FISH HYDROLYZATES FROM COMMERCIAL PHILIPPINE SPECIES PART I. PRELIMINARY STUDIES ON HYROLYZED FISH PROTEIN

by

L.G. Salcedo, Senior Fishery Technologist
G. Guevara, Junior Fishery Technologist
and
S.V. Bersamin, Chief Fishery Technologist
Acting Chief, Division of Fish and Sea Products Utilization,
Philippine Fisheries Commission,
Intramuros, Manila, Philippines

ABSTRACT

Hydrolyzed fish protein was prepared from five species of common Philippine market fishes. The process followed has the advantage of converting any kind of fish flesh into hydrolyzed protein, a product which is best recommended for special diet therapy as an important supplement to diets of convalescent patients and as medications to specific types of ulcer. Hydrolyzed fish protein also makes possible the utilization of cheap species of fish particularly those with low commercial value into high quality protein foods.

INTRODUCTION

Fish is a well-known source of protein but because fresh fish is not always available in some parts of the Philippines, there are prevalent cases of malnutrition due to protein deficiency in some sectors of the country. It has been recognized also that some diseases prevalent to patients in hospitals are caused by protein deficiency.

This situation necessitates the proper utilization of fish as a protein source. It will make available fish in processed and more nutritious form to people affected by malnutrition in hospitals or to those staying in rural areas.

REVIEW OF LITERATURE

Solubilized protein from fish was developed in Germany as a substitute for egg white known as Wiking Eiwess. An abstract from a report of the British Intelligence Objectives Sub-Committee

Proc. Indo-Pacific Fish. Coun., 11(II): 284-291.

mentioned the use of such product on bakery goods, sugar confectionary, ice cream, mayonnaise, custard powder, pharmaceuticals, textiles and leather industries. Roy Allen (1955) likewise states the use of hydrolyzed protein in treating specific types of ulcers such as duodenal and ventricular ulcers and as an important supplement to diets of convalescent patients.

Biological assays and studies however, should be carried out to define the deleterious effects of hydrolyzed protein, if any, and at the same time to measure the quality of such protein food for growth and maintenance. A.B. Morrison claimed that toxic products may be produced by reactions between fish solids and solvents; and solvent decomposition products or solvent impurities.

It is probable that latex from local fruits particularly the papaya can be used for enhancing the rate of hydrolysis of fish flesh. This may minimize whatever loss of essential nutrients that may occur during the alkali and acid hydrolysis. In this connection, Ngo-Ba-thanh (1953) mentioned good results when pineapple juice was used as a hastening agent which is similar to that of a proteolytic enzyme. In Mysore, India, they have conducted studies on hydrolysis of fish meat using papain to obtain hydrolyzates rich in peptone. It is claimed that papain has been used for hydrolysis because of its favorable properties of pH and temperature optima for activity. Chaldelin et al (1942) has shown that papain have outstanding value for liberating several of the B vitamins from their bond forms.

Information on the amino acid content of Philippine fish proteins is still very meagre so that a phase of this project will be directed to the determination of amino acid make-up of fish proteins and their sources by chemical as well as by bioassay studies.

Studies on the distribution of nitrogen have yet to be carried out to establish the precentages of the basic amino acids fraction in the fish proteins since the fish proteins vary in the manner in which they are broken down to their degradation products. A comparison of the amino acid make-up of the fish proteins and casein by paper chromatography is also being considered for future studies because fish proteins are claimed to compare favorably with standard casein. Deuel et al (1946) isolated proteins from mackerel, sardine and tuna and compared their nutritive value with casein. They found that these fish proteins are superior to casein.

The objective of this project is to utilize commercial species of market fishes which are not very palatable in ordinary food preparation due to unpleasant taste and odor. With this project, such species would be better utilized as special protein supplement in diet therapy, thereby enhancing their commercial value. Fish in its processed form can also be adequately supplied to people in the rural areas not easily reached by fresh fish.

The scope of this paper is confined only to the preliminary

studies on the preparation of hydrolyzed fish protein.

Studies dealing on the use of latex from local fruits as catalysts for hydrolysis; nitrogen distribution and amino acid make-up of the fish proteins under investigation; and the biological assays to measure the quality of such protein foods for growth and maintenance shall be presented in subsequent papers.

MATERIALS AND METHODS

Some species of fish used in this project were purchased directly from the local market. Some were requested through fish dealers and some were available at Dagatdagatan Saltwater Fishery Experimental Station of the Philippine Fisheries Commission at Malabon, Rizal.

In the present investigation, a method similar to that reported by the British Intelligence Objectives Sub-Committee with some modifications is employed. The details given below represent the method used and found satisfactory by Mohanty and Roy (1955) for the preparation of fish proteins.

Fish muscle was filleted and uniformly shredded. The pieces were leached with 0.5% acetic acid under reflux at 80°C for about 50 minutes. The soluble nitrogenous constituents were thus removed. The connective tissue was broken down and the ash content possible removed. The material was then washed in running water and pressed to reduce the water content. The oils and fat were extracted overnight from the press cake with 95% alcohol. Excess solvent was completely removed in an oven at 70°C. The dried material was ground to a fine powder and then made soluble by hydrolyzing with aqueous alkali. To every 100 g of fish powder about 500 ml of water and 5 g of caustic soda was added and hydrolyzed for about 2 hours at 80°C. When the substance was completely liquefied, it was neutralized with 10% acetic acid. The neutralized liquid was spraydried to yield a cream and flour-like powder.

Due to the inavailability of a spray dryer, the following procedure was followed:

One hundred grams of the powder was mixed with 500 ml of 1% sodium hydroxide and heated in a water bath for an hour at 70° to 80°C. This treatment resulted in a fairly good solution of the muscle powder in dilute alkali. This solution was filtered through a cotton plug. The filtrate was cooled to 50°C in order to facilitate the precipitation. The precipitation was carried out by the addition of dilute acetic acid (1 ml of glacial acetic acid diluted to 100 ml distilled water) to the filtrate. The solution was continously stirred during precipitation until neutral. The supernatant liquid was removed on a Buchner funnel. The protein was washed twice with distilled water and finally dried at about 50°C.

Purification consisted of repeating the above procedure of dissolving the wet precipitate in the alkali solution and reprecipitation with acetic acid for two or three times.

RESULTS AND DISCUSSION

Table I shows the proximate chemical composition of the different species of fish utilized in the preparation of hydrolyzed protein.

The proteins of tilapia, caesio, lizard fish, shark and surgeon fish contain about 3% nitrogen.

The proximate chemical analysis of fish protein obtained was carried out according to the method described in AOAC. Results of the analysis are presented in Table II.

The creamish and flour-like fish protein powder obtained attains more of a natural seashore odor than a fishy odor. It is soluble in water, hence may be easily assimilated. The product contains approximately 85% protein.

A 10% solution whips into a foam equivalent to natural egg white. The product is not coagulated by heat. Compared with other similar products, the keeping quality of hydrolyzed protein is better because it is in powdered form, with low fat content and can be easily vacuum-packed in bottles and polyethylene bags. Fish protein in its spray-dried form has a better appearance than ordinary fish flour. The protein content is higher than that contained in other foods such as raw or boiled eggs, cheese, roasted chicken, raw beef and fresh whole milk.

Its solubility in water with its high protein content makes it suitable for use as protein supplement in special diets in the form of soups, bakery goods, and as stabilizer in ice creams, mayonnaise and custard powder.

Flavor Profile:

According to the flavor profile evaluation illustrated in Table IV the non-hydrolyzed product conforms to a more or less preferable standard. Since the non-hydrolyzed form is not soluble, a second stage in which the product was hydrolyzed, rendered it more assimilable.

CONCLUSION AND RECOMMENDATION

The hydrolyzed fish protein obtained from Philippine market fishes was soluble, creamish and flour-like powder with a crude protein content of about 85% and the yield is about 10% of the raw material.

The final product can be included in dietary food preparations of hospitals and can also be incorporated in the food preparations of people in the rural areas to increase their protein intake.

The future studies such as: the use of latex from local fruits as catalysts for hydrolysis; the nitrogen distribution and amino acid make-up of the fish proteins

and biological assays as mentioned for consideration in subsequent papers are therefore recommended to further evaluate the protein quantity and quality as well as the true nutritive values of the final product.

TABLE I

Showing the proximate chemical composition of fish species

Local name	English name	Scientific name	Moisture per cent	Ash per cent	Crude Protein (Nx6.25)	Fat per cent
Tilapia	Tilapia	*Tilapia mosambica*	76.40	1.34	20.68	1.75
Dalagang-bukid	Caesio	*Caesio sp.*	80.01	1.45	17.37	0.91
Kalaso	Lizard fish	*Saurida tumbil*	77.29	1.48	19.54	0.79
Pating	Shark	*Carcharias melanopterus*	76.29	0.51	21.25	2.36
Labahita	Surgeon	*Acanthurus bleekeri*	79.77	1.14	19.19	0.43

TABLE II

Proximate chemical analysis of hydrolyzed protein

Fish Protein	Moisture (per cent)	Ash (per cent)	Nitrogen (per cent)
	Gram per 100 grams of dry sample		
Tilapia	9.63	8.52	14.68
Shark	8.95	0.53	13.27
Labahita	6.37	1.15	15.06
Dalagang-bukid	5.61	0.83	14.77
Kalaso	6.40	0.64	14.52

TABLE III

Showing the intensity scale followed in evaluating the odor and flavor description of the protein product 1/

)(	-	very weak
1	-	weak
2	-	medium
3	-	strong
4	-	very strong

TABLE IV

Illustrating the odor and flavor descriptions of the two stages of the products obtained

First Stage - Non-hydrolyzed product: Description	:	Intensity
Odor - seashore odor; feedy		)(
Flavor - dry; tasteless; like grains (or "feedy" like chicken eggs, chicken fed with fish meal)		)(
Aftertaste - seashore, fishy		)(
Second Stage - Hydrolyzed product:		
Odor - seashore odor		)(
Flavor - dry, tasteless		)(
Aftertaste - fishy		)(

1/ The Table III and IV sum up the so-called flavor profile methods as formulated by Dr. Gisela Jellinek, Organic Chemist from Heidelberg, Germany (Flavor Consultant - Sensory Analysis)

REFERENCES

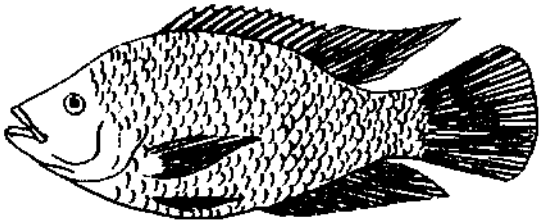
Basford, F.R. (1961). Hydrolysis of protein substances. Jour. Sci. Food and Agri., 12(9-12): 246.

Mohanty, G.B. and A.B. Roy (1955). Hydrolyzed fish protein from the flesh of waste fish. Science, 121: 41-42.

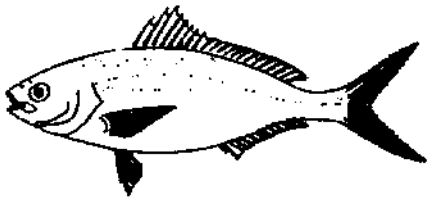
Sen, D.P., N.V. Sripathy, N.B. Lahiry, Sreenivasen and V. Subrahmanyan (1962). Fish hydrolyzates. Jour. Food Tech., 16(5): 138-141.

Sulit, J.I., O.B. Navarro, R.C. San Juan and E.A. Caldito (1953). Proximate chemical composition of various species of Philippine market fishes. Phil. Jour. Fish., 2(1): 109-123.

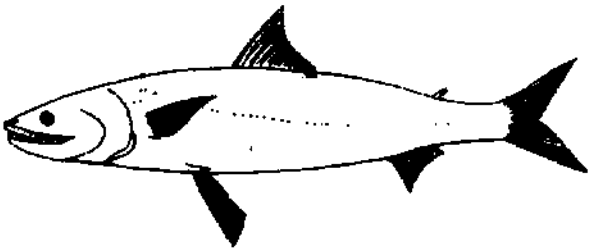
Valanju, N.M. and K. Sohonie (1957). The studies on the nutritive value of Bombay Fish. Part 2. 1957 Isolation, purification, nitrogen distribution and the amino acid make-up of fish proteins. Ind. Jour. Med. Res. (Indian Council of Medical Research), 45(1): 105.



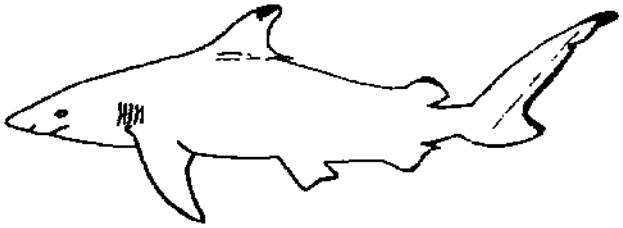
Tilapia mossambica (male)
15 to 20 cm.
(average length)



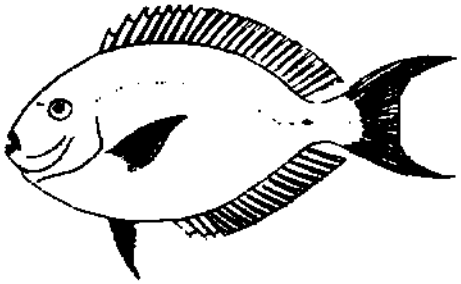
Golden caesio - Dalagang bukid,
Caesio chrysozonus (Kuhl and van Hasselt)
Average length - 15 to 20 centimeters



Common lizard fish - Kalazo
Saurida tumbil (Bloch)
Average length - 30 centimeters



Black-finned shark - Pating inglesa
Carcharias melanopterus (Quoy and Gaimard)
Average length - 0.5 to 1 meter



Blue-lined surgeon fish - Labahita
Acanthurus bleekeri (Gunther)
Average length - 30 centimeters

Fig. 1. Showing the 5 commercial species of fish used in the preparation of fish hydrolyzates