PART II

SCIENTIFIC AND TECHNICAL

BIOCHEMICAL INVESTIGATIONS ON THE EDIBLE MOLLUSCS OF KERALA

II. A STUDY ON THE NUTRITIONAL VALUE OF SOME GASTROPODS AND CEPHALOPODS

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Data on the biochemical composition and food value of the edible portions of two gastropods, *Pila virens* and *Achatina fulica* and two cephalopods, *Sepiella inermis* and *Loigo indica* have been presented. These molluscs posses nutritive meat very rich in protein and minerals, which compare favourably with popular food fishes in caloric value. The significance of the variations met with in the biochemical constituents of the different species has been discussed.

INTRODUCTION

Apart from prawns and shrimps, various molluscs such as squids, mussels, oysters and clams comprise the major part of shell fishery. As a matter of fact these molluscs constitute a comparatively unexploited fishery resource of great promise by virtue of their high productivity and natural abundance (Jones, 1968). Despite the considerable data available on the biochemical aspects of fishes of India (Saha and Guha, 1938; Giri *et, al*, 1944: Venkitaraman and Chari, 1955: Alexander, 1955, 56) investigations on the edible molluscs have been rather few (Joshi and Bal, 1968; Chinnamma *et al*, 1970; Pandit and Magar, 1972). Hence it was thought that a study of the various biochemical constituents of the edible molluscs found in the inland waters and west coast of Kerala would provide valuable data regarding their nutritional value and pave way for better exploitation and utilization of the molluscan fisheries of Kerala. The present report, dealing with the nutritional value of certain edible gastropods and cephalopods is the continuation of an earlier publication on the edible bivalves (Suryanarayanan and Alexander, 1972).

MATERIAL AND METHODS

Adult specimens of the fresh water gastropod, *Pila virens*, the terrestrial pulmonate, *Achatina fulica* and two cephalopods, *Loligo indica* and *Sepiella inermis* were collected from their natural habitats and were brought to the laboratory in live condition. They were later killed and their

edible portions were analysed for moisture content, total proteins, free amino acids, total lipids. glycogen, iron, phosphorus and ash content employing standard analytical techniques (Suryanarayrnan and Alexander, 1972). The food value was calculated using Rubner's (1901) Table.

Results

The data obtained for the various biochemical constituents of these edible molluscs are given in Table I and II.

The percentage of edible portions is comparatively high in cephalopods ranging from 68.5% *(sepiella inermis)* to 71.38% *(Loligo indica)* whereas the gastropods, *Pila virens* and *Achatina fulica* have only 29.08% and 24.7% respectively.

The moisture content in the cephalopods is rather low being 74. 78% in *Sepiella inermis* and 75.05% in *Loligo indica.* Of the two gastropods studied, *Pila virens* has a moisture content of 78.87% and *Achatina fulica*, 75.5%.

Relatively, the cephalopods have the highest protein content of 83.49% in *Loligo indica* and 81.49% in *Sepiella inermis.* The gastropod *pila virens* has only 75.32% and *Achatina fulica*, 76.2%.

The edible portions of the molluscs investigated appeared to possess all or most of the following amino acids namely, arginine, cysteine, glutamic acid, glycine, histidine, isoleucine, leucine lysine, methionine, phenylalanine, serine threonine, tryptophan, tyrosine and valine. Table II shows the free amino acids in the different animals concerned.

Regarding the glycogen content, *Achatina fulica* shows the highest percentage of 10.4%and *Pila virens* 7.2%. Nevertheless, the cephalopods exihibit only very low values of 0.53% *(Sepiella inermis)* and 0.61% *(Loligo indica).*

All molluscs investigated revealed a fairly high percentage of lipids. 5.56% in *Sepiella inermis*, 5.4% in *Loligo indica*, 4.4% in *Pila virens* and 10.8% in *Achatina fulica.*

The highest value for iron content is shown by *Achatina fulica* (153.8mg%) while *Pila virens* has a lower value of 124.4mg%. Relatively very low percentages, 16.64 mg% in *Loligo indica* and 12.88mg% in *Sepiella inermis,* have been observed.

The phosphorus content of cephalopods is rather high (138.0mg% in *Sepiella inermis* and 145.0mg% in *Loligo indica*) whereas both gastropods have much lower values (62.5mg% in *Achatina fulica* and 83.0mg% in *Pila virens*).

Sepiella inermis and *Loligo indica* showed a comparatively higher percentage of ash content, 13.42%, 12.5% respectively than *Pila virens* (10.96%) and *Achatina fulica* (6.3%).

The energy content of these molluscs range from 453.42 calories in *Achatina fulica*, 379.83 calories in *Pila virens*, 395.05 calories in *Loligo indica* to 387.99 calories in *Sepiella inermis.*

Discussion

The data suggest that among the molluscs studied, the percentage of edible portions is rather high in cephalopods (68.5% to 71.38%) whereas the gastropods possessed only lower percentage (24.7% to 29.08%). In fact the higher percentage of edible portions found in cephalopods could be attributed to their possession of light internal shells. Among the two gastropods, *Achatina fulica* has a relatively heavier shell which would explain its lower percentage of edible tissue. Since both gastropods and

TABLE 1.

BIOCHEMICAL COMPOSITION OF THE EDIBLE PORTIONS OF THE MOLLUSCS STUDIED

Animals	% of edible Portions†	Moisture content †	Proteins %*	Lipid %*	Glycogen %*	Phosphorus mg%*	Iron mg%*	Ash %*	Food value Calories/ 100gm.*
Pila virens	29.08	78.87	75.32	4.44	7.25	83.0	124.4	10.96	378.83
Achatina fulica	24.7	75.50	76.20	10 80	10.4	62.5	153.8	6.30	453.42
Sepiella inermis	68.56	74.78	81.49	5.56	0.53	138.0	12.88	13.42	387.99
Loligo indica	71.38	75.05	83.49	5.40	0.61	145.0	16.66	12.50	395.03

† Expressed as gms/100 gms wet weight.
* Expressed as units/100 gms dry weight.

TABLE II.

FREE AMINO ACIDS IN THE VARIOUS MOLLUSCS STUDIED

Animals	Phenyl-alanine	Gly-cine	Cyst-tine	Tyro-sine	Histi. dine	Vali-ne	Lysi-ne	Methi-onine	Glutamic acid	Insol-eusine	Leuc-ine	Ser-ine	Trypto-phan	Pro-line	Arg-inie	Thre onine
Pila virens	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	+
Loligo indica	+	+	+	+	+	—	+	—	+	—	+	—	+	—	+	—
Sepiella inermis	+	+	+	+	+	+	+	+	+	—	—	+	+	—	+	+

+ indicate presence and — absence

bivalves possess much heavier shells, they have comparatively lesser percentage of edible portions.

The moisture content of the gastropod, *Pila virens* is 78.87% and *Achatina fulica* 75.5%. Comparatively lower values have been obtained for the cephalopods, *Loligo indica* (75.5%) and *Sepiella inermis* 74.78%). The lower moisture content in the terrestrial pulmonate, *Achatina fulica* and in the marine cephalopods could be attributed to the osmotic requirements of the habitat concerned.

The cephalopods revealed high protein content (83.49% in *Loligo indica* and 81.49% in *Sepiella inermis*). Similar values have been reported by Pandit and Magar (1972) for *Sepia orientalis* (80.21%) and *Loligo vulgaris* (81.50%). It has been suggested that since the cephalopods possess only scant glycogen reserves, their intermediary metabolism may utilize body protein to sustain life at times of starvation (Goddard and Martin, 1966). Among the gastropods, *Achatina fulica* has a slightly higher protein content (76.2%) than *Pila virens* (72.32%).

Paradoxically the glycogen reserves exhibited by cephalopods are significantly low (0.53% and 0.61%). The present data compares favourably with those obtained by Boyland (1928) for *Sepia elegans* 0.037% and *Eledone* (0.11%). Studies on fuel reserves of molluscan muscle revealed very low glycogen content for cephalopod muscles (Suryanarayanan and Alexander, 1971). However higher concentrations of glycogen have been reported by Pandit and Magar (1972) for *Sepiaorientalis* (3.96%) and *Loligo vulgaris* (3.71%). The lower glycogen content in the cephalopods investigated may possibly be due to a paucity of glycogen reserves in their tissues. Further it has been reported that cephalopods may utilize protein in place of fuel reserves during intense muscular activity (Fields, 1965). In contrast to the low glycogen values of cephalopods the gastropods store larger amounts of glycogen in their tissues. Infact glycogen constitutes a major fuel reserve of terrestrial gastropods and is utilized as an energy source during hibernation and aestivation (Meenakshi. 1958; Thiele, 1959).

The lipids in the body and in the diet constitute a concentrated form of energy for metabolism and storage purposes. Further fats may serve important non-caloric metabolic functions also(George and Berger, 1966). Relatively, the cephalopods showed much higher percentages of lipids than glycogen (5.56% for *Sepiella inermis* and 5.4% for *Loligo indica*). The lipid content reported by Pandit and Magar (1972) for *Sepia orientalis* (3.9%) and *Loligo vulgaris* (4%) is a little lower than those obtained in our present study. The gastropods investigated also exhibited high lipid content (10.8% in *Achatina fulica* and 7.2% in *Pila virens*).

The ash content of particular animal indicates the amount of inorganic constituents present in its tissue. No significant variation could be observed in the ash content of the two cephalopods, *Sepiella inermis* (13.42%) and *Loligo indica* 12.5%). Lower values have been obtained for the gastropods, *Pila virens* (10.96%) and *Achatina* fulica (6.3%).

Among the molluscs investigated, the gastropods showed much higher percentage of iron (124.4 mg%: *Pila virens* and 153.8 mg%: *Achatina fulica*) than the cephalopods (12. 88mg% in *Sepiella inermis* and 16.64 mg% in *Loligo indica*).

The phosphorus content in the cephalopods studied are 138.0mg% for *Sepiella inermis*, 145.0mg for *Loligo indica*. Higher values of 292 mg% and 271mg% are reported for *Sepia orientalis* and *Loligo vulgaris*

by Pandit and Magar (1972). Both the gastropods investigated have only less phosphorus in their tissues (62.5mg% in *Achatina fulica* and 83.0mg% in *Pila vtrens*)

With regard to the food value, the gastropod, *Achatina fulica* possess 453.42 calories *Pila virens*, 379.83 calories and the cephalopods, *Sepiella inermis* and *Loligo indica* 387.99 calories and 395.03 calories respectively. These values compare favourably with those of edible bivalves *Lamellidens corrianus*, *Corbciula striatella*, *Mytilus edulis* and commercial fishes like Rohu, Shark and Bombay duck (Suryanarayanan and Alexander, 1972). It can be concluded that all the four species of molluscs studied could be considered excellent sources of protein, rich in caloric content and accordingly should be exploited on a commercial basis.

ACKNOWLEDGEMENTS

We are grateful to Council of Scientific and Industrial Research, New Delhi, for financial support for carrying out the scheme and also for the award of a Junior fellowship to one of us (R.S.K). One of us (H. S) indebted to the University of Kerala for the award of a Senior Research Fellowship. We are indebted to prof. K. K. Nayar, Head of the Department of Zoology, University of Kerala, for providing facilities and encouragement.

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