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A Simple Process for the Utilization of Small Bony Fish as Edible Fish Powder

A.K. Chattopadhyay, B. Madhusudana Rao and Sibsankar Gupta
Research Centre of Central Institute of Fisheries Technology, Andhra University, P.O., Visakhapatnam - 530 003, India

A simple process was developed to convert low value, small bony fish to nutritionally rich edible fish powder without deboning the fish. Dressed and beheaded silver bellies were processed in autoclave at 15 psi for 45 min and dried to moisture below 6%, ground well and packed. The yield of the fish powder varied between 10 to 12% of raw whole fish. Protein, calcium and phosphorus content of edible fish powder were 62.52%, 1310.96mg/100g and 2859.02mg/100g, respectively. The product was acceptable even upto five months. There was no significant variation in crude protein, calcium and phosphorus contents during storage. TVBN, PV, FFA, faecal coliforms, *Escherichia coli* and pathogenic coagulase positive *Staphylococci*, APC and TYM count were monitored at monthly intervals. The edible fish powder finds use as a fortifying agent to improve the food value and taste of different food items.

Key words: Edible fish powder, bony fish, storage

Low value bycatch containing small bony fishes viz., silver bellies, anchovies, mullets, sardines etc., are at present converted to fishmeal (Gopakumar, 1997). Estimated marine fish landings of silver bellies in India during 2002 - 2003 were 62,100 t, which was 2.35% of total marine landings (CMFRI, 2003). In 2001 - 2002, 651 t of siver bellies were landed at Visakhapatnam (CMFRI, 2002). Utilization of low value bycatch for human consumption is mainly done in the form of mince based products (fish sausage, cakes, cutlets, patties, balls, pastes, wafers, fingers, surimi, texturised products etc.) or fish protein concentrate type B (edible fish powder) with deboned fish (Gopakumar, 1997; Nair, 2003). However, in the above products fish bones are discarded for the convenience of eating, thereby wasting important minerals like calcium and phosphorus.

The present work was taken up to develop a simple process to convert locally abundant low value, small bony fish (silver belly) to nutritionally rich edible fish powder without deboning the fish, which can be used as a fortifying agent to improve the food value and taste of different food items.

Materials & Methods

Small bony fish, silver bellies (mixture of *Leiognathus sp.*) with length ranging from 3.8 to 8.0 cm and width ranging from 2.1 to 4.8 cm were selected for the preparation of edible fish powder. The fish were purchased from the Visakhapatnam fishing harbour, in fresh condition. Edible fish powder was prepared as per the flow chart (Fig 1). The powder was packed in 25g quantities and stored at room temperature. The packets were taken out at monthly intervals for analysis.

Moisture, protein, fat, ash, peroxide value (PV), free fatty acids (FFA) and calcium content were determined as per standard methods (AOAC, 1990). Inorganic phosphorus was estimated by the method of Fiske and Subba Row (1925). Total volatile base nitrogen (TVBN) was determined by the Conway micro diffusion method (Conway, 1947). pH of the fish powder was measured in a slurry made with distilled water (1: 10) and measured using pH meter (Systronics, GripH meter). Aerobic Plate Count (APC), MPN faecal coliforms, MPN *Escherichia coli*, coagulase positive *Staphylococci*, Total Yeast Mould (TYM) count were determined as per

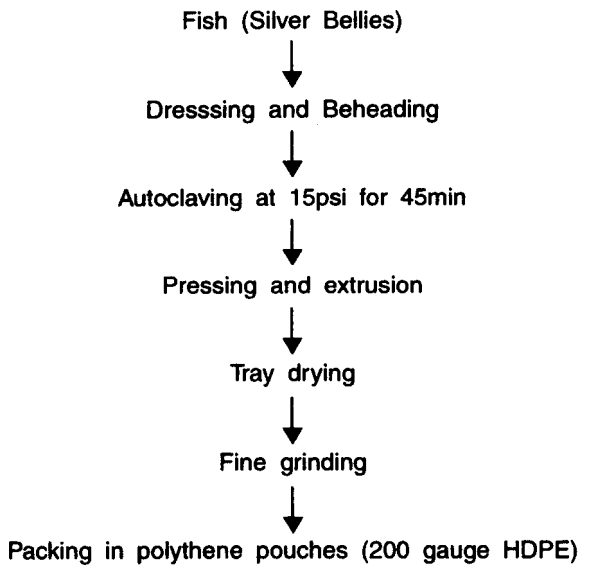

Fig 1. Flow sheet for the preparation of edible fish powder

Harrigan & McCance, (1976) and Bactreiological Analytical Manual, (1995).

Intensity of fish flavour of edible fish powder was assessed at the end of each month of storage (1st to 5th month). Fish powder at 5% (w/v) level was added to boiling water and continued boiling for an additional 10 min, after which panel members were asked to judge the intensity of fish flavour. Organoleptic quality of edible fish powder was also assessed by preparing vegetable curry (control) and adding fresh edible fish powder (treatment 1) and five month old fish powder (treatment 2) each at 5% (w/w) level to the vegetable curry at the time of cooking. The assessment was done in two batches. First batch consisted of control and treatment 1 and the second batch consisted of control and treatment 2. For each batch, the curries were placed in identical bowls and were presented for sensory analysis. Ten members were asked to judge the control & treatment 1 and control & treatment 2 for fish taste and flavour.

Results and Discussion

The thermal process conditions were standardized for different sizes of fish and the results are given in Table 1. Dressed fish were processed by spreading them as 5-6cm thick layer in round ordinary trays inside the autocalve. In the process for preparation of edible fish powder, dressed and beheaded silver bellies were processed in autoclave at 15 psi for 45 min in order to soften the bones completely, remove fat partially and develop flavour. It was observed that for fish with length < 8cm autoclaving at 15psi for 45 min was sufficient. Moreover, autoclaving at 15psi for 45 min destroys microorganisms and their spores (White, 1989). Pressing and extrusion as noodles using a hand extruder removed excess water from the autoclaved product. The product was then dried in tray dryer. To avoid contamination initially higher temperature of 62°C to 65°C was employed for five hours, progressively bringing it

Table 1. Thermal process conditions for different sizes of fish

S.No.	Length Range (cm)	Width Range (cm)	Thermal process condition	Properties of the dough
1.	3 – 8	2 - 5	10 psi for 45 minutes	Bones were not softened completely.
2.	3 – 8	2 – 5	15 psi for 45 minutes	Bones softened completely with canned flavour and very light brown colour.
3.	9 – 11	5 – 6	15 psi for 45 minutes	Big sized bones not softened completely.
4.	9 – 11	5 – 6	15 psi for 60 minutes	Bones softened completely with canned flavour and very light brown colour.
5.	12 - 14	> 6	15 psi for 75 minutes	Bones softened but with over cooked flavour and brown colour.

Table 2. Charactreristics of raw (dressed and beheaded) silver bellies, pressure-cooked silver bellies and edible fish powder

	Raw silver bellies with bones (dressed and beheaded)	Pressure-Cooked silver bellies	Edible Fish Powder from silver bellies
Moisture, %	72.50	67.90	5.55
Crude Protein, %	19.05	ND*	62.52
Crude Fat,%	3.58	3.05	8.97
Ash,%	4.07	4.66	15.50
TVBN, mg/100g	12.25	ND	19.13
PV, meq/kg of fat	7	ND	15.21
FFA, % oleic acid	3.52	ND	11.63
Calcium, mg/100g	394.35	ND	1310.96
Phosphorus, mg/100g	845.92	ND	2859.02

* ND = not detemined

down to 50°C and maintaining at 50°C for next five hours while drying the pressure-cooked fish in a tray drier. The moisture content of the dried product was reduced below 6% level for microbial safety. The dried product was ground and packed in polythene pouches (200 gauge HDPE). The yield of the fish powder varied between 10 to 12% of raw whole fish.

Proximate composition of raw (dressed and beheaded) silver bellies, pressure-cooked silver bellies and edible fish powder made from silver bellies is given in Table 2. Edible fish powder was rich in protein and minerals like calcium and phosphorus. The calcium and phosphorus content of the muscle portion of silver belly was reported to be 720.1mg/100g and 735.3mg/100g respectively (Nair and Mathew, 2000) whereas the calcium and phosphorus content of edible fish powder was 1310.96mg/100g and 2859.02mg/100g, respectively. The source of calcium and phosphorus contents of this product was mainly from the bones of the fish, which were otherwise discarded.

Biochemical and microbiological changes occuring during storage of edible fish powder at room temperature at monthly intervals are presented in Table 3. The product was acceptable even upto five months (maximum period tested). The moisture content of the edible fish powder was low and varied between 5.45% and 7.0%, which was essential to control the growth of microorganisms (Schlegel, 1992). There was no significant variation in crude protein, calcium and phosphorus contents during storage. TVBN increased from 19.13mg/100g to 32.25mg/100g, which was well within the limit compared to the recommended value of 100 – 200mg/100g for salted and dried fish (Gopakumar, 2002). There was no significant change in PV and FFA. Rancidity development is a major problem in the storage of dried fishes but the PV and FFA values, which are measures of oxidative and hydrolytic rancidity, were low in the edible fish powder during the period of storage. Since the dressed raw material was autoclaved before drying and

Table 3. Biochemical and Microbiological changes during storage of Edible Fish Powder

	Fresh powder	1st month	2nd month	3rd month	4th month	5th month
Moisture,%	5.55	5.45	6.01	6.63	6.76	7.00
Crude Protein,%	62.52	61.12	60.67	58.12	58.25	58.98
Crude Fat, %	8.97	8.93	7.21	8.12	8.62	7.97
Calcium, mg/100g	1310.96	1251.84	1222.80	1335.19	1281.11	1255.5
Phosphorus, mg/100g	2859.02	3429.55	3487.87	3194.62	3016.0	2906.36
pH	6.4	6.02	6.06	6.06	6.12	6.08
Aerobic Plate Count (APC), cfu/g	9.0×10^3	9.9×10^3	1.02×10^3	1.0×10^3	1.1×10^2	8.6×10^2
Total Yeast Mould Count (TYM), count/g	0	10	20	0	10	0
Faecal Coliforms, MPN/g	0	0	0	0	0	0
E.coli, MPN/g	0	0	0	0	0	0
Coagulase positive *Staphylococci*, cfu/g	0	0	0	0	0	0

pulverization, the edible fish powder had very low bacterial count and pathogens and faecal indicator organisms were absent (Table 3). Yeast and mould were detected at the end of first, second and fourth month of storage but at low counts of 10/g, 20/g and 10/g, respectively. Dry foods owe their durability to dry state but get rapidly attacked by moulds and bacteria when exposed to moist air with consequent absorption of water; hence good packaging is essential to retain the original quality. 200 gauge HDPE, which is a readily available packaging material, preserved the quality of edible fish powder without any adverse effect even upto 5 months (maximum period tested). Sensory quality of the product was also assessed during the period of storage and was found acceptable. Fish flavour of freshly prepared fish powder was very high but the intensity decreased gradually with each month of storage. However, even at the end of 5th month of storage there was distinct fish flavour in the fish powder. The members recorded good fish taste and distinct fish flavour in vegetable curry fortified with fresh edible fish powder (treatment 1) but reported relatively lesser degree of fish flavour in vegetable curry fortified with five month's stored edible fish powder (treatment 2). The fish taste was appreciated in the vegetable curry fortified with edible fish powder.

The preparation of edible fish powder by autoclaving, drying and pulverization provides a viable way of utilizing low value small fishes. This powder is rich in protein, calcium and phosphorus and can be incorporated in curry preparation. Hygienic handling of the product during the process, especially at the time of pressing, extrusion, grinding and packaging, is essential to prevent external microbial contamination.

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