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Nutritional quality of fresh water catfish (*Wallago attu*) available in Manipur, India

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The nutritional quality of catfish *Wallago attu* brought from other states and sold in the local market (IF) was compared with that of freshly caught fish (FF) over a 2-month period (February and March, 1995). FF have slightly higher values of crude protein, non-protein N and pH, and lower values of moisture and TVBN than IF. Peroxide value (POV), thiobarbituric acid (TBA) number and free fatty acid (FFA) of FF and IF were studied. Moisture, crude protein, lipid and ash contents of FF and IF were 79.43 vs 80.47, 16.7 vs 15.8, 1.98 vs 1.43 and 1.23 vs 0.52, respectively. *In vitro* digestibilities of FF, IF and reference casein were 92.7, 91.8 and 98.0, respectively. *In vivo* digestibilities for 28 days of feeding to albino rats were 83.1, 80.4 and 86.6. The PER value of FF is not significantly different from that of casein, but that of IF is significantly different, both from FF and reference casein at the 5% level of significance. The probable effect of icing on the nutritional quality of the fish is discussed. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Icing of fish for transportation is a common practice in India. It is reported that most iced fish in the major marketing centres of India are of substandard quality (Nair *et al.*, 1974; Govindan, 1985). Iced storage of fish results in a decrease of total nitrogen (TN) and non-protein nitrogen (NPN) (Reddy & Shrikar, 1991), denaturation of myofibrillar proteins (Fredrick & Thomas, 1985) and proteolytic activity, indicated by an increase in the α-amino nitrogen and tyrosine values (Nair *et al.*, 1971). Freshwater catfish, *Wallago attu*, is an important food fish for household consumption. As the depleted fish stock of the state cannot meet the demand of the growing population, a considerable quantity of iced *W. attu* is purchased from other states. Transportation of the fish takes several days. It is desirable to determine the microbial and nutritional quality of such fish reaching the market in order to assure health and hygiene to consumers. Vishwanath & Lilabati (1995) studied the microbiological quality of the fish in detail. This paper reports a comparison of the composition and nutritional quality between freshly caught fish (FF) and iced fish (IF) brought from other states and sold in Imphal market, Manipur.

MATERIALS AND METHODS

Sample collection

Fresh *W. attu* (FF) weighing 0.5–2 kg were caught with the help of rod and line from the Imphal river in February and March, 1995. Fish were packed in ice and brought to the laboratory. Within 2–3 h of the catch, muscles from three to four fish were sampled and pooled together for analysis. In the case of IF, similar numbers of fish were selected from ice boxes in the Imphal market, randomly, and muscles sampled, as for fresh fish. Such samplings were carried out weekly in the 2-month period of study.

Biochemical analysis

Total N, non-protein N, moisture, lipid and ash were estimated following AOAC (1975). Crude protein (CP) values were obtained from N values as described by Singh *et al.* (1990). Free fatty acid (FFA), peroxide value (POV) and total volatile basic N (TBVN) were determined using the method of Morris (1959). The pH was measured using a pH meter (Valsan, 1975). The thiobarbituric acid (TBA) number was determined as in Sinhuber & Yu (1958).

Table 1. Composition of diets (g/100 diet)

Ingredients	Control diet	FF diet	IF diet	Protein-free diet
Casein vitamin-free (Hi-Media, India)	10	—	—	—
Fish powder (lipid-free)	—	11.12	11.69	—
Refined groundnut oil (Dalda, India) (ml)	9.0	9.0	9.0	4.0
Vitamin mixture (AOAC, 1960)	1.0	1.0	1.0	1.0
Salt mixture (AOAC, 1960)	4.0	4.0	4.0	4.0
Sucrose	—	—	—	20.0
Starch	—	—	—	65.0
Wheat flour	76.0	74.88	74.31	—

Table 2. Composition of wheat flour (proximate composition) and FF and IF

Composition	Wheat flour	FF	IF
Moisture	14.00 ± 0.22	79.43 ± 0.21	80.47 ± 0.53
CP (%)	10.30 ± 0.21	16.72 ± 0.26	15.48 ± 0.39
NPN (%)	—	0.52 ± 0.05	0.49 ± 0.01
Lipid (%)*	0.80 ± 0.04	1.98 ± 0.07	1.43 ± 0.17
TVBN (mg/100 g)	—	10.0 ± 2.0	12.0 ± 2.0
FFA (oleic acid %)*	—	1.80 ± 0.10	5.5 ± 0.28
POV (mmol/kg fat)*	—	0.00 ± 0.0	11.43 ± 0.11
TBA No. (mg malonaldehyde/kg)*	—	0.46 ± 0.4	0.78 ± 0.09
Ash (%)*	0.70 ± 0.02	1.23 ± 0.10	0.52 ± 0.03
pH	—	6.95 ± 0.24	6.76 ± 0.14

*Composition shows that the values of FF and IF are significantly different ($P < 0.05$) in ANOVA test.
Note: results are mean ± SD of eight samplings.

Digestibility, biological value (BV) and PER

Digestibility *in vitro* was determined as described by Singh *et al.* (1990). For determination of digestibility *in vivo*, a feeding experiment was carried out using 21 ± 1-day-old albino rats. Six rats weighing 30–40 g from the same colony were used for a particular diet. Four sets of experiments were performed using the following diets: (1) casein diet as a control diet; (2) FF diet as test diet A; (3) IF diet as test diet B; and (4) a protein-free diet for determination of metabolic N. The protein content of the diets was calculated taking into account the proximate composition of wheat flour, FF and IF, as in Table 2. The compositions of the test diets are given in Table 1. Feeding was carried out for 28 days at ambient temperature, with food and water being provided *ad libitum*. At the end of every fourth day, the amount of food consumed and weight gain by the rats were noted. N content in food, excreta and faecal matter were estimated.

Digestible protein was calculated by subtracting the value of CP in excreta and faecal matter from that of food consumed. True digestibility was obtained by correction with metabolic N, the latter determined from the excreta and faecal matter of rats fed with protein-free diet. PER was calculated as weight gain (in g)/protein consumed (in g).

RESULTS AND DISCUSSION

Biochemical compositions of FF and IF in Table 2 show slightly higher values of moisture and TVBN, and slightly lower values of CP, NPN and pH in IF. Ice storage results in the uptake of water by fish (Joseph *et al.*, 1988). Increases in the TVBN value in tropical marine fish are comparatively higher than those of freshwater fish under ice storage conditions (Connell, 1980). Perigreen *et al.* (1987) observed a TBVN value of 16.2 mg/100 g after 13 days of ice storage of channid fish, murrel, which is unacceptable. The ice-stored *W. attu* in the present study showed a value of 12.0 mg/100 g sample, which is fairly high. The lower values of CP and NPN might be due to dripping or leaching out of water-soluble protein fractions from muscle along with ice melt water (Solanki & Venkataraman, 1978; Joseph *et al.*, 1980; Garg & Stephen, 1982). The lower values of pH may be attributed to the accumulation of lactic acid by anaerobic glycolysis (Jasmine, 1985).

Significantly higher ($P < 0.05$) values of lipid, FFA, TBA and POV, and ash were seen in IF. The results show that considerable oxidation of lipids has taken place in the process of preservation and transportation. However, the fish is within acceptable limits as a TBA value of less than 3 mg malonaldehyde/kg sample of frozen fish indicates good condition (Sinhuber & Yu, 1958).

Table 3. Digestibility of protein *in vitro*

Sample	Digestibility (%)	
	Pepsin	Pepsin + trypsin
Casein	88.0 ± 0.70	98.0 ± 0.33
FF	81.52 ± 0.82	92.7 ± 0.63
IF	80.6 ± 0.32	91.8 ± 0.82

Table 4. N intake, N output, digestibility *in vivo*, biological value (BV) and PER of test diets. Mean values for 28 days of feeding trials

Diet	N in diet (g)	N in excreta (g)	Metabolic N (g)	Apparent digestibility (%)	True digestibility (%)	BV (%)	PER
Casein	9.04	1.85	0.64	79.5	86.6	92.8[a]	2.44[a]
FF	6.12	1.47	0.44	76.0	83.1	93.0[a]	2.43[a]
IF	7.05	1.89	0.58	73.2	80.4	90.2[b]	2.24[b]

Note: BV and PER values with different superscripts are significantly different ($P < 0.05$).

Digestibilities of casein and fish diets are listed in Tables 3 and 4. Casein diet was the most digestible of the three, followed by the FF and IF diets in decreasing order. Lower digestibility in IF may be related to coagulation of muscle protein in rigor mortis (Fredrick & Thomas, 1985). The presence of oxidized sulphur amino acids in the protein chain also makes it resistant to enzyme hydrolysis, thus reducing its digestibility (Devadashan *et al.*, 1985).

BV and PER values of the IF diet were slightly lower than those of the casein and FF diets ($P < 0.05$), while the values in the latter two diets were not significantly different. These results indicate a probable loss of nutrient-rich tissue water containing minerals and water-soluble protein as drip (Kreuzer, 1965) and also the interaction of protein with oxidized lipid (Devadashan, 1981).

The FF of the Imphal river are nutritionally rich, as shown by its BV and PER values which are comparable to those of the casein diet. IF brought from other states have a slightly lower nutritive value; the PER, however, is more than 2.00, a value considered appropriate for a protein-rich food (Singh *et al.*, 1990). It may be concluded that both FF and IF are nutritionally rich, except for the higher counts of bacteria and fungi in IF that demand attention (Vishwanath & Lilabati, 1995). The establishment of re-icing facilities en route to Manipur may improve the quality of iced fish.

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