Nutritive Value of Edible Meat Powder and Meal from Three Fatty Deep Sea Fishes

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Evaluation of the nutritive quality of edible meat powder from *Pseneopsis cyanea* and of fish meals from *Pseneopsis cyanea*, *Chlorophthalmus agassizi* and *Epinnula orientalis* was carried out by chemical and biological methods. Protein efficiency ratio (PER) was lower than or equal to that of the reference protein casein for the meals from *P. cyanea* and *C. agassizi* and for the edible meat powder from *P. cyanea*. The intake of food and PER of *E. orientalis* meal was very low. Based on essential amino acid data, leucine, cystine, methionine, threonine and valine were found to be the limiting amino acids in the meals, the amino acid scores being respectively 78, 85, 72 and 53 for the fish meals from *P. cyanea*, *C. agassizi* with and without stick liquor and *E. orientalis*.

Recent studies have revealed the enormous potential uses of many of the hitherto under/unexploited fishery resources available from the Exclusive Economioc Zone of India (Gopakumar *et al.*, 1983; Mukundan & Devadasan, 1988 a, b; Lekshmy Nair *et al.*, 1989; Perigreen *et al.*, 1988). The presence of high amount of fat in many of these fishes makes product development difficult. Meals prepared from these fishes usually possess an unappealing appearance and are oily. This paper summarises the results of the studies on the nutritional quality of meals prepared from three fatty deep sea fishes, namely, *Pseneopsis cyanea, Chlorophthalmus agassizi* and *Epinnula orientalis* and of the edible meat powder prepared from one of them.

Materials and Methods

Chlorophthalmus agassizi and *Epinnula orientalis* caught during August-September 1986 from the West Coast of India and *Pseneopsis cyanea* caught off Cochin in September - October 1987 in the trawl nets of FORV 'Sagar Sampada' were used for these studies. The fish were washed well, packed in polythene bags, quick frozen at -40^{0}C on board the vessel, stored at -18^{0}C till the end of the cruise and kept at the frozen storage of the laboratory (-23^{0}C) for 2-3 weeks before processing.

The fish was thawed and the edible portion was separated, minced and dried in a tunnel drier at 45-50^{0}C for 8 h. The dried and pulverised sample was used for chemical analysis and nutritional quality evaluation.

The thawed fish was cooked under steam at 0.7 kg cm^{-2} for 20 min, stick water was drained off, as much oil as possible was removed by pressing and the press cake was spread on perforated aluminium trays and sundried for 12-14 h. In the case of *C. agassizi* another batch of meal in which the stick water after removal of the separated oil was added back to the press cake before drying was also prepared. Proximate composition of the products was determined according to AOAC (1975) procedure.

The defatted samples were hydrolysed with 6N hydrochloric acid in a sealed tube at 110°C for 22 h and the amino acid analysis of the hydrolysed samples was carried out on a Technion NC 2P amino acid analysing system (single column). The chemical score of the products were calculated as follows:

$$\text{Amino acid score} = \frac{\text{mg of amino acid in g of test sample x 100}}{\text{mg of amino acid in reference pattern (FAO/WHO, 1973)}}$$

Test diets were prepared using the samples according to Chapman *et al.*, (1959). Casein was used as the reference protein. The level of protein was adjusted to 10% in all the diets and necessary adjustments for the minerals and fat provided by the test proteins were made so that the final diets conformed to the formula as advocated in the method. Seven male albino rats of Wistar strain were used for each test diet. Food and water were given *ad libitum* and a record of daily intake of food and weekly gain in weight was kept for 4 weeks. Observations on the behaviour and physical changes, if any, on the rats were also recorded periodically.

At the end of 4 weeks, the rats were sacrificed with chloroform and spleen, kidney and liver were removed and weighed. The organ weights of the group fed on *E. orientalis* were not taken.

Results and Discussion

The yields and chemical composition of the edible portion of *P. cyanea* and of the meal from the three fishes are presented in Table1. Yields of edible meat powder from *P. cyanea* was 12.0% and of the meals from *P. cyanea, C. agassizi* with and without stick water and *E. orientalis* were respectively 24.7, 24.0 20.6 and 30.0%. Fat content of the edible meat powder was 36.67% and hence the pulverization of the edible meat was difficult. The meals were deep brown in colour and extremely oily. Addition of stick water increased the yield of fish meal from *C. agassizi* by 3.4%. The fat content of the fish meal varied from 18.6 to 44.0%. As such none of them conform to IS specifications for fish meals (IS: 4307, 1973). Protein content of the meals from *C. agassizi* and *P. cyanea* conformed to grade I and grade 2 fish meal respectively.

Amino acid composition of edible meat powder and fish meals are shown in

Table 1. *Yield and chemical composition of edible meat powder and fish meals*

	Edible meat powder from *Pseneopsis Cyanea*	Meals from *Pseneopsis cyanea*	Meals from *Chlorophthalmus agassizi* with stick water	*Chlorophthalmus agassizi* without stick water	Meals from *Epinnula orientalis*
Yield, % of whole fish	12.00	24.70	24.00	20.60	30.00
Moisture, %	4.01	5.69	3.91	4.27	4.01
Fat, %	26.67	30.00	19.10	18.60	44.00
Ash, %	3.55	8.98	13.07	13.35	6.13
Crude protein, %	55.73	53.68	63.18	62.47	45.93

Table 2. Total essential amino acids in the samples ranged from 35.4 to 45.1 g per 100 g protein. These values compared well with the reference pattern protein (FAO/ WHO,1973) and whole egg protein (FAO, 1970). The lysine content ranged from 6.9 to 10 g/100g protein. This is more than the amount advocated in the FAO/WHOpattern (1973). The chemical score for fish meals from *P. cyanea*, *C. agassizi* with and without

Table 2. *Amino acid composition of edible meat powder and fish meals (g amino acid/100 g protein)*

Amino acid	Edible meat powder from *P cyanea*	Meal from *P.cyanea*	Meal from *C. agassizi* with stick water	Meal from *C. agassizi* without stick water	Meal from *E. orien*
Aspartic acid	9.7	8.5	10.7	9.0	8.0
Threonine	4.0	3.1	4.2	4.8	2.1
Serine	3.6	3.0	3.8	3.1	5.0
Glutamic acid	16.6	15.2	14.9	11.9	14.8
Proline	3.0	3.8	4.2	5.6	4.8
Glycine	3.8	3.8	6.5	5.5	3.5
Alanine	5.6	5.9	6.1	5.5	5.7
Cystine	0.4	0.4	0.7	0.9	0.3
Valine	5.1	5.2	3.6	6.1	4.7
Methionine	2.8	3.0	2.5	5.6	2.5
Isoleucine	5.0	4.6	4.0	4.8	4.5
Leucine	8.1	7.0	6.9	6.4	7.4
Tyrosine	4.2	3.9	3.4	6.1	3.8
Phenylalanine	3.3	3.3	3.5	5.5	3.0
Histidine	3.1	4.2	2.8	4.5	3.8
Lysine	10.5	8.5	9.0	6.9	6.0
Arginine	7.6	7.8	6.2	5.2	6.9

stick liquor and *E. orientalis* were respectively 78, 85, 72 and 53. Leucine, cystine, methionine, threonine and valine comprised a group which formed the limiting amino acids in the fish meal samples. The edible meat power from *P. cyanea* had all the essential amino acids in sufficient quantities (FAO/WHO, 1973) and a high level of lysine.

The weight gain, protein intake and protein efficiency values for the edible meat powder and fish meals are shown in Table 3. PER of the edible meat powder from *P. cyanea* was comparable to casein while that of the fish meal was lower. Food intake of the control and test diets did not show much variation. Although the edible meat powder had a high level of lysine it did not reflect in the PER value. The PER of the meal from *C. agassizi* with the stick water was slightly higher than the PER of casein, but the meal without stick water showed a lower PER. The markedly improved nutritional quality of the meal with stick water may be due to the addition of fish solubles to the press cake thus increasing the availability of nutrients for growth purposes. The test diets were quite palatable to the experimental animals. No untoward symptoms were noticed during the feeding trials.

The food intake in the case of *E. orientalis* meal was very poor and the rats exhibited stunted growth and loss of physical activity. The PER was significantly lower than that of casein. However,diarrhoea,

Table 3. *Weight gain, protein intake and protein efficiency ratio of edible meat powder and fish meals*

Protein source	Initial weight g	Final weight g	Gain in weight g	Protein intake g	PER	Adjusted PER
Edible meat powder from *P. cyanea*	36.66 ± 1.89	98.04 ± 10.19	61.38 ± 9.03	22.91 ± 3.00	2.67 ± 0.07	2.41
Meal from *P. cyanea*	36.22 ± 1.20	87.38 ± 7.79	51.16 ± 8.05	20.29 ± 3.65	2.53 ± 0.11	2.28
Casein	37.66 ± 4.76	93.86 ± 12.16	56.20 ± 8.73	20.24 ± 2.14	2.77 ± 0.23	2.50
Meal from *C. agassizi* with stick water	40.42 ± 5.59	101. 17 ± 15.33	60.75 ±11.41	22.78 ± 2.86	2.64 ± 0.18	2.54
Meal from *C. agassizi* without stick water	41.22 ± 6.15	95.42 ± 11.86	54.20 ± 7.38	23.04 ± 2.33	2.35 ± 0.18	2.26
Casein	40.27 ± 7.14	93.75 ± 10.91	53. 48 ± 6.29	20.57 ± 1.75	2.60 ± 0.18	2.50
Meal from *E. orientalis*	42.90 ± 4.50	53.41 ± 8.64	10.51 ± 2.18	12.50 ± 3.06	1.21 ± 0.18	1.12
Casein	42.88 ± 4.10	93.96 ± 3.63	51.08 ± 4.06	18.84 ± 1.20	2.71 ± 0.11	2.50

seborrhoea or mortality was not noticed during the entire experimental period. Mukundan and Devadasan (1988b) reported PER values of 1.9±0.15 and 2.21±0.15 for the edible muscle powders from *C. agassizi* and *E.orientalis* in comparison to a PER of 2.56±0.10 for skim milk powder. The present studies in meals revealed a different pattern, the *E. orientalis* meal showing poorer nutritional quality compared to the *C. agassizi* meals. The low value obtained for the former meal in the present studies can be attributed to the low protein content of the meal and to a probable reduction in the availability of the essential amino acids (Table 2). The very high fat content of the meal might also have adversely affected its nutritional quality. Palatability of the meal was poor.

Table 4 shows the weights of organs of the rats fed on experimental and controal diets. Rats fed on meals from *P. cyanea* and *C. agassizi* showed organ weights similar to that of the control group. The group fed on edible meat powder from. *P. cynea* had higher organ weights. Final weights of the experimental rats of this group were higher due to marginally better intake of food. The increased organ weights was proportional to total final weight. The present studies showed that conversion of these fatty fishes into meals by conventional methods results in a product with low protein quality and hence modified processing techniques are required to retain the protein quality of the final product.

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Table 4. *Organ weights of experimental and control rats* (g)

	Spleen	Kidney	Liver
Edible meat powder from *P. cyanea*	.46 ± .01	.76 ± .08	4.39 ± .15
Meal from *P. cyanea*	.23 ± .02	.68 ± .03	3.68 ± .08
Casein	.27 ± .03	.72 ± .05	3.79 ± .03
Meal from *C. agassizi* with stick water	.32 ± .06	.84 ± .07	4.09 ± .35
Meal from *C. agassizi* without stick water	.38 ± .03	.82 ± .01	4.03 ± .18
Casein	.40 ± .09	.79 ± .06	3.85 ± .15

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