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Bursa spinosa - A Mesogastropod Fit for Human Consumption

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Abstract: Not a great deal of work available on the biochemical concerto of prosobranch gastropods, which are fit, for human consumption. To study the nutritive value of a commonly occurring gastropod *Bursa spinosa,* which is found in huge numbers in the trash along Southeast coast of India was selected for the investigation. Tissues of different body parts were analyzed and the results showed that the percentage of protein ranged from 19.25 to 27.9%, carbohydrate 3.4 to 7.7% and lipid 2.8 to 4.9%. The ash content was found between 0.86 and 1.42%. The water content was found between 49.02 and 55.54% in all the samples analyzed. The SFA was found dominant 38.73%, PUFA of 36.12% and MUFA contributed 4.31% of the total fatty acids. From the present study it is clear that this gastropod is fit for human nutrition. The total amino acid available was found to be 96.8%, among them the essential amino acids (EAA) 50.01% non essential amino acids (NEAA) 46.79% and unidentified amino acids 3.2% were found to present. The results of present study revealed that (EAA) methionine 14.54%, threonine 11.21% and leucine 10.78% and (NEAA) Glutamine10.87%, glutamic acid 10.85% and arginine 10.66% are the major contributes.

Key words: Amino acid, *Bursa spinosa*, fatty acids and Proximate composition

INTRODUCTION

Biochemical assays and nutrients play a vital role on physical growth and development, maintenance of normal body function physical activity and health. The knowledge of the biochemical composition of any edible organisms is extremely important since the nutritive value is reflected in its biochemical contents (Nagabhushanam and Mane, 1978). A newer species should be recommended for human consumption only after assessing the nutritive value of the species with regards to its nutritional merits (Xavier, 1996). Even though large numbers of marine gastropods are suitable for human consumption, our knowledge on its nutritive value is fragmentary.

Generally proximate composition means percentage composition of five basic constituents such as protein, carbohydrate, lipid, ash and water. The proximate composition varied widely depending on several factors like species, size, sex, maturity, season and feeding regimes. Information on daily dietary intake of nutrients especially cholesterol is quite important for especially those with cardiovascular problems (Xavier, 1996; Ajaya, 2002).

Proteins are fundamental bio molecules in all aspects of cell structure and function. An increasing demand for good quality of animal protein for the exploding population has led to effective and increasing exploitation of the aquatic resources. Carbohydrates are major sources of energy in all human diets. The ratio of carbohydrate was less when compare to the other nutrients such as proteins and lipids in animal tissues, especially in aquatic animals. Lipids can be defined as substances such as a fat, oil or wax that dissolves in alcohol but not in water.

Fatty acids are the principal components in lipids. Their diversity in terms of chain length, degree of unsaturation, geometry and position of the double bonds is responsible for the definitive characteristics of lipids for different organisms (Gutanikov, 1995). Fats are the fatty acid esters of glycerol. Lipids of marine origin are rich sources of Omega-3 (n-3) polyunsaturated fatty acids and they have pronounced hypocholesterolemic effect when supplemented in human diet. Fats are concentrated sources of energy, providing 9.45k.cal/g and act as carrier or vehicles for A, D, E and K vitamins and promote their absorption (Ajaya, 2002).

The malnutrition problem in our country can be overcome by effective utilization of nutrient rich molluscan seafood. Malnutrition is considered as a serious problem, which is facing by the developing countries. In India 20-30% of the population does not get adequate nutrition. Proper exploitation of aquatic organisms through captures and culture fisheries will supply the balanced nutritious food and malnutrition can be controlled. A balanced diet should provide around 60-70% of total calories from carbohydrates, preferable starch, about 10–12% from proteins and 20–25% from fat.

Fatty acids are an organic compound consisting of a hydrocarbon chain and a terminal carboxyl group. The fatty acids of seafood differ from vegetable fatty acids in

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length. In the presence of Omega – 3 fatty acids, the action of prostaglandins on epinephrine is diminished and thus constriction or narrowing of blood vessels is prevented. Amino acids are the micro molecules and building blocks of proteins which are essentially organic compounds consisting of amino as well as acidic groups. There are 21 amino acids, as found in animal proteins. The molluscs are excellent sources of seafood. In order to fulfill the demand for malnutrition, the present study was carried out to analyze the proximate composition, fatty acids and amino acid profiles of the frog shell *Bursa spinosa*.

MATERIALS AND METHODS

The *Bursa spinosa* were collected from the trash fish during Sep, 2008 in Mudasalodai (Lat 11º29″N; Long 79º46″ E) landing center along Cuddalore coast, Tamil Nadu, Southeast coast of India.

Estimation of total Protein: The Folin - Ciocalteu Phenol method of Lowry *et al.,* (1951) was adopted for the estimation of total protein in the tissue.

Estimation of total Carbohydrate: The estimation of total carbohydrate content, the procedure of Dubois *et al.* (1956) using phenol – sulphuric acid was followed.

Estimation of total Lipid: The chloroform – methanol extraction procedure of Folch *et al.* (1956) was used for extracting lipid from the various body parts.

Estimation of Water content:

$$\text{Percentage of water content} = \frac{\text{Amount of water in body tissue}}{\text{Wet weight of body tissue}} \times 100$$

Estimation of Ash content: 1gm of powdered tissue was taken in a porcelain crucible and kept in a muffle furnace at 60ºC for 4 hours. The ash content was weighed.

Analysis of Fatty acids by GC (Kashiwagi *et al,* 1997): Preparation of samples was oven dried at 70ºC for 24 hrs until no more weight reduction was observed. After that samples were grounded finely with pestle and mortar. To the 100-200 mg of finely ground tissue samples 1:1 ratio of chloroform: methanol (2ml) was added and kept for 30 seconds. The residual matter was removed by filtering through Whatman No.1filter paper (125mm). This was washed with 1ml of chloroform: methanol (2:1vol) to remove the inorganic substances from the combined extract by partition and treated with chloroform: methanol: water (8:4:3) where the lower phase evaporated to dryness. The dried matter was subjected in a sealed test tube with 3% Methanolic HCL at 80ºC for 18hrs. To this 2ml of hexane was added to extract the Fatty acid methyl esters (FAME) obtained from methanol phase in Hexane. Top 1 ml of the hexane phase was collected in a micro vial. The residual fraction was dissolved in 10/µl of ethyl acetate and injected 1/µl aliquot into a gas chromatograph (Agilent 6890, 1997) equipped with flame identification detector and column HP ULTRA – 225m, 0.2mm ID).

Estimation of Amino acid: The collected gastropod samples were dried at 60ºC for 24 hours in an oven and they were packed in airtight polyethylene covers and kept in desiccators. The oven-dried samples were finely grounded before estimating amino acid profile. Amino acids were estimated in HPLC – Lachrom e merck in SPD- 10A VP Detector.

RESULTS

Biochemical assays play a major role in recent years. The biochemical composition is the yardstick to measure and assess the nutritional quality of food sources. Biochemical compositions vary during different stages in species and so it is more appropriate to assess the biochemical composition of seafood. So as mentioned the *B. spinosa* was taken and the nutritional analysis was done.

The percentage composition of protein values in foot was 22.1%, mantle 19.25%, gonad 27.9% and other body tissue 24.18%. The high range of protein was found in gonad 27.9%. The carbohydrate concentration recorded in foot was 4.4%, mantle 3.4%, gonad 7.7% and other body tissue 6.25%. The carbohydrate level was high in gonad was 7.7%. The lipid content observed in foot was 2.8%, mantle 3.47%, gonad 4.9% and other body tissue 3.91%. The maximum assessment was in gonad 4.9%. The water content recorded in foot was 50.74%, mantle 51.55%, gonad 49.02% and other body tissue 55.54%. The significant level of water was in other body tissue 55.54%. The ash content observed in foot was 0.97%, mantle 0.86%, gonad 1.42% and other body tissue 1.0%. The maximum ash content was observed in gonad 1.42% (Fig. 1).

In the present study, 11 individual fatty acids were identified. Among them the saturated fatty acids (SFA) were found dominant (38.73%) and most of which were C16:0 (22.37%) and C14:0 (9.4%). The polyunsaturated fatty acids (PUFA) were the next most common fatty acids (36.12%) with the higher levels of C20:5 ω3C (16.35%) and C22:6 ω3C (8.05%). The monounsaturated fatty acid (MUFA) occupying the third position contributed 4.31% of total fatty acids, represented by C18:1 ω9C together accounted for about 80% of the fatty acid. At the same time the Omega – 6 and omega - 3 fatty acids accounted for 11.35 % and 16.35% of the total PUFA. The analysis of the fatty acid composition of the *Bursa spinosa* soft body revealed composition showed quantitative differences in the percentage of individual acids. (Fig. 2 and Table 1).

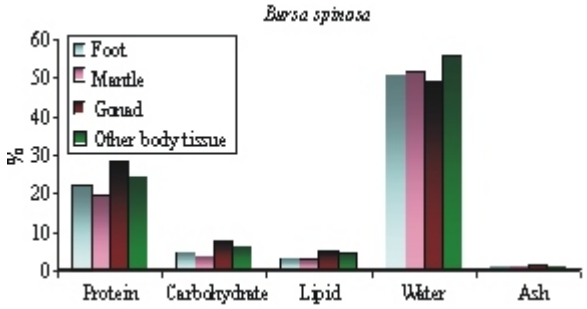

Fig. 1: Proximate compositions in different body parts of *Bursa spinosa*

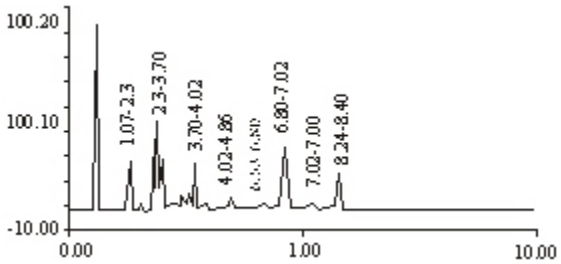

Fig. 2: Fatty acid of *B. spinosa* showing peak

Table 1: Fatty acid composition of *Bursa spinosa* (g amino acid/ 100g Protein)

S. No.	Saturated fatty acids	Position of the Carbon atom	Concentration of SFA percentage
1	Lauric	C12:0	0.028%
2	Myristic	C14:0	9.4%
3	Palmitic	C16:0	22.37%
4	Stearic	C18:0	2.16%
5	Arachidic	C20:0	2.96%
6	Behanic	C22:0	1.81%
Total			38.728%
Monounsaturated fatty acids			
1	Oleic	C18:1 ω9C	4.31%
Total			4.31%
Polyunsaturated fatty acids			
1	Linoleic	C18:2 ω6C	11.35%
2	Linolenic	C18:3 ω6C	0.37%
3	Eicosapentaenoic acid	C20:5 ω3C	16.35%
4	Docasahexaenoic acid	C22:6 ω3C	8.05%
Total			36.12%

Total amino acid content in the protein of *Bursa spinosa* was 96.8%. Among them, the Essential Amino Acids (EAA) 50.1%, Non-Essential Amino Acids (NEAA) 46.79% and unidentified amino acids 3.2% were found to present. The results of present study revealed that methionine 14.54%, threonine 11.21% and leucine 10.78% forms as major are the essential amino acids. Glutamine 10.87%, glutamic acid 10.85% and arginine 10.66% contributed as major non-essential amino acids. Valine and phenylalanine showed the lowest concentration of essential amino acids. Alanine showed the lowest concentration among the non-essential amino acids (Table 2).

Table 2. Amino acid composition of *Bursa spinosa* (g amino acid/ 100g Protein)

Essential amino acids	Percentage of EAA in *Bursa spinosa*
Phenylalanine	0.67%
Valine	0.16%
Threonine	11.21%
Histidine	4.54%
Isoleucine	1.45%
Methionine	14.54%
Leucine	10.78%
Lysine	6.75%
Total	50.01%
Non essential amino acids	**Percentage of NEAA**
Alanine	0.78%
Arginine	10.66%
Asparagine	1.57%
Aspartic Acid	In trace
Cysteine	Below detectable level
Cystine	In trace
Glutamic Acid	10.85%
Glutamine	10.87%
Glycine	10.56%
Ornathine	Below detectable level
Proline	In trace
Serine	Below detectable level
Taurine	Below detectable level
Tyrosine	1.5%
Total	46.79%

DISCUSSION

In the present study the biochemical constituents *viz*, protein, carbohydrate, lipid, ash and water content exhibited a remarkable decreasing and increasing trends in *Bursa spinosa*. To support the present study, similar to this findings were made by Stella (1995) in *Chicoreus virgineus* and in *Rapana rapiformis* (Rajkumar, 1995).

Nirmal (1995), described protein content in *Babylonia zeylonica* male foot was 40.31–66.37% in female 41.87–67.2%. In male protein values in mantle ranged from 44.37–67.31%, whereas in females the range was 45.23–66.27%. The protein values fluctuated in testis from 35.33–60.37% and in the ovary from 36.40–61.52%. The highest value of protein content in other body tissue of *B. zeylonica* male was recorded 42.18–68.31%. In females the minimum level of protein was recorded 43.15% and maximum was recorded 69.75%. In the present study percentage composition of protein values in foot was 22.1%, mantle 19.25%, gonad 27.9% and other body tissue 24.18%. The high range of protein was found in gonad 27.9%.

Baskara (2001) described in *Lambis lambis* male foot protein was varied from 47.26–69.27%. In females protein ranged from 46.12–71.08%. In males of the *L. lambis* protein values in mantle ranged from 47.10-68.27%, whereas in females the range was 46.01–70.18%. The protein values fluctuated in testis from 48.17–70.38% and in the ovary from 49.82–73.78%. The highest value of protein content in other body tissue of *L. lambis* male was recorded 47.5–69.13%. In females the minimum level of protein was recorded 46.75% and maximum was recorded 70.88%. The present study showed a slight variation in all the biochemical compositions.

In *Turbo brunneus*, the major variation in carbohydrate value shows that it could be utilized in considerable quantity for various metabolic activities. In general, carbohydrate values were 1.1–9.2% in male and 1.5–9.2% in females (Suryanarayanan and Nair, 1976).During this analyses the carbohydrate level was 3.4 to 7.7% which is comparatively more or less equal than the previous study.

According to Ansari *et al*. (1981), the carbohydrates of molluscs are mainly composed of glycogen and changes in the carbohydrate level may be due to the accumulation of glycogen at different stages like gametogenesis and spawning. In *T. brunneus*, the maximum values observed for carbohydrate was high in foot (8.82%) followed by gonad (6.14%) and mantle (5.82%). Baskara (2001) described carbohydrate level of *L. lambis* in the male foot was 9.9–14.09%, in females 8.41–15.33%. In males of *L. lambis* the carbohydrate content varied from 9.95–13.18% whereas females it is varied from 8.02–14.21%. In *L. lambis* the carbohydrate content in testis ranged from 7.09–12.08%. In ovary values varied from 6.18–13.01%. The percentage of carbohydrate values in males fluctuated from 9.70–14.12%, in females the values varied from 8.32–15.17%. In *B.spinosa* the carbohydrate concentration recorded in foot was 4.4%, mantle 3.4%, gonad 7.7% and other body tissue 6.25%. The carbohydrate level was high in gonad was 7.7%.

Giese (1969) observed that lipid acts a reserve material and is utilized during stress situation. In contradiction with that Ansari *et al*. (1981) reported that the lipids have little role throughout the seasonal cycle. In *T. brunneus*, the lipid value is higher in ovary with a maximum value of 4.85% and in testis 4.20%. Lombard (1980) observed that lipid values range from 3.90–7.40% in various size groups of *Turbo sarmaticus*.

Nirmal 1995 reported that the range of lipid values of *B. zeylonica* male foot was 4.38–8.31%, in the female it amounts from 4.71–9.20%. The percentage of lipid content varied in mantle from3.38–9.11%, whereas in females 4.02–10.21%. The lipid content in testis of *B. zeylonica* from 1.57–8.15%, in ovary it ranged from 2.18–8.78%. In males of *B. zeylonica* lipid values from 3.21–9.20% whereas in females 3.33–10.38%. The lipid content of the present study of *B. spinosa* observed in foot was 2.8%, mantle 3.47%, gonad 4.9% and other body tissue 3.91%. The maximum assessment was in gonad 4.9%.

The main purpose of the present study was to eliminate differences in food intake of the gastropods affecting the fatty acid composition in the *Bursa spinosa*. This study achieved by sampling from Mudasalodai. This result probably reflected the dietary sources available to *Bursa spinosa*. Fatty acid profiles of other molluscs are usually dominated by SFA and the present study also revealed the same where maximum SFA was present (38.73%) in *Bursa spinosa*.

The polyunsaturated fatty acids (PUFA) have been recognized as effective factors in human health and nutrition, especially for cardiovascular diseases (Bruckner, 1992). The fatty acids composition of oceanic Gastropod *Xancus pyrum* have been analysed by combined GC-MS technique, and the result showed the presence of 8 saturated and 6 unsaturated fatty acids. The methyl fatty acids were identified as n-decanoate, n-tridecanoate, n-pentadecanoate, n-hexadecanoate, n-octadecenoate, methyl nonadecanoate, 3,3-dimethyl heneicosanoate, n-pentacosanoate, and tetradecenoate, pentadecenoate, hexadecenoate, heptadecedienoate, heptadecenoate, octadecadecedienoate. (Usmanghani *et al*., 1989)

Jacob exler and Weihrauch (1977) recorded the most prevalent SFA found in shell fish were palmitic acid (C16:0), the most commonly occurring MUFA are (C16:1) and (C18:1) with (C18:1) usually present in greater quantities and the PUFA (C20:5) and (C22:6) are the most common. PUFA contribute about 30% of the total fatty acids.

Lauric was lower (0.028%) in the SFA of the gastropod and Palmitic was higher in the *Bursa spinosa* compared with the PUFA and MUFA. The most dominant SFA was C16:0 present at 22.37% in the SFA. The dominant SFA in the species was C16:0 followed by C14:0 which is the Myristic. The level of total fatty acids measured in the whole body of *Bursa spinosa* was not very high and there might be several explanations for this fact. Primarily lipids are not the main energy reserve in molluscs, which are generally characterized by low total fat contents (Bonnet *et al*., 1974 added). The fatty acid analysis of the *Bursa spinosa* tissues revealed that the quantitatively most important SFA are C16:0, C14:0 and C20:0, the predominant SFA are C16:0and C14:0.

Ajaya (2002) observed that the amino acid content in the bivalve molluscs *Perna viridis*, *Crooosostrea madrasensis*, and *Maretrix casta*. Totally 18 amino acid were recorded. The total amino acid in the *P. viridis* was 95.76% among them essential amino acid 47.28%, in *C. madrasensis* total amino acid 98.4% among them essential amino acid 54.52% and in the *M. casta* least amount only observed was found to be 65.17% among them essential amino acid 38.17%.

The present study showed that totally 19 amino acids was estimated. The total amino acid concentrations were exhibited high levels of methionine followed by Threonine and glutamine based on the quantum of availability of EAA in the tissue of *Bursa spinosa*. This clearly indicated the potential source for the EAA for human consumption. Therefore it is strongly recommended that *Bursa spinosa* is fit for human consumption.

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