining and preserving all bycatch and trash fish. Marketable size fish as well as those that were often discarded (immature, snake fish, small pelagic, crabs etc.) are transferred to collector boats carrying it to Limbe and Douala Jabru markets.

The quality of bycatch landed

The quality and sanitary conditions of Jabru fish have also improved. After towing net and hauling the capture onto the deck, the catch is washed with seawater and sorted. While sorting, shrimp is picked up continuously and put into a basket. Fish of high commercial value (most valuable fish) are sorted out first (Croaker, Barracuda, Sole, Bar etc.), and then separated into sizes, species and different categories. There exist 9 fish commercial categories. These include average size bars, small size bars, average size soles, small size soles, big fish species, whitebait, Mix 3, rays and sharks. The different fish categories are then packed into rectangular plastic baskets, and marked accordingly. After the sorting operation has finished, the fish is washed again by clean seawater; the plastic baskets filled with ice (the layer of ice covering the fish) and then stored properly in the fish holds. The trash fish remaining, that would have been discarded, is also considered and put in plastic bags and stored. The discards here are very insignificant and are mainly made up of marine debris. The ice compartment is at normal temperature control, medium in the fish hold for most small to medium-size boats. This allows normal conditions to keep and upgrade the fish quality, both for target and bycatch.

Fish from collectors includes fish of high commercial value (big fishes as barracuda, bar, captains of good quality), shrimp and other crustacean well appreciated as boat collectors sometimes are offered possibilities of keeping ice on board for the quality of fish carried.

The total bycatch production in Cameroon

Production of bycatch is mainly from industrial shrimp fishing. The bycatch from the artisanal shrimp fishery is negligible. The composition of bycatch landed by trawlers includes croaker (Scianidae), sole (Cynoglossidae), *Arius* spp. (Ariidae), shinose (Polynemidae), grunter (Haemulidae), bonga and sardinella (Clupeidae) and the mixed category includes ribbon fish, mullets, threadfin, moonfish, spade fish, etc. Data on the landings were collected from a sample of 12 boat collectors by categories (6 big and 6 small).

Table 3 shows, on a monthly basis, data collected by all the sample units and expressed in bags. It shows average monthly landings of 2,056 bags for the category big and 681 bags for the category small. Considering a weight of 20 kg per bag, this gives an annual transfer estimated at 5,428 tonnes by big canoes category and 3,923 tonnes by small canoes category, for a total landing of 9,351 tonnes of Jabru commercialized in Limbe Dockyard Fish market.

The total quantity of Jabru landed in Dockyard Limbe (one of the Jabru's biggest market in the country) appears to be higher than the total industrial fish production, 8,000 tonnes of fish and shrimp landed by all the industrial vessels operating in Cameroon (Meke and Njifonjou, 2007). Moreover, there are two other Jabru landing sites in Douala (Youpwe) and Kribi Mbouamanga, having also similar bycatch landings, and many other small jabru landing sites along the coast. When taking these sites into account, one can estimate the total landings of Jabru to be around 20,000 tonnes in the whole country. This situation emphasizes the economic importance of bycatch and expresses concern that bycatch reduction may lead to lower catches and consequently to lower incomes.

Table 3. Data collected and total bycatch marketed in Limbe during 2005

Month	Sample of 6 big boats (bags of 20 kg)	Sample of 6 small boats (bags of 20 kg)
January	12 800	4 280
February	12 192	4 232
March	14 496	3 352
April	12 280	4 304
May	11 944	4 232
June	12 784	3 776
July	11 624	3 656
August	9 760	3 840
September	12 008	4 296
October	12 960	4 200
November	12 328	3 504
December	12 896	4 368
TOTAL	**148 072**	**49 040**
Monthly average of the sample	12 339	4 087
Monthly average per collector vessel	2 056	681
Annual landings per category of boat	5 428 tonnes	3 923 tonnes
TOTAL landings of bycatch at Dockyard Limbe (tonnes)	9 351 tonnes	

Marketing of bycatch products

As mentioned earlier, selected bycatch and trash fish chilled in plastic sacks on board the trawler are collected at sea by collector boats. Once on shore, the sacks are discharged and transported from the boats by *boloboys* (conveyors) and packed on the cemented floor. Those of commercially important species are sold in bags directly to wholesalers having stores in Douala and Limbe, or to "buy and sell" women and other retailers for local consumption. Trash fish (greater part of the landings) is sold to women who make a second sort to take off small marketable fish that is sold fresh to consumers. The remaining fish is transported for the smoking/drying process. Women dominate in the processing and marketing of Jabru fish. Smoking is the common technique used in processing, done in smoke houses traditionally known as Banda.

Seventy "buy-and-sell" including 47 women and 23 men are involved in the commercialization of bycatch in Limbe Dockyard landing site. They are the only ones allowed and recognized by their association to buy from the collectors and to sell to retailers. Most of them own one or even two boat collectors or are simply financing the business (fuel and buying of fish to trawlers).

Up to 80% of fish landed here including bycatch is processed through smoking/drying process. The department of Fisheries and the Limbe Urban Council have constructed a big smoked fish market in Limbe. There are two market days per week, Tuesday and Friday. The market is managed by the "Buy and Sell Organization" (The BSO). This is a kind of trading force dominated by women. The BBO works effectively to clean the environment and improve sanitary conditions, to prevent conflicts among the members, to guaranty security from thieves, to ensure the price of fish is profitable to the retailer and to ensure safety of the products when reaching the final market. This fish marketing sector also generates a lot of opportunities for informal employment, informal and institutional "rent capturing" activities.

Table 4 shows that prices of fish vary with commercial categories. Fish bycatch is cheaper when landed by boat collectors than when landed by the trawler itself in Douala. In Limbe, fish price of different categories ranges from FCFA 600–800, 900–1200, and 1300–1500 when buying from trawlers, at the landing site or from the retailers, respectively.

These prices are a little bit higher in internal markets. Those of the retailers carrying their products to internal markets, use big baskets or big cartons for the purpose. Packaging is usually in plastic bags or in recuperated newspaper and cement paper. The product is then carried by public transport from Limbe and Douala to different destinations. From the recent survey of the "buy and sell" buying in Limbe fish market, the main destination markets are: Douala (23%), Limbe (20%), Kumba (15%), Yaounde (14%), Bamenda (9%) Bafoussam (8%) and other towns (11%). The actual markets for the smoked/dried big fish products are both domestic and export markets mostly towards European countries (France, England, Germany, etc.) and United

States of America. Currently, this product generates the highest value in the sector of traditional fish exported products. The price here ranges from FCFA 1,300 at the landing site to FCFA 2,200 when smoked for exportation.

Table 4. Price of fish bycatch in Limbe fish market

Different categories (in bags of 20 kg)	From trawlers (FCFA)	From the landing site (FCFA)	From retailers (FCFA)
Big size bar	16,000	24,000	30,000
Small size bar	14,000	20,000	26,000
Average size sole	16,000	22,000	28,000
Small size sole	12,000	18,000	26,000
Mix 3	16,000	22,000	28,000
Friture	14,000	20,000	26,000
Big fish (fresh in pieces) FCFA/kg	1,000	1,300	1,500
Price of fresh fish/kg in FCFA	600 to 800	900 to 1200	1,300 to 1,500
Trash fish in bag (fresh)	2,000	3,500	8,000 (smoked)
Price of trash fish in kg	100	175	400 when smoked

5. THE PROJECT FOOD SECURITY DILEMMA

With regard to the main goal of the REBYC project (the reduction of bycatch) it has to be recognized that the situation and conditions under which the shrimp fisheries operate vary considerable among countries.

As seen in the Central Gulf of Guinea, notably Cameroon and Nigeria, or in some Southeast Asia countries (Indonesia and the Philippines), all or most of the bycatch is used and carries a - although sometimes low - commercial value. Hence, operators have little incentive to reduce it. Boat owners and crew may also have different incentives; in some places bycatch is sold by the crew outside the control of the boat owner. Some times, as stated by Ogbonna (2006) in Nigeria, unscrupulous captains deliberately fish near the shore in other to produce more bycatch of juveniles in order to make extra money. There is therefore a socio-economic implication of the project because an intricate network of processed fish bycatch market has developed along the coastal communities and even into the hinterland. Moreover, low-value fish play a role in food security by giving employment to traders/processors and supplying local markets. Therefore, there are important differences between the countries where bycatch is used and has commercial value and those where bycatch is generally not wanted and discarded. Moreover, where bycatch is being used, it often plays an important role in food security for poorer population groups and this situation needs to be better understood.

As mentioned by Ekowati (1998), the REBYC project is likely to be more successful (and sustainable) in countries where there are economic incentives for the industry to reduce bycatches (Mexico and some other Latin American countries).

An important consideration that has been observed is the continuing decline of the size of fish captured which is tending towards increasing number of juveniles. This means that some economically valuable and ecologically important species might have been overfished. This is an important consideration for the project and the focus of actions for the REBYC II. The questions that need to be answered for a proper management of these tropical resources are:

- Are any of the economically valuable and ecologically important species overfished?
- What levels of bycatch are sustainable and result in vibrant fisheries and contribute to food security?
- Are there some important areas which have large densities of juveniles and can these be protected through spatial and temporal closures;
- Where should multispecies shrimp trawling be allowed to take place and how can damage to the environment from trawling be minimized;
- Could the vessel reduce its operating costs by becoming more energy efficient, or by increasing the value of the catch? If yes, then the effort to adopt reduction measures may have less of an impact; and
- Long-term food security requires that measures are taken to ensure that catches are sustainable, in which case there may be requirements to introduce effort control measures.

6. CONCLUSIONS AND RECOMMENDATIONS

The REBYC project has an honourable objective, that of reducing bycatch for a sustainable development of our fisheries' resources. One should notice that with regard to likely sustainable impact of the project, there is an important difference between the countries where bycatch is used and has commercial value and those where bycatch is generally not wanted and discarded. Once a fish is caught and removed from its environment, even discarded immediately, it has a very little chance to survive, mainly for the juveniles. When a country is willing to operate shrimps fisheries, it must be aware of the production of an important quantity of bycatch, particularly for the multi-specific fisheries. However, all regions have something in common and that is the requirement that all fish and shrimp are managed sustainably. As a consequence, this may require the consideration of some form of effort control. For those fisheries where all bycatch is retained, this may require that spatial and temporal closures, MPAs, etc. be considered either in combination with or as an alternative to BRDs.

The Device to be introduced by the REBYC's project simply tends to reduce bycatch, mainly juveniles that should grow for the sustainability of the resources and better future incomes.

With respect to food security, bycatch should neither be discarded at sea nor be made up only of juvenile fish, as is the case in Cameroon and Nigeria. In this respect, one can say that the REBYC project is likely to be successful, and sustainable, in all the participant countries, each country in its own way.

Governments should then try to regulate and implement bycatch trades, and Regional cooperation in the context of harmonization of regulations should be put in place in an area where many countries share the resources as well as the observer programme.

About trading of bycatch and discards:

- It is advisable to legalize the trade of bycatch and organize the marketing;
- There is a need of onboard chilling of bycatch in order to improve the quality at landings and thus raise commercial value;
- Bycatch must be handled hygienically;
- There should be research into simply market-oriented methods of value-addition to bycatch, with emphasis on small-scale fish traders and processors.

While concluding, it is important to give information about the REBYC's project. The phase1 has ended in September 2008. After the valuable gains made by the REBYC phase1 towards the objective of establishing tropical shrimp trawl fisheries on a sustainable basis, the REBYC phase2 is now in the process of being put in place. The draft Project Concept Note has proposed 33 Recipient Countries instead of 12. In Africa four more countries are willing to participate bringing the number to six participating countries: Nigeria, Cameroon, Madagascar, Mozambique, Kenya and Tanzania. www.fao.org/fi/gefshrimp.htm.

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ANNEX I

Various species identified in the discards of shrimps trawlers

N°	Common name	Family name	Scientific name
1.	Soles	Soleidae	*Synaptura* sp.
2.		Cynoglossidae	*Cynoglossus senegalensis*
3.	Bonga (sardine)	Clupeidae	*Sardinella maderensis*
4.			*Ethmalosa fimbriata*
5.	Bars	Scianidae	*Pseudotolithus senegalensis*
6.			*P. typus*
7.			*P. elongatus*
8.	Petits capitaines	Pomadasyidae	*Pomadasys rogeri*
9.			*Galoides decadactylus*
10.			*Polydactylus* sp.
11.	(Fritures)		*Brachydeuterus auritus*
12.	Grands capitaines	Polynemidae	*Pentanemus quinquarius*
13.	Disque		*Drepana africana*
14.	Fritures		*Eucinostamus melanopterus*
15.		Tetradontidae	*Lagocephalus laevigatus*
16.		Bagridae	*Chrysichtis negrodigitatus*
17.	Carangues	Carangidae	*Selen dorsalis*
18.			*Alectis alexandrinus*
19.			*Caranx hippos*
20.			*Caranx senegalus*
21.			*Chlorocombrus chrysurus*
22.			*Trachurus* sp.
23.	Ceintures	Trichiuridae	*Trichiurus lepturus*
24.	Raies	Rajidae	*Raja miraletus*
25.		Dasyatidae	*Dasyatis margarita*
26.	Barracuda	Sphyraenidae	*Sphyraena piscatorium*
27.		Sparidae	*Pagellus* spp.
28.			*Dentex* spp.
29.	Rasoirs	Clupeidae	*Illisha africana*
30.	Crabs	Calapidae	*Calappa rubroguttata*
31.		Squillidae	*Squilla aculeata calmani*
32.		Portunidae	
33.	Mulets	Mugilidae	*Mugil* spp.
34.			*Mugil capunil*
35.	Seiche	Sepiolidae	*Sepia* spp.
36.	Shrimps	Peneidae	*Penaeus notialis*
37.			*P. keraturus*
38.	Carpes	Lutjanidae	*Lutjanus* spp.
39.	Congres		*Conger*
40.	Mâchoiron	Ariidae	*Arius heudeloti*
41.	Ceintures		
42.	Sharks		

The second Workshop on Fish Technology, Utilization and Quality Assurance in Africa was organized by the Fish Utilization and Marketing Service of FAO's Fish Products and Industry Division in collaboration with the Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), under the auspices of the Institut national de recherche halieutique (INRH) in Casablanca, Morocco. The workshop reviewed progress in post-harvest fish utilization in Africa and made recommendations to FAO, its member countries and institutes interested in fish utilization in Africa. The experts reviewed in particular fresh or live fish handling, fish processing, post-harvest loss assessment, quality and safety, and marketing and socio-economic issues. The meeting included: a presentation by the secretariat of a report on progress and events since the workshop held in 2005, presentation of 22 papers and a field trip to the port of Agadir (fish auction and jetty) and to CSVTPM. The report includes the recommendations as well as the papers that were made available to the experts.

Le deuxième Atelier sur la technologie, l'utilisation et l'assurance de qualité du poisson en Afrique a été organisé par le Service de l'utilisation et de la commercialisation du poisson de la Division des produits et de l'industrie de la pêche de la FAO, en collaboration avec le Centre spécialisé de valorisation et de technologie des produits de la mer (CSVTPM), sous les auspices de l'Institut national de recherche halieutique (INRH) de Casablanca, au Maroc. L'atelier a passé en revue les progrès dans l'utilisation du poisson post-capture en Afrique et fait des recommandations à la FAO, à ses pays membres et aux instituts intéressés par l'utilisation du poisson en Afrique. Les experts ont passé en revue notamment la manutention du poisson frais ou vivant, la transformation du poisson, l'évaluation des pertes post-captures, la sécurité sanitaire et la qualité, la commercialisation et les questions socioéconomiques. Cette révision s'est effectuée à travers la présentation, par le secrétariat, du rapport sur les progrès et événements depuis l'atelier qui s'est tenu en 2005, des présentations de 22 communications et une visite de terrain au port d'Agadir (halle de criée et débarcadère) et au CSVTPM. Le rapport inclut les recommandations de même que les communications qui ont été mises à la disposition des experts.

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