Soluble Protein Isolates from Low Cost Fish and Fish Wastes

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The method of preparation, composition, amino acid content, protein efficiency ratio and areas of possible application of water soluble protein isolates from low cost fish and fish wastes are discussed in detail in this communication.

One of the most widely spread nutritional deficiencies in the world today is that of high quality protein. A large proportion of India's population subsist on cereal grains, the proteins of which are low in quantity as well as in quality. Protein malnutrition is, therefore, an important cause of infant mortality, stunted physical growth, low work output, premature ageing and reduced life span.

A major portion of the marine fish catch in India (1.06 lakh tonnes per annum) is constituted by low cost fish of several species obtained as by-catch from shrimp trawlers (Anon, 1979). Besides this a good percentage of quality fish goes as waste during processing. Determination of the proximate composition of several species of Indian miscellaneous fish has shown that their protein content varies from 16.0 to 20.8 g per 100 g of whole minced wet fish (Kutty Ayyappan *et al.,* 1976). Wastes from filleting and canning of quality fishes contain 12.4 to 13.6% crude protein.

Protein hydrolysates in various forms are presently used in therapeutics as a source of readily assimilable protein in gastrointestinal and liver disorders and in the treatment of severe cases of protein malnutrition (Elman, 1947; Trowell *et al.*, 1954; Bose & Guha, 1961). Starting materials for such hydrolysates are usually liver, meat, fish, casein, vegetable proteins etc. For the past few decades several workers (Sen, *et al.*, 1962; Tarky *et al.*, 1973; Yanez, *et al.*, 1976) have attempted to develop methods for conversion of low cost fish and fishery wastes into acceptable and highly nutritious soluble preparations. Methods of preparation, composition, nutritive value and probable areas of use of protein isolates from fish and fishery wastes are presented in this paper.

Materials and Methods

Fresh fish were collected from fishing boats and were used either immediately or frozen whole and stored at –23°C for future use. Papain was used as the proteolytic agent. Hydrolysis of the comminuted fish flesh was carried out by the method of Thankamma *et al.* (1979). Moisture, ash, protein and fat were determined as per AOAC (1975). Amino acid distribution of the hydrolysates was determined microbiologically by the method of Shockman (1963) and biological evaluations were performed on albino rats as growth experiments according to the method of Chapman *et al.* (1959). The diet contained 10% protein and casein was used as the reference standard. Supplementation of the hydrolysate was done by admixture with the limiting amino acid at 0.1% level or casein (1:1).

Results and Discussion

The yield of protein hydrolysate from trash fish and fish waste are given in Table 1. The products were usually golden yellow to brown hygroscopic powders and could be stored in screw-capped glass or polythene bottles with proper wax coating. The shelf-life of the products from threadfin bream, jew fish and lizard fish and cat fish waste were studied for 6 to 12 months. The solubility and colour of the products remained unaffected.

Table 1. *Yield of protein hydrolysate from low cost fish and fish waste*

Substrate	Yield (%) Dry solubles/Wet fish of fish waste
Lizard fish *(Saurida tumbil)*	13.3
Jew fish *(Johnius* sp.)	10.6
Threadfin bream *(Nemipterus japonicus)*	12.0
Cat fish *(Tachysurus* sp.)	10.9
Cat fish waste	4.0
Perch *(Nemipterus bleekeri)*	7.5
Milk fish *(Chanos chanos)* waste	8.1
Jew fish waste	7.8

Table 2. *Composition and properties of protein hydrolysates*

	Lizard fish whole	Threadfin bream whole	Milk fish waste
Moisture (%)	5.0	3.5	1.6
Protein (%)	83.1	86.4	93.1
Fat (%)	0.1	0.1	Nil
Ash (%)	5.4	7.6	5.2
Colour	Pale brown	Reddish brown	Creamy yellow
Solubility	Instantly and completely soluble in water		

Proximate composition and other properties of few hydrolysates are presented in Table 2. The protein content of the isolates was about 90% on dry weight basis and fat content was negligible. Usually the samples were rich in lysine and showed excellent amino acid profiles. Amino acid pattern of a typical hydrolysate from threadfin bream is presented in Table 3. Chemical score was calculated using the amino acid scoring pattern proposed by FAO/WHO (1973). The limiting amino acids were tryptophan and threonine and the chemical score was 80.

The results of nutritional evaluation of the hydrolysate as such and after supplementation are shown in Table 4. The rats showed slight diarrhoea when fed on diet with hydrolysate alone. The food intake was low and the protein efficiency ratio was inferior to that of casein. However, supplementation of the hydrolysate with the limiting amino acids at 0.1% level or admixture with casein brought about a significant change in nutritive value and gave PER values almost equivalent to that of casein.

Table 3. *Essential amino acid profile of hydrolysate from threadfin bream*

Essential amino acid	Amino acid (g/100 g protein) FAO provisional pattern	Protein isolate
Isoleucine	4.0	5.6
Leucine	7.0	7.6
Lysine	5.5	9.4
Methionine + Cystine	3.5	5.0
Phenylalanine + Tyrosine	6.0	6.4
Threonine	4.0	3.9
Tryptophan	1.0	0.8
Valine	5.0	5.2

Table 4. *Nutritional evaluation of hydrolysates from threadfin bream**

	PER
Casein	2.8
Hydrolysate	1.8
Hydrolysate supplemented for limiting amino acid	2.4
Hydrolysate + Casein (1:1)	2.7

*Protein at 10% level

Areas of fortification

Methods of preparation and results on consumer acceptability studies on high energy food incorporating fish hydrolysates have been reported (Gopakumar, 1973; Prabhu *et al.* 1975; Gopakumar *et al;* 1975). Protein content of commercial cereals, the staple food in developing countries, is between 6.2 to 13.6 g per 100 g of edible portion of foods (Gopalan *et al.,* 1980). Amino acid profiles of cereal grain proteins often deviate from the needs of man and animals, lysine being the first limiting amino acid for most of them (Block & Mitchell, 1946). The fish hydrolysate is high in lysine (Table 2) and may be used for incorporation in cereal and other foods.

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