UTILIZATION OF FRESH WATER CATLA (*Catla catla*) FOR PREPARATION OF MYOFIBRILLAR PROTEIN CONCENTRATE

by

T.V. SANKAR AND A.RAMACHANDRAN
School of Industrial Fisheries, Cochin University of Science and Technology,
Fine Arts Avenue, Cochin 682 016, India

ABSTRACT

Minced fish offers a new area of fish utilization and scope for diversification of international trade. Washing the minced fish to remove the solubles and to increase the frozen storage life opens a new dimension to mince based technology. The global demand for the washed mince or myofibrillar protein (MFP) for diversion to surimi and other use is on the increase and the industry is in the look out for new sources.

Carp culture is gaining importance in recent times and marketing in the fresh condition is going to be a constraint if alternate utilization methods are not developed. Here a study has been made on the feasibility of preparing MFP from a major carp (*Catla catla*). The deboned meat was washed once, twice and three times with water (1:4 fish to water) with stirring for 10 minutes. A major portion of the solubles was lost in the first washing. Based on the round weight, the yield of MFP was 24%. Besides the loss of lipids, considerable loss of salt soluble protein was also noticed. The natural sea weedy or muddy odour associated with the fish was lost to a large extent as a result of washing. The changes in the rheological properties – folding test, gel strength and compressibility are discussed. There is overall reduction in the compressibility and gel strength of gel made from the MFP in comparison to unwashed mince, though the results of folding tests remained almost the same.

INTRODUCTION

Fish is an important food commodity world-wide. The technology of fish mince based products has undergone tremendous advancement in recent years. The era is slowly shifting to the development of fish mince based industry.

Fish itself is a highly perishable commodity. When the fish is comminuted to fish mince, due to the damage of the actual tissue make up a lot more changes could be expected and the same has been established (Anon, 1981). The spoilage of fish during storage is due to the combined effect of autolysis and bacterial action. Mincing accelerates decomposition, aggregation and cross-linking of myofibrillar protein (Laird et al., 1979) with consequent decrease in soluble proteins, water holding capacity and other rheological properties. However, mincing of fish opens a new field of fish utilization that offers scope for diversification of industry and international trade in value added products.

Further development of mince based technology following the commercialization of surimi led to the production of white, odourless and bland flavoured products. In surimi preparation, fish mince is washed in chilled water to remove the solubles which interfere with the storage and rheological characteristics (Lee, 1984). Washing fish mince decreases its stability but increases the storage tolerance (Shimizu and Fujita, 1985) and the tolerance is species dependent. The material obtained as a result of washing is nothing but the concentrated myofibrillar protein. Grinding the same with cryo-protectant makes surimi with better storage and rheological functions and this is used as a raw material for a number of fabricated seafood products.

Because of the high demand for the mince based products the preparation of mince and surimi is extended to more fish species.

The study on the suitability of freshwater species for mince based technology has gained importance due to the reduction in fish landings from marine sources and the importance given by several countries to fresh water fish culture to increase fish production. Freshwater fish, in the coastal states of India, is not that easily accepted primarily for its muddy flavour and the presence of pin bones. Hence, the objective of the present study is to:

1) Standardize the washing schedule for the preparation of surimi from one of the most popular fresh water carp, *Catla catla*.
2) Study the changes in the fish mince as a result of washing.

MATERIALS AND METHODS

Three different lots of pond fresh catla (*Catla catla*) were brought from the freshwater pond in iced condition (1:1) and kept for 24 hours to resolve the rigor. The post rigor fish was used for experiment. The fish was processed to remove head, fins and viscera and washed in ice cold water to remove remaining slime, scales, blood and adhering viscera. The flesh was separated from the processed fish using a Baader 694 deboning machine equipped with a rotating drum with 5-mm hole and operated at medium pressure to eliminate bones and for optimal recovery.

Fish
↓
Beheaded, Fins removed, eviscerated
↓
Processed fish
↓
Cleaned
↓
Deboned
↓
Minced flesh
↓

Wash I
↓
Washed in water (1:4, 10°C) containing 0.1% NaCl
↓
Screw press
↓
MFP (Washed mince)

Wash II
↓
Washed in water 1:4, 10°C) drained using nylon mesh
↓
Washed in water 1:4, 10°C) containing 0.1% NaCl
↓
Screw press
↓
MFP (Washed mince)

Wash III
↓
Washed in water 1:4, 10°C) drained using nylon mesh
↓
Washed in water 1:4, 10°C)
↓
Drained
↓
Washed in water 1:4, 10°C) containing 0.1% NaCl
↓
Screw press
↓
MFP (Washed mince)

Fig. 1. Washing schedule for the preparation of myofibrillar protein from catla.

Flesh was then washed (Fig.1) in a stainless steel vessel once, twice and three times, in ice cold water (8-12° C) in the ratio of 1 to 4 (W/V). After stirring the mixture for 10 minutes, it was dewatered as much as possible using a laboratory model manual screw press. 0.1% NaCl was used in the last wash to facilitate dewatering. Washing efficiency was calculated by measuring and comparing the total solids and protein recoveries and reductions in the lipid and ash of the minced flesh before and after washing.

Moisture, total nitrogen, lipid and ash were analysed using AOAC (1976) procedures. The salt soluble proteins were extracted (Monterchia et al.., 1997) by homogenizing the meat in 5% NaCl containing 0.02M $NaHCO_3$ for 60 seconds followed by centrifugation at 10000 rpm for 20 minutes at 5°C. The supernatant was taken as salt soluble protein. The water-soluble protein was extracted in the same way using 0.02M $NaHCO_3$ instead of just water. The protein content was estimated by the biuret method (Gornall et al., 1949).

The rheological characteristics were studied by folding test, gel strength and compressibility of the gels prepared. The gel was prepared (Lee, 1984) by grinding the myofibrillar protein with 3% NaCl for 20 minutes using a mortar and pestle maintained at about 15°C. The paste was filled manually into polypropylene tubing of 6.0 cm diameter, taking care to eliminate the trapped air as much as possible. The ends of the tubes were tied and cooked by immersion in a boiling water bath for 30 minutes. The gels thus formed were cooled at once in ice and then kept at 5°C over night and analysed.

For folding test (Lee, 1984) a 3 mm piece (of diameter 37cm) of the gel was cut and folded between thumb and index finger and depending on the breakage they are graded as AA, A, B, C etc.

The gel strength and compressibility were studied using a 'SUN' rheometer using a 2.5 cm long (diameter 37cm) gel (Lee,1984). Gel strength (g x cm) is the product of force and deformation while the force (g) required to compress the sample by 4 mm is taken as compressibility.

RESULTS AND DISCUSSION

Manual processing yielded 61.87% processed fish based on round weight (Table 1). Machine separated minced flesh was 30.71% based upon round fish and 58.81% based processed fish. Gleman and Benjamin (1987) reported 41.4-45.2% mince yields in the case of silver carps. Generally, higher yields of mince are reported for marine fishes (Perigreen, 1979; Joseph and Perigreen, 1983; Muraleedharan, 1996). Yield of fish mince depends on the processing method and the type of equipment used (Crawford, 1972; Chang Lee et al., 1990). The yield in this case was less because of the size of its head, which in the case of fresh water catla accounts for about 25-27% of the total weight of fish.

Table 1. Yield based on round weight from processed Catla before and after mechanical flesh separation.

Batch	**% Yield**	
	Processed Fish	Minced Fish
1	62.93	30.74
2	62.48	31.28
3	60.21	30.12
Mean	61.87	30.71
SD	1.46	0.57

Washing the flesh to remove the solubles enhanced the over all characteristics of the fish flesh. A fish to water ratio of 1:4, with 10 minutes stirring time, was reported (Lee, 1986) to be adequate and economical. Excessive washing results in the hydration of the mince making water removal difficult. Recoveries of solids protein and ash during washing depend on the amount of water used for washing though the effect is not directly proportional (Pacheco-aguilar, 1989). In this experiment, first exchange yielded 24% myofibrillar protein on round weight basis and the second and third washing reduced the yield by further 3% and 7%, respectively (Table 2).

Table 2. Yield of myofibrillar protein based on round weight and minced fish.

Washing cycle	Yield based on	
	Round fish	Minced fish
1	24.6 (1.55)	71.2 (3.42)
2	21.4 (3.22)	70.3 (3.62)
3	17.0 (2.23)	56.3 (1.05)

Standard Deviations given in parenthesis.

The fresh water carp had a moisture content of 83.3%. The low fat content (0.45%) and the high protein content (16.54%) of the fish may be related to the quality of the fish, its maturity stage and the condition of storage prior to processing. A moisture content of 76% and protein content of 19.1% have been reported in the case of fresh rohu (Gopakumar, 1993). In this experiment the fish was kept in ice for 24 hours to resolve the rigor which could have enhanced its water content. The fresh fish had a salt soluble protein content of 9.7% and about 50% of this is water-soluble protein. The soluble protein content of mince was usually lower than that of fillets indicating denaturation of protein as a result of mincing (De Koning and Mol, 1991).

Table 3. Effect of washing on the composition of *catla* minced meat.

	Unwashed	Washing cycles		
		I	II	III
Moisture (%)	83.3	85.32	86.47	84.60
Solids (%)	16.7	14.68	13.52	15.40
Protein DWB	97.04	95.44	95.23	94.63
Lipids DWB(%)	2.70	2.32	1.48	1.76
Ash DWB (%)	0.60	2.52	2.63	2.62

Washing results in the increase in the water content (Table 3) and a corresponding decrease in solids. On comparing protein content on a moisture-free basis, it is seen that the protein content decreases as washing progresses. Maximum loss of 4% was noticed in the first washing itself. Only 15% of oil is lost in the first wash and up to 45% is lost in the second washing. But this being lean fish, the importance of fat removal is not that important. The initial ash content itself is low in this case; however, the increase shown during washing is as a result of the use of NaCl for final washing to effect efficient dewatering.

About 26% of total soluble protein was lost in the first exchange and water-soluble protein contributes to about 50% of it (Fig. 1). The solubility of myofibrillar protein in water and low ionic strength buffers was reported in the case of cod (Stefensson and Hultin, 1994). This loss of myofibrillar protein on a moisture-free basis was calculated to 42%. But subsequent washes removed the water-soluble fraction and enriched the myofibrillar fraction resulting in the retention of myofibrillar protein. Lin and Park (1996) showed increased loss of protein as a function of washing cycles and further demonstrated that the protein loss decreased when the wash solution contained less than 1% salt in the wash solution.

Table 4.Effect of washing on the organoleptic characteristics of catla minced meat.

	Unwashed	Washing cycles		
		I	II	III
Colour	1	3	5	5
Flavour	1	3	4	5
Texture	1	3	5	5

Numerical scores used in the evaluation.
Colour and appearance: 1- characteristic pale red, 3 - slight loss of pale red, 5 - whitish
Texture: 1 – soft slippery, 3 – firm, 5 – firm chewable
Odour: 1 – muddy, 3 – slight loss of sea weedy, 5 - bland

The acceptability of the fresh water fish was very much limited due to its characteristic strong muddy odour. This is related to the algal flora of the water source. The odour gets diluted and the pale red colour of the meat is also becomes almost white as a result of first washing (Table 4). Though further washing improves the colour, the yield of the mince is considerably reduced.

Table 5. Effect of washing on the rheological properties of catla minced meat.

	Unwashed	Washing cycles		
		I	II	III
Folding test	AA	AA	AA	AA
Gel Strength (gxcm)	211	136	88	136
Compressibilty (g)	100	92	76	92

The rheological properties (Table 5) did not improve to any large extent as a result of washing although the acceptability in terms of its odour and flavour improved to a large extent. The flesh from fresh water carp itself had a very high binding characteristic and had a folding test grade of AA which in not normally seen in the unwashed marine fish flesh. The folding test grade is not affected as a result of washing. The gel strength and the compressibility of the gel, however, got reduced, signifying that the unwashed flesh itself is comparable with that of the washed flesh of marine fish but for the smell associated.

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