Research Paper

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Biochemical Composition Assay of Different Body Parts of Marine Bivalves Meretrix Casta And Anadara Granosa in Muthupet Estuary, Tamil Nadu, India

Zoology

KEYWORDS : Muthupet, bivalve, Meretrix casta, Anadara granosa, biochemical composition.

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ABSTRACT

Estuaries are highly productive, dynamic and unique ecosystems providing food, transport, recreation, etc. Mangrove vegetation, ranking high in productivity, is often associated with tropical and subtropical estuaries. Quality aspects of bivalves (Meretrix casta and Anadara granosa) in the Muthupet estuary were examined in different season over a 12 month period and also different body parts. Nutritional quality parameters of bivalves were determined at different seasons of the year. Seasonal variations were observed in the nutrient content, with particular observed in the nutrient content, with particular regard to average value of protein was 56.10%, carbohydrate 4.1%, lipid (3.30%) lipase 0.4% and protease 0.12% in Meretrix casta whereas in Anadara granosa protein average value of protein was 55.68% and lipid 4.71%, lipase 0.13% and protease 0.14%. Inspite of this variability, the nutritional quality of the bivalves was generally good. It could also be added that the composition of marine bivalves is a nutritional assurance to millions of malnourished people.

Introduction

Molluscs are delicious and protein rich food among the sea foods (Jagadis, 2005). The bivalves in the coastal line could form an important source of food, raw materials for village industries, indigenous medicine, etc., and it is widely used as a cheaper food source for coastal area people. Shellfish such as mussel, clam contains approximately 20 to 28% calories of fat. Shell fish also provide high quality protein with all the dietary essential amino acids for maintenance and growth of the human body for this reason, shell fish should be considered a low fat, high protein food that can be included in a low-fat diet (King et al., 1990).

Cyclical changes in biochemical composition of animal tissue are mainly studied to assess the nutritive status of an organism. Sea food is an important contributor to the diets of money individuals because of their unique nutritional composition. The shell fishes are known to be high protein, low in fat and low in calories. The green mussel, P. viridis enjoys a wide distribution along the west coast (Nair and Rao, 1985). Due to the importance and abundance of the commercial bivalve species Meretrix casta and Anadara granosa occur in intertidal areas of Indian coasts. This study investigated the nutritive value of Meretrix casta and Anadara granosa.

Materials and Methods

Samples of the bivalves Meretrix casta and Anadara granosa were collected the period of 12 months during January 2011 to December 2011 in Muthupet estuary (Latitude 10°4' N; Longitude 79°51'E) situated 400 km south of Chennai and lies close to Point Calimere on the South East Coast Peninsula India. It is at the South East of Cauvery delta covering an area of 1803 hectare (Shanmuga Sundaram, 1985). Of which only 4% is occupied by well-grown mangroves. The specimens of (20 animals) were brought to the laboratory cleaned with brush and immediately dissected. Proximate composition of M. casta and A. granosa were analased for protein, carbohydrate and lipid.

The folin-cioculate phenol method of Lowry (1951) was adopted for the estimation of total proteins in the tissue. The dry tissue sample weighing 10 mg was thoroughly homogenized with 1 ml of deproteinizing agent (10% TCA) by keeping the tubes in ice. All samples were centrifuged for 2 min at 300 rpm. The precipitate was dissolved in 2 ml 1N NaOH and to 1 ml of this solution, freshly prepared 5 ml alkaline reagent was added. This was kept at room temperature for 10 min, after which 0.5 ml of 1 N folin ciocalteu reagent was added and mixed thoroughly. A standard stock solution was prepared and using bovine serum albumin crystals at a concentration of 25 mg/5 ml NaOH. OD was evaluated against the blank at 660 rpm.

For the estimation of total carbohydrate content, the procedure of Dubois et al. (1956) using phenol sulphuric acid was followed. About 5 mg of oven dried tissue was taken for carbohydrate analysis. The tissue was taken in a test tube and 1 ml of phenol (5%) and 5 ml of concentrate H_2SO_4 were added for quick succession. The tubes were kept for 30 min at 30°C and the optical density of the colour developed was measured at 490 nm against the blank.

The chloroform-methanol extraction procedure of Folch et al. (1956) was used for extracting lipid was extracted from 500 mg of powdered oven-dried tissue with 5 ml of chloroform; methanol mixture added. This extract was taken in a preweighed beaker oven dried. Beaker was reweighed with lipid. The difference in weight was taken as total lipid content and the percentage was calculated.

The total protease activity was measured by the casein digestion method by using the amino or carboxyl groups separated from a protein substrates (Mahadevan and Sridhar, 1996) in both test samples separately.

The lipase was measured by the method of Sadasivam and Manickam (1996) in both test samples. This method estimates the quantity of fatty acids released per unit time by measuring the quantity of NaOH required to maintain pH constant. The milliequivalent of alkali consumed was taken as measure of the enzyme.

Result

In matured animals of M. casta, the carbohydrate content was determined in whole body of the bivalve which varied from 2.5 (August 2011) to 5.6 per cent (April 2011) at monthly intervals with an average of 4.1 per cent (Table 1). In A. granosa, the carbohydrate content varied from 4.51 (Jan.2011) to 7.92 per cent (April 2011) with an average of 6.16 per cent. The carbohydrate content of gonad of M. casta varied from 2.8 (August 2011) to 6.9 per cent (April 2011) at monthly intervals with an average of 4.0 per cent. In A. granosa, the carbohydrate content varied from 4.84 (August 2011) to 7.52 per cent (May 2011) with an average of 6.11 per cent. In M. casta, the carbohydrate content

of mantle varied from 1.2 (August 2011) to 5.2 per cent (April 2011) at monthly intervals with an average 3.5 per cent. In A. granosa, the carbohydrate content varied from 3.21 (August 2011) to 9.84 per cent (March 2011) at monthly intervals with an average of 5.48 per cent. The carbohydrate content of adductor muscle (M. casta) was determined and it varied from 0.8 (August 2011) to 3.5 per cent (April 2011) at monthly intervals with an average of 2.39 per cent. In A. granosa, the carbohydrate content varied from 2.88 (August 2011) to 5.86 per cent (April 2011) with an average of 4.30 per cent. In matured individuals of M. casta the carbohydrate content was determined in digestive gland showed variations from 1.3 (August 2011) to 5.1 per cent (April 2011) with an average 3.33 per cent. In A. granosa, it varied from 3.34 (August 2011) to 7.74 per cent (April 2011) at monthly intervals with an average of 5.32 per cent. In M. casta, the carbohydrate content was determined in foot of the bivalve which varied from 0.3 (August 2011) to 2.5 per cent (April 2011) at monthly intervals with an average of 1.57 per cent. In A. granosa, the carbohydrate content varied from 2.32 (August 2011) to 4.87 per cent (April 2011) in A. granosa with an average of 3.55 per cent. In M. casta, the carbohydrate content varied from 0.34 (August 2011) to 2.50 per cent (May 2011) with an average of 1.63 per cent in the gills. In A. granosa, it varied from 2.15 (November 2011) to 4.89 per cent (May 2011) at monthly intervals with an average of 3.37 per cent. In matured animals of M. casta, the carbohydrate content was determined in siphon of the bivalve which varied from 1.02 (Oct.2011) to 3.51 per cent (April 2011) with an average of 2.7 per cent. In A. granosa, the carbohydrate content varied from 3.00 (October 2011) to 5.89 per cent (April 2011) with an average of 4.09 per cent. In matured samples of M. casta, the protein content was determined in whole body of the bivalve which varied from 48.4 (October 2011) to 66.02 per cent (June 2011) at monthly intervals with an average of 56.29 per cent (Fig.1). In A. granosa, the protein content varied from 50.45 (October 2011) to 68.32 per cent (June 2011) with an average of 55.68 per cent (Fig.2). The matured animals of M. casta, the protein content was determined in the gonad which varied from 48.40 (December 2011) to 64.20 per cent (March 2011) at monthly intervals with an average 55.35 of per cent (Fig.1). In A. granosa, the protein content varied from 49.98 (December 2011) to 64.83 per cent (April 2011) with an average of 54.89 per cent (Fig.2). In M. casta, the protein content was determined in mantle of the bivalve which varied from 46.20 (December 2011) to 58.3 per cent (June 2011) at monthly intervals with an average of 52.58 per cent (Fig.1). In A. granosa, the protein content varied from 47.60 (December 2011) to 60.56 per cent (June 2011) with an average of 55.11 per cent (Fig.2). In matured individuals of M. casta, the protein content varied from 49.82 (September 2011) to 61.32 per cent (June 2011) at monthly intervals with an average of 55.93 per cent (Fig.1). In A. granosa, the protein content varied from 51.76 (April 2011) to 60.51 per cent (July 2011) with an average of 54.76 per cent (Fig.2).

In M. casta, the protein content was determined in digestive gland of the bivalve which varied from 50.86 (October 2011) to 65.56 per cent (June 2011) with an average of 55.60 per cent (Fig.1). In A. granosa, the protein content varied from 51.00 (November 2011) to 61.63 per cent (May 2011) at monthly intervals with an average of 55.53 per cent (Fig.2). In matured samples of M. casta, the protein content was determined in foot of the bivalve which varied from 46.32 (December 2011) to 56.30 per cent (May 2011) at monthly intervals with an average of 50.44 per cent (Fig.1). The protein content varied from 47.86 (December 2011) to 66.02 per cent (July 2011) in A. granosa with an average of 53.13 per cent (Fig.2). In M. casta, the protein content of gill varied from 39.74 (February 2011) to 53.62 per cent(July 2011) with an average of 46.13 per cent (Fig.1). In A. granosa, it varied from 41.24 (February 2011) to 55.83 per cent (July 2011) at monthly intervals with an average of 47.19 per cent (Fig.2).

In matured individuals of M. casta, the protein content was determined in siphon of the bivalve which varied from 47.52 (October 2011) to 53.62 per cent (May 2011) with an average of 51.02 per cent (Fig.1). In A. granosa, the protein content varied from 49.54 (September 2011) to 55.91 per cent (April 2011) with an average of 52.67 per cent (Fig.2). In matured samples of M. casta, the lipid content was determined in whole body which varied from 1.6 (September 2011) to 3.8 per cent (June 2011) at monthly intervals with an average of 3.39 per cent (Fig.3). In A. granosa, the lipid content varied from 3.07 (August 2011) to 6.12 per cent (June 2011) with an average of 4.71 per cent (Fig.4). The lipid content of gonad tissue of M. casta varied from 1.4 (August 2011) to 3.8 per cent (May 2011) at monthly intervals with an average 2.85 per cent (Fig.3). In A. granosa, the lipid content varied from 3.07 (August 2011) to 6.31 per cent (May 2011) with an average of 4.00 per cent (Fig.4). The lipid content of mantle tissue of M. casta varied from 1.5 (September 2011) to 3.7 per cent (June 2011) at monthly intervals with an average 2.65 per cent (Fig.3). In A. granosa, the lipid content of mantle tissue varied from 3.81 (October 2011) to 6.43 per cent (June 2011) at monthly intervals with an average of 4.69 per cent (Fig.4). In M. casta, the lipid content was determined in the adductor muscle and it varied from 0.9 (August 2011) to 3.5 per cent (May 2011) at monthly intervals with an average of 2.19 per cent (Fig.3). In A. granosa, the lipid content varied from 2.87 (August 2011) to 6.1 per cent (June 2011) with an average of 4.19 per cent (Fig.4). In matured samples of M. casta, the lipid content was determined in digestive gland of the bivalve is which varied from 1.2 (August 2011) to 4.2 per cent (May 2011) with an average 2.78 per cent (Fig.3). In A. granosa, it varied from 3.32 (August 2011) to 6.45 per cent (May 2011) at monthly intervals with an average of 4.66 per cent (Fig.4). In M. casta, the lipid content was determined in foot of the bivalve which varied from 1.3 (October 2011) to 3.8 per cent (April 2011) at monthly intervals with an average 2.67 per cent (Fig.3). The lipid content varied from 3.33 (October 2011) to 6.30 per cent (April 2011) in A. granosa with an average of 4.70 per cent (Fig.4). In M. casta, the lipid content of gill varied from 0.5 (August 2011) to 3.2 per cent (April 2011) with an average of 1.98 per cent (Fig.3). In A. granosa, it varied from 2.87 (September 2011) to 5.84 per cent (July 2011) at monthly intervals with an average of 4.07 per cent (Fig.4). In matured animals of M. casta, the lipid content was determined in siphon of the bivalve which varied from 0.7 (September 2011) to 3.3 per cent (May 2011) with an average of 2.05 per cent (Fig.3). In A. granosa, the lipid content varied from 2.63 (September 2011) to 5.67 per cent (May 2011) with an average of 4.02 per cent (Fig.4). The average composition of carbohydrate values in M. casta were observed as 4.1, 4.0, 3.5, 2.39, 3.33, 1.57, 1.63 and 2.7% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum was observed in whole body tissue (4.1%) and minimum was observed in foot (1.57%) (Table 3). The average composition of carbohydrate values in A. granosa were found out as 6.16, 6.12, 5.48, 4.30, 5.32, 3.55, 3.37 and 4.09% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum of carbohydrate was observed in whole body (6.16%) and minimum was observed in gill (3.37%) (Table 4). The average composition of protein values in M. casta were observed as 56.29, 56.10, 55.10, 55.93, 55.60, 50.44, 46.13 and 51.02% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum level observed in whole body tissue (56.10%) and minimum was observed in gill (46.13%) (Fig.1). The average composition of protein values in A. granosa were observed as 55.68, 54.25, 55.10, 55.04, 55.96, 53.13, 47.19 and 52.67% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum level was observed in whole body tissue (55.68%) and minimum was observed in gill (47.19%) (Fig.2). The average composition of lipid values in M. casta were observed as 3.39, 2.85, 2.65, 2.19, 2.78, 2.67, 1.98 and 2.05% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum was observed in whole body tissue (3.39%) and minimum was observed in gill (1.98%) (Fig.3). The average composition of lipid values in A. granosa were observed as 4.71, 4.00, 4.69, 4.19, 4.66, 4.70, 4.07 and 4.02% in whole body, gonad, mantle, adductor muscle, digestive gland, foot, gill and siphon, respectively. The maximum was observed in whole body (4.71%) and minimum level of lipid was observed in siphon (4.02%) (Fig.4). Nutritional quality of meat in both bivalves

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was very high, during summer season. Protein was the major organic constituent found in both bivalves. Carbohydrate was the second major organic component found. The present studies indicate inverse relation between water and protein content. In the present investigation, A. granosa and M. casta of coastal waters and estuaries show very high calorific values throughout the year. In matured individuals of M. casta, the protease content was determined in gut of the bivalve varied from 0.08 (Dec.2011) to 0.22% (July 2011) and at monthly intervals with an average of 0.12%. In A. granosa, the protease content varied from 0.07 (Jan.2011) to 0.22% (July 2011) with an average of 0.14% (Fig.5 and 6). The protease content of digestive gland was determined in the bivalve M. casta which varied from 0.06 (Jan.2011) to 0.24% (July 2011) and at monthly intervals with an average of 0.14%. In A. granosa, the protease content varied from 0.07 (Jan.2011) to 0.21% (June 2011) with an average of 0.14% (Fig.5 and 6). In matured individuals of M. casta, the lipase content was determined in gut of the bivalve which was varied from 0.08% (Jan. 2011) to 0.22% (July 2011) at monthly intervals with an average of 0.14%. In A. granosa, the lipase content varied from 0.06 (Jan.2011) to 0.21% (June 2011) with an average of 0.13% (Fig.7 and 8). The lipase content of digestive gland of M. casta varied from 0.06 (Jan.2011) to 0.21% (May 2011) at monthly intervals with an average of 0.13% whereas in A. granosa, the lipase content varied from 0.08 (Jan.2011) to 0.24% (July 2011) with an average of 0.15%.

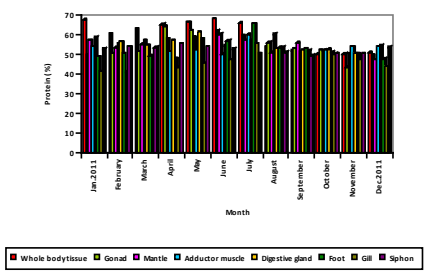


Fig.1. Monthly variations in protein content (%) of M. casta during January 2011 to December 2011 at station I (Adirampattinam)

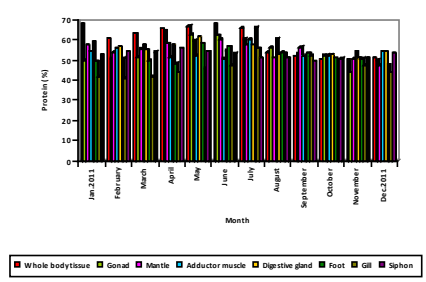


Fig.2. Monthly variations in protein content (%) of A. granosa during January 2011 to December 2011 at Muthupet estuary

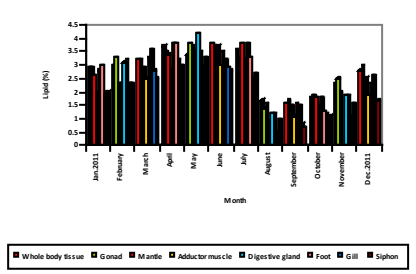
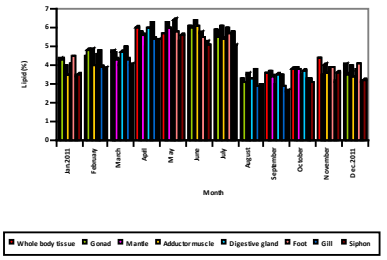


Fig.3. Monthly variations in lipid content (%) of M. casta during January 2011 to December 2011 at station I (Adirampattinam)



`Fig.4. Monthly variations in lipid content (%) of A. granosa during January 2011 to December 2011 at station II (Muthupet estuary)

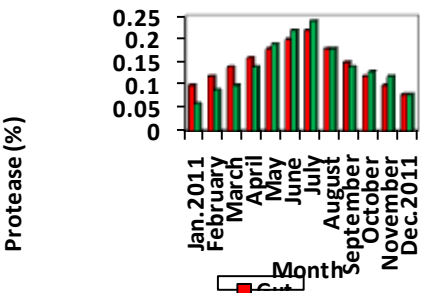


Fig.5. Seasonal variations in protease values (%) in different parts of M. casta during January 2011 to December 2011 at Station I.

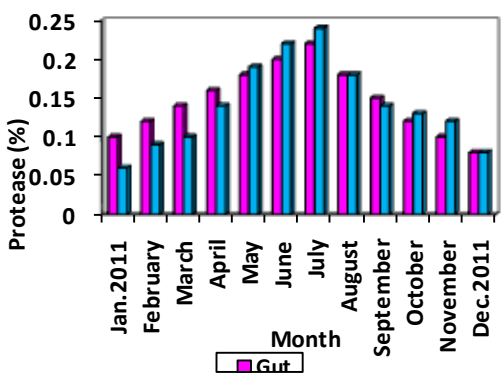


Fig.6. Seasonal variations in protease values (%) in different parts of A. granosa during January 2011 to December 2011 at Station II

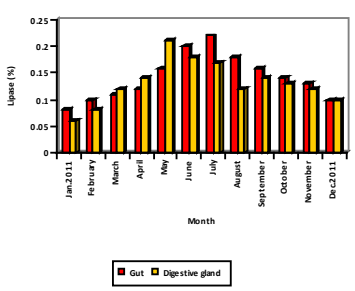


Fig.7. Seasonal variations in lipase values (%) in different parts of M. casta during January 2011 to December 2011 at Station I.

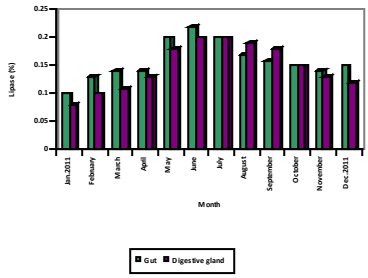


Fig.8. Seasonal variations in lipase values (%) in different parts of A. granosa during January 2011 to December 2011 at Station II.

DISCUSSION

Biochemical constituents (proximate composition like protein, carbohydrate and lipids) were estimated in the different body tissues of the bivalves, A. granosa and M. casta. Among the body fractions, whole body tissue recorded the highest protein, lipid and carbohydrates. Investigation on biochemical compositions in different parts of an animal would be more informative than estimation in the entire body for studies (Giese, 1969; Babu et al., 2012). Biochemical compositions in different body fractions were mainly influenced by reproductive cycle and secondarily by food availability. Accumulation of protein, carbohydrate and lipid will be high during proliferation of gonads (George, 1980). Percentage of these constituents will increase during maturation of gonads (Ansell, 1974). In the present study, the percentage of proteins, carbohydrates and lipids were recorded from eight body fractions. Among the eight body fractions, whole body tissue portion recorded high protein, carbohydrates and lipids. The digestive gland acts as a storage site in most of the bivalves (George, 1980). The variation in the biochemical constituents in digestive gland indicated that this organ acts as probable storage site in both bivalves, A. granosa and M. casta.

The biochemical compositions of A. granosa and M. casta tissues are similar to those of other marine bivalves, such as oyster and scallops, Gafrarium tumidum (Babu et al., 2012) which typically high protein content and low levels of fat and cholesterol. The fat and cholesterol content of number of bivalves including oyster, scallops, mussels, cockles, ranged between 1.3 and 2.3% and 0.33 and 0.59% respectively (Pearson, 1977; Babu et al., 2012). The seasonal variation in biochemical constituents of different body components of Meretrix meretrix were also studied by Jayabal and Kalyani (1987), the results showed 24.82% protein, 13.53% carbohydrate and 7.26% fat. The results of the species, A. granosa and M. casta showed the same trend in the present study. Biochemical constituents of many species of bivalves have been analysed by Rajan et al. (1990), Jagadis (2005) and Babu et al. (2012). Salaskar and Nayak (2011) found that the nutritional quality of the oyster, Perna viridis was generally good, especially just before gamete release (pre monsoon) when the concentration of the nutrients was as its maximum.

A low level of fat was detected in the edible meat of oysters and mussels. Protein is the major biochemical constituent of bivalve meat. In the present study, the highest protein content was recorded in whole body tissues of both bivalves during summer and premonsoon seasons. In the case of bivalves, it was noticed that as temperature increases protein content also increases. During monsoon season gradual fall in protein content can be seen. While in case of oyster and mussels two peaks can be seen during post monsoon (66.51%) and pre-monsoon (63.54%) (Salaskar and Nayak, 2012).

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