BIOCHEMICAL INVESTIGATIONS ON EDIBLE MOLLUSCS OF KERALA
1. A STUDY ON THE NUTRITIONAL VALUE OF SOME BIVALVES

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Data on the biochemical constituents and food values of five commercially important edible bivalves of Kerala, *Lamellidens corrianus*, *Corbicula striatella, Mytilus edulis, Vellorita cohinensis and Ostrea cucullata* have been presented. Physiological significance of the variations have been discussed. Present study reveals that the bivalve meat compares favourably with the common food fishes with regard to their caloric value and hence would be an excellent and economic source of nutrition for our people.

INTRODUCTION

Apart from fishes, shell fishes also contribute a sizable portion of the fish catches of Kerala State. In fact various molluscs such as squids, mussels, oysters and clams essentially comprise the major part of shell fishery by virtue of their high productivity and natural abundance (Jones, 1968). Despite the abundant data available on the biochemical aspects of fishes of India, hardly little information is available on molluscan tissues (Saha and Guha, 1939; Giri *et al*, 1943; Venkataraman and Chari, 1951; Chinnamma *et al*, 1970; and Suryanarayanan and Alexander, 1971). Hence it was thought that a biochemical study of the various edible molluscs met with in the inland waters and west coast of Kerala would yield fruitful data which would facilitate better utilization of the molluscan fishery resources of the state. The present paper deals with an account of the nutritional aspects of some bivalves of Kerala.

MATERIALS AND METHODS

ANIMALS	TISSUES TAKEN
Lamellidens corrianus	Edible portions comprised of various muscles excluding visceral mass and gills
Vellorita cochinensis	
Corbicula striatella	
Mytilus edulis	
Ostrea cucullata	

These edible bivalves were collected live from their natural habitat, brought to the laboratory and weighed. Later they were killed and edible portions were dissected out. The samples were weighed and dehydrated to a constant weight, in an air oven kept at 100°C. The dehydrated tissues were powdered well in a porcelain mortar and samples were taken for the assay of protein, fat, glycogen, ash, phosphorus and iron employing standard techniques. The food value was calculated using Rubner's table (1901).

TABLE I BIOCHEMICAL CONSTITUENTS AND FOOD VALUES OF DIFFERENT EDIBLE BIVALVES

Animals	Total wt with shell. g	Edible portion %	Moisture %	*Protein %	Glycogen* %	Fat* %	Ash* %	Food value* cal /g 100	Phosphorus mg %	Iron* mg%
L. corrianus	35	15.43	85.39	71.27	7.98	5.43	15.32	376.43	165.25	49.09
V. cochinensis	55	15.71	80.53	71.08	5.83	11.04	12.05	418.00	139.25	37.60
C. striatella	45	12.06	77.60	68.32	11.59	7.62	12.47	398.50	165.25	35.50
M. edulis	24	16.50	73.97	78.45	3.66	7.72	10.17	408.46	185.10	33.00
O. cucullata	25	15.00	70.01	83.45	2.81	5.62	8.12	405.90	136.20	35.00

* Expressed on dry weight basis.

Free amino acids:

A known amount of fresh tissue was homogenized in 80% ethanol for 15 minutes and centrifuged at 3000 rpm for 30 minutes for preparing the free amino acid extract. Free amino acids were studied by paper chromatography and thin layer chromatography (Smith, 1965.)

Protein:

Protein was estimated by Wong's Micro-kjeldhal method (1923).

Total lipids:

Total lipids were assayed by Sauxhlet extraction using solvent ether.

Glycogen:

The anthrone method of Seifter *et al* (1950) was employed for estimation of glycogen.

Ash: A known amount of the dehydrated powdered sample was taken in a silica crucible and heated to 600°C in a muffle furnace and ashed (Joshi and Bal, 1968.)

Iron: Iron was assayed by the method of Kennedy (1927).

Phosphorus:

A modified method of Allen (1940) was employed for the estimation of phosphorus.

Food value:

As for food value, the energy content was calculated from the table of Rubner (1901).

RESULTS AND DISCUSSION

The data obtained for the various biochemical constituents of the edible portions of different bivalves under study are given in Table I. The percentage of

TABLE II DISTRIBUTION OF AMINO ACIDS IN VARIOUS BIVALVES

Free amino acids	*L. corrianus*	*C. striatella*	*V. cochinensis*	*M. edulis*	*O. cucullata.*
Phenyl alanine	+	+	+	+	+
Glycine	+	+	+	+	+
Cysteine	+	+	+	+	+
Tyrosine	+	+	+	+	+
Histidine	+	+	+	+	+
Valine	+	+	+	+	+
Lysine	+	—	+	+	+
Methionine	+	+	+	+	+
Glutamic acid	+	+	+	+	+
Isoleucine	—	—	+	+	+
Leucine	+	+	+	+	+
Serine	+	+	+	+	+
Tryptophan	+	+	+	+	+
Proline	+	—	+	+	+
Threonine	—	—	+	—	+
Total	13	11	16	14	15

+ Indicates presence and – absence.

edible tissue is comparatively low in all forms ranging from 12.06% *(C. striatella)* to 16.50% *(M. edulis)* with *L. corrianus* (15.43%), *V.cochinensis* (15.71 %), *O.cucullata* (15.00%) having intermediate values.

As for moisture contents, the highest value is exhibited by fresh water forms *L. corrianus* (85.45%) with *V. cochinensis* (80.53%) and *C. striatella* (77.60%) showing lower values.

The highest values for total protein are exhibited by marine forms such as *O. cucullata* (83.45%) and *M. edulis* (78.45%). The fresh water forms *L. corrianus* (71.27%) and *V. cochinensis* (71.08%) had comparatively lower values with *C. striatella* (68.32%) having lowest protein value.

The pattern of distribution of free amino acids in different bivalves under study is given in Table II. The maximum number of free amino acids was found in *V. cochinensis* (16) which are as follows: Phenyl alanine, Glycine, Cysteine, Tyrosine, Histidine, Valine, Lysine, Methionine, Glutamic acid, Isoleucine, Leucine, Serine, Tryptophan, Arginine, Threonine and Proline.

As for glycogen content, *C. striatella* (11.59%) and *L. corrianus* (7.93%) exhibit higher values with *V. cochinensis* having 5.83%. But the marine bivalves *M. edulis* (3.66%) and *O. cucullata* (2.61%) have rather low glycogen contents.

V. cochinensis (11.04%) and *M. edulis* (7.72%) exhibit higher lipid contents than other bivalves *L. corrianus* (5.43%) and *C. striatella* (7. 62 percent).

The ash content of tissues of the bivalves under study ranged from 8.12% found in *O.cucullata* to 15.32 percent in *L.corrianus*.

The highest value for iron content is shown by *L. corrianus* (49.0 mg%) with *M. edulis* (33.0 mg%) having the lowest. However, *M. edulis* exhibits a higher phosphorus content (186. 1 mg%) as compared to other bivalves.

The energy contents of these molluscs, calculated on the basis of Rubner's table (1901) range from 376.43 cals in *L. corrianus* to 418 cals in *V. cochinensis*.

The data suggest that in all the bivalves studied the percentages of the edible portions range between 12.6% and 16.5% only, whereas the gastropod, *Pila virens* had 22.49% and in the cephalopods, *Sepiella mermis* and *Loigo indica*, the edible portions were found to be 72.50% and 80.06% respectively (Suryanarayanan and Alexander, 1971). In fact the heavier shells of the commercially important shell fisheries involve transportation problems of the catch from the fishery site to the marketing zone. It may be better if the shells are removed at the fishing site and the edible tissues stored in ice and transported so that spoilage can be minimised and transport difficulties could be considerably eased.

The moisture contents of fresh water bivalves are comparatively much higher (77.60% to 85.39%) than those of the marine forms (70.01% to 73.97%). This could be attributed to the osmotic requirements of the environment concerned (Robertson, 1964). In fact it has been observed that the skeletal muscles of fresh water teleosts have comparatively higher moisture contents than those of marine teleosts (Alexander, 1955.) The marine bivalves exhibit comparatively much higher protein contents than the fresh water animals. Protein contents in general show an inverse relationship with glycogen contents. Alexander (1956) has reported comparatively higher protein contents in marine fishes than in fresh water forms.

Regarding glycogen content, it is quite low in marine bivalves such as *M. edulis* (3.66%) and *O. cucullata* (2.82%). This low concentration of glycogen met with in the marine forms may possibly be due to lesser volume of muscles per unit body weight and their sedentary habits. Among the various forms, *C. striatella* (11.59%) has the highest glycogen content.

The lipid contents of these bivalves did not show much variation except in *V. cochinensis* which has the highest value of 11.04%.

The ash content of a particular animal indicates the amount of inorganic compounds present in it. Among the forms under study *L. corrianus* (15.32%) shows the maximum percentage of inorganic solids whereas *O. cucullata* (8.12%) shows the lowest ash content, despite the fact that it is a marine form. In fact the fresh water forms possess higher values for ash in them than the marine forms, which cannot be explained. *L. corrianus* has a higher percentage of iron (49.09 mg%) as compared to other bivalves, whereas phosphorus is seen in greater concentration in *M. edulis* (185.10 mg%) which is an intertidal form.

As regards the energy contents, *V. cochinensis* possesses 418.00 cals per 100 g of the dried tissues whereas *L. corrianus* yields only 376.43 cals per 100 g. Joshi and Bal (1968) have reported a value of 322.19 cal for the clam, *Katylesia marmorata*. The energy content of some of the important food fishes like *Labeo rohita* (Rohu), *Chiloscyllium indicum* (Shark) and *Harpodon nehereus* (Bombay duck) are 510.40 cals, 401. 53 cals and 393.53 cals per 100 g of dried tissues respectively (Alexander, 1971). The gastropod *Pila virens* and cephalopods *Sepia* sp. have 376.61 cals and 388.80 cals respectively per 100 g of dried tissue (Suryanarayanan and Alexander, 1971). As compared to the popular food fishes such as Bombay duck and shark, the bivalves are at a par in their calorific values. Further, since it is a rather cheap source of food item in contrast to the fishes, it could serve as an excellent source of nutrition to our people. Observations reveal that, if processed properly these bivalve meats provide tasty food. Hence adequate steps should be taken to popularise these excellent and economic resources of nutrition amongst our masses.

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