Fishery Technology
2008, Vol. 45(2) pp : 181 - 188

Edible Fish Powder from Small Sized Indian Major Carps

A.K. Chattopadhyay, B. Madhusudana Rao and Sibsankar Gupta
Research Centre of Central Institute of Fisheries Technology, Visakhapatnam - 530 003, Andhra Pradesh
E-Mail : cift@itpvis.ap.nic.in

A new product in the form of edible fish powder was developed from small sized Indian Major Carps by utilizing these fish at the time of glut. Small sized rohu, catla and mrigal were converted to nutritionally rich edible fish powder by thermal processing, without deboning the fish. Freshly prepared edible fish powders from rohu, catla and mrigal were rich in protein (67.4 to 72.6%) and minerals like calcium (1213 to 1344 mg%) and phosphorus (1770 to 1934 mg%). Water activity (a_w) of edible fish powders was low. The fresh edible fish powders were negative for the presence of *E.coli*, coagulase +ve *Staphylococci* and Yeast & mould. The powder made from rohu was acceptable up to 4 months and the powder made from catla was acceptable up to 5 months (maximum period tested) of storage in 200 gauge HDPE at room temperature. Sensory quality of edible fish powders made from rohu and catla (both fresh and at monthly storage intervals) used at 10% level was found acceptable.

Key words : small sized Indian major carps, edible fish powder, storage

Introduction

India is the second largest producer of fresh water fish in the world and fresh water fish production registered a growth rate of over 5% in the last two decades (Tripathi, 2004). The 10th Five Year Plan (2002-2007) envisages an 8% growth rate for inland fisheries (Ayyappan and Biradar, 2004). Andhra Pradesh ranks second in inland fish production and the state targets about 0.6 million tones of inland fish production by the year 2010 (Murthy, 2002). Andhra Pradesh's fish production was 5.94 lakh tones during 2003-04 and the targeted production for 2004-05 was 5.96 lakh tones (Anon, 2005). Indian Major Carps viz., rohu (*Labeo rohita*), catla (*Catla catla*) and mrigala (*Cirrhinus mrigala*) are important food fishes that are predominantly cultured.

Consumer preference is usually for rohu, catla and mrigala with sizes above 1000g. However, small sized Indian Major Carps (< 500g) also enter the market as a glut for various reasons such as: due to complete harvest of fish ponds; due to non-uniform growth of fish, the small sized fish are segregated and marketed separately; distress sale of fish to avoid mass mortalities, etc. These fish have less market demand and hence attract a low price.

Consumer demand is expected to be high for ready to use convenience products that require minimal processing before consumption. A major problem for preparing convenience products from fresh water carps is the presence of bones. Removal of these bones is difficult. Moreover, the removal of bones results in loss of important minerals like calcium and phosphorus.

Value addition to fresh water fish in the form of fish pickles, coated products, fish fingers, ready to eat fish curry was reported (Chattopadhyay, 1985, 1986; Joseph, 2002; Joseph, 2003; Khasim *et al*, 2005). All these products are made from market sized fresh water fish.

Low value marine by-catch was utilized as fish protein concentrate type B and edible fish powder with deboned fish (Gopakumar, 1997; Nair, 2003). Edible fish powder was prepared from red meat of tuna (CIFT, 2006). Edible fish powder was prepared from small bony marine fish without deboning the fish (Chattopadhyay *et al.*, 2004). The present work was taken to develop a process to convert small sized fresh water carps to nutritionally rich edible fish powder without deboning the fish to prevent loss of important minerals like calcium and phosphorus.

Materials and Methods

Fish : Small sized rohu, catla and mrigala weighing about 500g (Table 1) were utilized for preparation of edible fish powder. The fish were purchased from the local markets in fresh condition.

Preparation of edible fish powder: Edible fish powder was prepared as per the method previously described (Chattopadhyay *et al*, 2004) with some modifications. The process is shown as the flow chart (Fig. 1). The

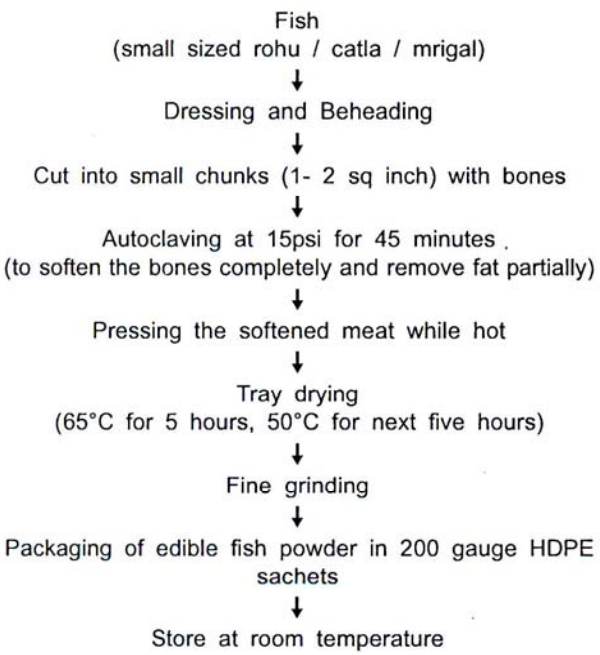

Fig. 1. Flow sheet for the preparation of edible fish powder from small sized Indian Major Carps

Table 1. Size characteristics of Indian Mazor Carps used for edible fésh powder preparation

	Rohu (*Labeo rohita*)	Catla (*Catla catla*)	Mrigal (*Cirrhinus mrigala*)
Length, cm	33	33	35
Width, cm	9	14.5	7.5
Weight of whole fish, g	495	550	450
Weight of dressed fish, g	220	195	215

powder was packed in 100g quantities in readily available 200 gauge HDPE sachets and stored at room temperature. The powders' were analysed at monthly intervals.

Nutritional composition and Quality evaluation: Moisture, protein, fat, ash, peroxide value (PV), calcium, iron, sodium and potassium were determined as per standard methods (AOAC, 1990). Total volatile base nitrogen (TVBN) was determined by the Conway micro diffusion method (Conway, 1947). Inorganic phosphorus was estimated by the method of Fiske and Subba Row (1925). pH of the edible fish powder was measured in a slurry made with distilled water (1:10) and measured using pH meter (systronics GripH meter). Water activity (a_w) was measured using a water activity meter (CIFT, Cochin). Aerobic plate count (APC), MPN *E.coli*, coagulase positive staphylococci, total yeast mould (TYM) count were determined as per Harrigan & McCance, (1976) and Bacteriological Analytical Manual, (1995).

Organoleptic evaluation:

Intensity of fish flavour and taste of edible fish powders prepared from rohu and catla was tested separately. The edible fish powder (fresh and at monthly storage intervals) at 10% level was added to boiling water and continued boiling for 10 min, after which the panel members (n = 10) were asked to judge the intensity of the fish

flavour and taste. The assessment was given on a 5 point score (0 to 5) by the panel members; with a score of 2 being the limit of acceptability.

Overall organoleptic quality of edible fish powders was also assessed by preparing vegetable curry with 10% rohu powder (treatment 1) and vegetable curry with 10% catla powder (treatment 2). The powders were added to the vegetable curry at the time of cooking. The organoleptic assessment was done for fresh powder and at monthly storage intervals. Each time treated batches were placed in identical bowls and were presented for sensory analysis. The members were asked to judge the curries for fish taste and flavour and give the overall acceptability score on a 9 point Hedonic scale (Joseph, 2003), where the product was considered unacceptable if score was below 5.

Statistical Analysis: The data was subjected to analysis by Snedecor and Cochran method (1967)

Results and Discussion

Edible fish powders were prepared from small sized rohu, catla and mrigal by thermal processing as shown in Fig. 1 as per the method described by Chattopadhyay *et al.*, 2004 for small bony marine fishes. However, the present process uses specially designed perforated aluminium trays which help in the uniform distribution of steam during autoclaving. A patent is pending (Chattopadhyay *et al*) for the process of preparation of edible fish powder from marine fishes using perforated aluminium trays.

Small sized rohu, catla and mrigal were selected for the preparation of edible fish powder. The size characteristics of the fishes were given in Table 1. The yield of edible fish powder from small sized Indian major carps was 8 to 9% of whole fish. Dressing losses were above 50% for all the small sized Indian Major carps (Fig. 2). In the case of catla the dressing loss was above 65% which was mainly due to its bigger head size. The waste obtained during dressing can be utilized as fish meal for use in animal feeds.

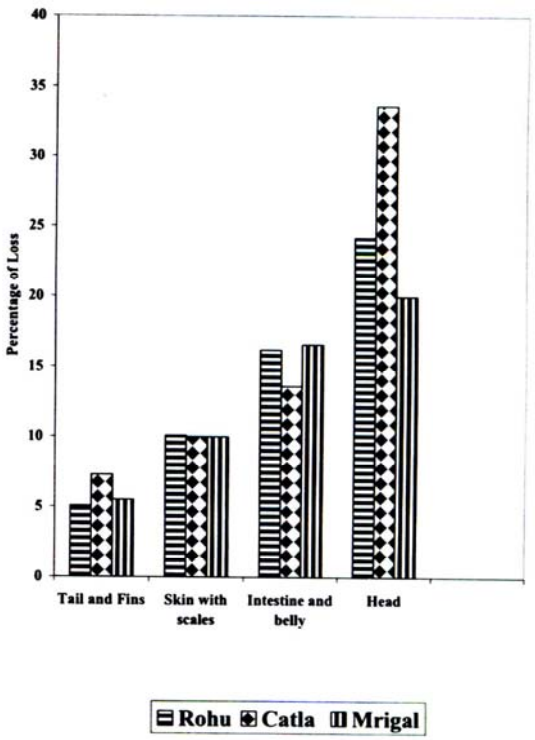

Fig. 2. Losses (as percentage of whole fish) during dressing of small sized Indian Major Carps

The proximate composition of meat (including bones) of small sized Indian major carps (Table 2) shows that these fish were rich in protein (18.37% to 18.6%) and minerals (calcium 51.11 to 247.57mg%, phosphorus 335 to 389 mg%). The proximate composition values were similar to those reported (Joseph, 2002; Sankar and Ramachandran, 2002). The quality of raw fish was found to be good as the chemical and microbiological parameters were within acceptable limits (Connell, 1975; Anon, 1995).

Freshly prepared edible fish powders from rohu, catla and mrigal (Table 3) were

Table 2. Composition and quality of fresh fish meat (including bones) of Indian Major Carps

	Rohu (*Labeo rohita*)	Catla (*Catla catla*)	Mrigal (*Cirrhinus mrigala*)
Moisture, %	78.25	80	80.1
Protein, %	18.37	18.56	18.6
Fat, %	1.34	1.04	1.44
Calcium, mg%	51	130	248
Phosphorus, mg%	389	350	335
Iron, mg%	1.09	1.08	1.1
Sodium, mg%	54.8	10.8	60.6
Potassium, mg%	204	270	106
APC, cfu/g	$1.4x10^4$	$5.1x10^4$	$1.5x10^5$
E.coli, MPN/g	20	3.6	0
Coagulase +ve *Staphylococci*, cfu/g	40	80	0
TYM/g	0	0	20
TVBN, mg%	11.52	14.62	14.25
PV, meq of O_2/ kg of fat	4.0	0	9.16

rich in protein (67.4 to 72.6%) and minerals like calcium (1213 to 1344 mg%) and phosphorus (1770 to 1934 mg%). The source of calcium and phosphorus contents of edible fish powder was mainly from the bones of the fish which are otherwise discarded. The moisture content of the edible fish powder was reduced to below 5% level for microbial safety. Water activity (a_w) of edible fish powders was low in fresh edible fish powder prepared from rohu (0.243) and catla (0.159). The fresh edible fish powders did not contain *E.coli* and coagulase +ve *Staphylococci*. Yeast and mould were not detected. TVBN values ranged from 24.58 to 32.25 mg% which were well within the limits compared to recommended value of 100 to 200 mg% for salted and dried fish (Gopakumar, 2002).

Biochemical and microbiological changes occurring during storage of edible fish powders made from rohu and catla at room temperature at monthly intervals are presented in Table 4 and 5. The powder made from rohu was acceptable up to 4 months and the powder made from catla was acceptable up to 5 months (maximum period tested). The variation in crude protein, calcium and phosphorus content during storage was low. TVBN increased from 32.25mg% to 50.87mg% at the end of 4 months storage in case of rohu and from 24.58mg% to 60.52mg% at the end of 5 months storage in the case of catla which were well within the limits compared to the recommended value of 100-200mg% for salted and dried fish (Gopakumar, 2002). Peroxide value, a measure of rancidity, did not show significant change during storage. *E.coli*, coagulase positive *Staphylococci*, yeast and mould were not detected. There was a slow increase in APC during storage. a_w of the edible fish powder during storage increased from 0.288 to 0.326 at the end of 4 months of storage in the case of rohu and increased from 0.2 to 0.542 at the end of 5 months of storage in the case of catla in 200 gauge HDPE sachets at room temperature.

Table 3. Nutritional Composition and quality of fresh edible fish powders prepared from Indian Major Carps

	Fresh Edible Fish Powder		
	Rohu	Catla	Mrigal
Moisture, %	4.13	3.47	2.15
Protein, %*	67.4	69.97	72.62
Fat, %*	5.17	3.223	4.75
Calcium, mg% *	1344	1529	1213
Phosphorus, mg% *	1770	1801	1934
Iron, mg% *	5.01	4.65	5.25
Sodium, mg% *	242	77.6	354
Potassium, mg% *	619	673	302
APC, cfu/g	$3.8x10^3$	$4.1x10^3$	$1.6x10^3$
E.coli, MPN/g	0	0	0
Coagulase +ve *Staphylococci*, cfu/g	0	0	0
TYM/g	0	0	0
TVBN, mg%	32.25	24.58	29.52
PV, meq of O_2/ kg of fat	9.08	9.54	5.80
a_w	0.243	0.159	-
pH	6.0	6.0	6.0

* Values were on wet basis

Table 4. Storage studies of edible fish powder prepared from small sized Rohu

	Storage period in months				
	0	1	2	3	4
Moisture, %	4.13	5.01	6.5	6.95	7.34
Protein, %	67.4±0.28* (70.3)**	68.32±0.20 (71.92)	68.92±0.17 (73.71)	66.52±0.17 (71.48)	66.02±0.11 (71.24)
Fat, %	5.17±0.27 (5.39)	5.8±0.07 (6.1)	5.7±0.76 (6.09)	6.1±0.03 (6.55)	6.25±0.13 (6.74)
Calcium, mg%	1344±8.49 (1401)	1300±19.80 (1368)	1312±19.8 (1403)	1231±16.97 (1322)	1250±14.14 (1349)
Phosphorus, mg%	1770±19.8 (1846)	1801±16.97 (1895)	1740±7.07 (1860)	1702±14.14 (1829)	1695±7.07 (1829)
APC, cfu/g	$3.8x10^3$	$4x10^3$	$6x10^3$	$6.2x10^3$	$6.4x10^3$
E.coli, MPN/g	0	0	0	0	0
Coagulase +ve *Staphylococci*, cfu/g	0	0	0	0	0
TYM/g	0	0	0	0	0
TVBN, mg%	32.25	38.09	41.52	50.52	50.87
PV, meq of O_2/ kg of fat	9.08	9.52	9.6	10.31	11.23
a_w	0.243	0.288	-	-	0.326

* mean ± SD

** Value in parentheses indicates mean value on dry basis

Table 5. Storage studies of edible fish powder prepared from small sized Catla

	Storage period in months					
	0	1	2	3	4	5
Moisture, %	3.47	5.06	4.80	5.39	6.88	8.48
Protein, %	69.97±0.35* (72.48)**	70.52±0.76 (74.27)	67.58±0.31 (70.98)	67.88±0.28 (71.74)	66.12±0.28 (71)	66.82±0.01 (73.01)
Fat, %	3.223±0.13 (3.338)	3.85±0.1 (4.05)	3.7±0.2 (3.88)	3.3±0.42 (3.48)	2.72±0.4 (2.92)	3.15±0.35 (3.44)
Calcium, mg%	1529±15.56 (1583)	1603±15.56 (1688)	1661±4.24 (1744)	1408±18.38 (1488)	1389±9.9 (1491)	1356±8.49 (1481)
Phosphorus, mg%	1801±9.9 (1865)	1740±15.56 (1832)	1800±11.31 (1890)	1802±4.24 (1904)	1789±9.9 (1921)	1743±12.73 (1904)
APC, cfu/g	$4.1x10^3$	$4.8x10^3$	$6.4x10^3$	$6.8x10^3$	$8.1x10^3$	$8.2x10^3$
E.coli, MPN/g	0	0	0	0	0	0
Coagulase +ve *Staphylococci*, cfu/g	0	0	0	0	0	0
TYM/g	0	0	0	0	0	0
TVBN, mg%	24.58	41.05	49.52	56.36	58.11	60.52
PV, meq of O_2/ kg of fat	9.54	10.36	11.30	12.31	13.53	14.71
a_w	0.159	0.2	-	-	-	0.542

* mean ± SD

** Value in parentheses indicates mean value on dry basis

Table 6. Overall organoleptic assessment of edible fish powders prepared from Indian Major Carps

Storage Period	Treatment 1 (vegetable curry with 10% rohu powder)	Treatment 2 (vegetable curry with 10% catla powder)
Fresh	9 ± 0.67*	9 ± 0.67
1 month	9 ± 0.67	9 ± 0.67
2 months	8.5 ± 0.53	8.5 ± 0.53
3 months	8 ± 0.67	8.5 ± 0.53
4 months	7.5 ± 0.85	8 ± 0.67
5 months	-	7.5 ± 0.85

* mean ± SD

Intensity of fish flavour and taste of edible fish powders prepared from rohu and catla (fresh and at monthly storage intervals) used at 10% level was found acceptable. The assessment was given on a 5 point score (0 to 5) by the panel members. Fresh and one month stored powders were scored as 5 by the panel members, while at the end of 2 months the average score was 4.6±0.5 and at the end of 3rd month the score was 3.6±0.5 for both rohu and catla powders. At the end of 4th month the mean score for rohu powder was 3±0.67 and for catla powder it was 3.2±0.78. Even at the end of 4 months of storage of rohu powder and after 5months of storage of catla powder, the panel members gave mean value higher than the limit of acceptability.

Vegetable curry with 10% rohu powder (treatment 1) and vegetable curry with 10% catla powder (treatment 2) were assessed for overall organoleptic acceptability and the results given in Table 6. The average scores for both rohu and catla powders were similar. The fish flavour and taste were high in fresh powders but the intensity of fish flavour showed a decreasing trend with increase in storage period. However, the members scored distinct fish flavour and taste even at the end of 4 months of storage for rohu powder and 5 months of storage for catla powder. The powder made from rohu was acceptable up to 4 months and the powder made from catla was acceptable up to 5 months (maximum period tested) of storage in 200 gauge HDPE at room temperature.

A new product in the form of edible fish powder has been developed from small sized Indian Major Carps by utilizing these fish at the time of glut so as to improve the consumer acceptance and profitability. The edible fish powders were rich in protein and minerals like calcium and phosphorus and can be used as a fortifying agent for human consumption to mitigate malnutrition problem.

The authors are grateful to Dr. K. Devadasan, Director, Central Institute of Fisheries Technology for giving permission to publish this paper. Technical help rendered by N. Venkata Rao and P. Radhakrishna is gratefully acknowledged.

References

AOAC (1990) *Official Methods of Analysis*. 15th edn., Associtaion of Official Analytical Chemists, Washington, DC, U.S.A.

Anon (1995) *Quality assurance and monitoring system manual on export of fresh, frozen processed fish and fishery products*. Export Inspection Council of India, Ministry of Commerce, Order S.O. 729(E) dt. 21-8-1995.

Anon (2005) Highlights of fisheries development of Andhra Pradesh. *Fishing Chimes*, **24**, pp 64-70

Ayyappan, S. and Biradar, R.S. (2004) Indian Fisheries : Looking ahead. In : *Current scenario and future needs of Indian Fisheries*. pp 1-7, Decennial publication of FOFP-2004, Forum of Fisheries Professionals, Visakhapatnam.

Bacteriological Analytical Manual (1995) 8th edn., AOAC International, U.S.A.

Chattopadhyay, A.K., Bhattacharya, S.K. and Bandopadhyay, J.K. (1985) Development of pickled products from low cost fresh water fish. In: *Harvest and Post-Harvest Technology of Fish*, Society of Fisheries Technologists (India), Cochin, pp 611-614

Chattopadhyay, A.K., Bandopadhyay and J.K. Bhattacharya, S.K. (1986) Low cost fresh-water fish pickle using cheap citrus fruit (*C. reticulata*). *Fish. Technol.* **23**, pp 171-173

Chattopadhyay, A.K., Rao, B.M. and Gupta, S. (2004) A simple process for the utilization of small bony fish as edible fish powder. *Fish. Technol.* **41**, pp 117-120

CIFT (2006) *Annual Report 2005-06*, Central Institute of Fisheries Technology, Cochin, pp 30

Connell, J.J. 1975. *Control of Fish Quality*, pp 123-129. Fishing News (Books) Ltd., Surrey, England

Conway, E.J. (1947) *Microdiffusion Analysis and Volumetric Error.* pp 157-159, Crosby Lockwood, London.

Fiske, C.H. and Subba Row, Y. (1925) The colorimetric determination of Phosphorus. *J. Biol. Chem*, **66**, pp 375-380

Gopakumar, K. (1997) Products from whole fish. In: *Tropical Fishery Products*, pp 45-67, Oxford & IBH Publishing Co Pvt Ltd, New Delhi, India

Gopakumar, K. (2002) Post-mortem changes in fish and quality assessment. In: *Text Book of Fish Processing Technology*, Indian Council of Agricultural Research, New Delhi, India, 36 p.

Harrigan, W.F. and McCance, M.E. (1976) *Laboratory methods in Food and Dairy Microbiology.* 141p, Academic Press, London, U.K.

Joseph, A.C. (2003) Coated fish products for export and domestic markets. In: *Seafood Safety* (Surendran, P.K., Mathew, P.T., Thampuran, N., Nambiar, V.N., Joseph, J., Boopendranath, M.R., Lakshmanan, P.T., Nair, P.G.V., Eds), pp 1-12, Society of Fisheries Technologists (India), Cochin.

Joeph, J. (2002) Present status and future prospects of fresh water fish processing. In : *Riverine and Reservoir Fisheries of India* (Boopendranath, M.R., Meena Kumari, B., Joeph, J., Sankar, T.V., Pravin, P. & Edwin, L., eds) Society of Fisheries Technologists (India), Cochin, pp 281-287

Joseph, J. (2003) Sensory evaluation of food. In: *Seafood Safety* (Surendran, P.K., Mathew, P.T., Thampuran, N., Nambiar, V.N., Joseph, J., Boopendranath, M.R., Lakshmanan, P.T., Nair, P.G.V., Eds), Society of Fisheries Technologists (India), Cochin, pp 99-121

Khasim, D.I., Jeeva, J.C., Rao, B.M and Gupta, S. (2005) Processing and value addition of freshwater fishes in Andhra Pradesh. In : *Sustainable Fisheries Development: Focus on Andhra Pradesh*, (Boopendranath, M.R., Mathew, P.T., Gupta, S.S., Pravin, P. and Jeeva, J.C., Eds.), Society of Fisheries Technologists (India), Cochin, pp 1-9

Murthy, D.S. (2002) Highlights of fisheries development of Andhra Pradesh. *Fishing Chimes*, **22**, pp 64-70

Nair, K.G.R. (2003) Products from less utilized fish. In : *Seafood Safety* (Surendran, P.K.,

Mathew, P.T., Thampuran, N., Nambiar, V.N., Joseph, J., Boopendranath, M.R., Lakshmanan, P.T., Nair, P.G.V., Eds), Society of Fisheries Technologists (India), Cochin, pp 13-19

Sankar, T.V. & Ramachandran, A. (2002). Changes in Bio-chemical composition of Indian major carps in relation to size. *Fish. Technol.* **38**, pp 22-27

Snedecor GW, Cochran WG (1967) Statistical Methods, Oxford and IBH Publishing Co, Calcutta.

Tripathi, S.D. (2004) Fresh water aquaculture in India. In : *Current scenario and future needs of Indian Fisheries*. pp 41-46, Decennial publication of FOFP-2004, Forum of Fishermes Professionals, Visakhapatnam.