Fish. Technol. (1982) **19**, 97-100

Squilla Protein: Chemical Composition and Nutritive Value

P. T. MATHEW, A. LEKSHMY NAIR and P. V. PRABHU
Central Institute of Fisheries Technology, Cochin-682 029

Protein extract prepared from squilla *(Orato squilla nepa)*, a commercially unexploited crustacean, was analysed for crude protein and essential amino acids. All the essential amino acids except tryptophan and threonine were present in nutritionally adequate amounts. The protein was evaluated for its nutritional quality in respect of growth rate, protein efficiency ratio (PER) and liver nitrogen content by feeding on rats. Growth rates and protein efficiency ratios were similar in rats fed on casein, squilla protein and a combination of squilla protein and casein (1:1) diet. The weight of liver and kidneys were normal.

Squilla is a crustacean caught in large quantities along with shrimp during trawling operations. A correct estimate of the total catch of squilla by fishing trawlers along the east and west coasts of India cannot be made since most of it is thrown overboard when caught and whatever landed mixed with fish and prawns is again disposed off as waste at the landing sites. It has not been put to any commercial use so far. Attempts have been made to prepare quality chitosan from squilla by Madhavan & Nair (1975) and by Moorjani *et al.* (1977). A simple method for the preparation of protein from squilla has been reported by Garg *et al.* (1977). The objectives of the present study were to develop useful products from squilla and to determine the chemical composition of the squilla protein as well as evaluate its nutritional quality by the PER assay.

Materials and Methods

Of the three important commercial varieties of squilla namely, *Orato squilla nepa, Orato squilla holoschista* and *Harpio squilla naphida,* the first named species was used in the studies. Squilla caught was iced immediately and brought to the laboratory within 6 to 8 h of catch. It was processed either immediately or after storage in ice for 1–2 days. The details of the method developed to produce protein from squilla have been reported earlier (Garg, *et al.,* 1977). Fine grade lactic casein from a commercial source was used for the preparation of the control diet.

Standard analytical procedures of AOAC (1975) were followed for the analyses of moisture, nitrogen, fat and ash in the squilla protein extract. Available lysine was determined by the modified method of Carpenter (Booth, 1971). The amino acid composition of the sample was determined microbiologically according to the method of Shockman (1963). Chemical score was calculated using the amino acid scoring pattern proposed by FAO/WHO (1973).

Protein efficiency ratio (PER) of squilla protein was measured in rats at 4 weeks by the method of Chapman *et al.* (1959). The effects of feeding squilla protein to albino rats, such as growth rate, PER, kidney and liver weight were studied.

Three different experimental diet was formulated. The composition of the diet is given in Table 1. Casein was chosen as the standard reference protein and the amount of protein was kept at 10% level in all the diet. Adequate quantities of mineral mixture (Hubbell *et al.,* 1937) and vitamins (Chapman *et al.,* 1959) were also added. Since all the diet had the same composition with the exception of the protein part, the difference between the three diet will only be that due to the differences in the

Table 1. *Percentage composition of the diet*

Ingredients	Casein	Squilla protein	Casein and squilla protein (1:1)
Casein	12.6	—	6.3
Squilla protein	—	15.2	7.6
Refined groundnut oil	5.0	5.0	5.0
Shark liver oil	2.0	2.0	2.0
Vitamin mixture	1.0	1.0	1.0
Salt mixture	1.0	2.0	2.0
Dextrose	25.0	25.0	25.0
Corn starch	52.4	49.8	51.1

Table 2. *Chemical composition of squilla protein*

	%	Range %
Moisture	5.3	4.4– 6.4
Protein (N x 6.25)	65.5	64.6–68.5
Ash	13.6	12.3–14.0
Ether extract	7.9	5.8–10.3
Available lysine (g/16 g N)	5.4	

amino acid profile of the proteins used in the 3 groups.

Ten male weaning rats (Wistar Strain, inbred) were assigned to each test diet. The animals were divided at random into groups adjusted to give similar mean weights and were housed individually in cages having wire mesh bottoms. The initial weight of the animals was 47–55 g. They were fed on weighed amount of the diet and water was supplied *ad libitum*. During a period of 28 days, the daily food intake and weekly increase in body weight were recorded. The protein efficiency ratio was calculated as g weight gain/g of protein consumed. At the end of the experiment, the animals were killed, liver and kidneys weighed after removing the connective tissues. Total nitrogen of liver was also determined.

Results and Discussion

The chemical analyses of six different batches of squilla protein are given in Table 2. It may be seen that the material contains a high percentage of protein and moderate levels of ash and fat.

The essential amino acid pattern of squilla protein in comparison with that of casein (Milner *et al.*, 1978) and the FAO/WHO reference protein is presented in Table 3. It can be seen that the most significant differences between the two types of proteins are the tryptophan and threonine levels. Compared to the provisional pattern set by FAO/WHO (FAO/WHO, 1973) lysine, isoleucine and phenylanine plus tyrosine are excessive, leucine, valine and the sulphur containing amino acids adequate and threonine and tryptophan the limiting amino acids, the amino acid score being equal to 80%. The lysine content of squilla protein is much higher than that contained in the pattern and is almost equal to that of casein. Of this 76% is biologically available as measured by the modified method of Carpenter (Booth, 1971).

Growth rates of rats fed with the 3 diet are shown in Fig. 1. Diet containing squilla protein induced growth rates similar to casein and no stunting effect was noticed.

Feeding trials showed that the three groups of rats consumed the formulated diet in good quantities. There was no rejection by the rats for the feeds containing squilla protein and no unhealthy symptoms were observed in the two groups fed on diets containing squilla protein throughout the experimental period. There was no significant difference in intake, digestibility or PER when fed on casein, squilla protein or a mixture of the two,

Table 3. *Essential amino acid pattern of squilla protein to casein and FAO/WHO amino acid scoring pattern*

g per 16 g nitrogen

Amino acid	Squilla protein	Casein	FAO/WHO pattern
Isoleucine	5.2	16.7	4.0
Leucine	7.0		7.0
Lysine	7.1	8.2	5.5
Methionine – Cystine	3.6	3.7	3.5
Phenylalanine – tryosine	7.3	10.7	6.0
Threonine	3.2	4.5	4.0
Tryptophan	0.8	1.4	4.0
Valine	5.0	6.4	5.0
Total	39.2	52.6	36.0

Table 4. *Protein efficiency ratio of different diet*

Assay group	Average weight start	Average weight gain	Average food intake	Average protein consumed	PER
	g	g	g	g	
Casein	55	65	223	22.3	2.92
Squilla protein	47	58	205	20.5	2.83
Casein & squilla protein (1:1)	49	66	231	23.1	2.86

Table 5. *Relative weight of liver and kidney and liver nitrogen of rats fed with the experimental diet*

	Total liver wt g	Kidney wt per 10 g body wt g	Liver nitrogen mg/total liver
Casein	5.74	0.84	184.5
Squilla protein	5.66	0.90	190.6
Casein & squilla protein (1:1)	5.60	0.85	181.6

although casein had a slightly higher PER value (Table 4). When casein and squilla protein were mixed in equal quantities, an increase was recorded in PER value. However this difference was not significant. The slightly lower PER values can be attributed to the low food intake by rats in the initial stages and the limiting quantities of certain essential amino acids.

The relative weights of liver and kidneys and total liver nitrogen levels of the animals fed on the three diets are presented in Table 5. The organs selected had weights similar to controls and the nitrogen levels in the liver were also similar. No negative effect was noticed.

References

AOAC (1975) *Official Methods of Analysis* (Howitz, W., Ed.) 12th edn., Association of Official Analytical Chemists, Washington

Booth, V. H. (1971) *J. Sci. Fd Agric.* 22, 658

Chapman, D. G., Castillo, R. & Campbell, J. A. (1959) *Can. J. Biochem. Physiol.* 37, 679

FAO/WHO (1973) *Energy and Protein Requirements* p.63. Food and Agricultural Organization of the United Nations, Rome

Garg, D. K., Lekshmy Nair, A. & Prabhu, P. V. (1977) *Fish. Technol.* 14, 53

Hubbell, R. B., Mendel, L. B. & Wakemann, A. J. (1937) *J. Nutr.* 14, 273

Madhavan, P. & Ramachandran Nair, K. G. (1975) *Fish. Technol.* 12, 81

Moorjani, M. N., Imam Khasim, O., Rajalakshmi, S., Puttarajappa, P. & Amla, B. L. (1977) *Proceedings of the First International Conference on Chitin/Chitosan.* April 11–13, 1977, Boston.

Milner, M., Scrimshaw, N. S., Wang, D.I.C. (1978) *Protein Resources and Technology; Status and Research Needs* AVI Publishing Company, Inc., Westport, Connecticut

Shockman, G. D. (1963) In *Analytical Microbiology* (Kavanagh, F. Ed.) p. 567, Academic Press, New York