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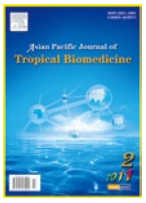

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Nutritional value of gastropod *Babylonia spirata* (Linnaeus, 1758) from Thazhanguda, Southeast coast of India

Periyasamy N*, Srinivasan M, Devanathan K, Balakrishnan S

Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai, Tamil Nadu-608 502, India

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ABSTRACT

Objective: To study the biochemical composition, *i.e.*, protein, carbohydrate, lipid, and amino acids from *Babylonia spirata* (*B. spirata*). **Methods:** The gastropod (*B. spirata*) were collected from the Thazhanguda, Southeast coast of India. The animal shell was broken and body muscles (expected digestive gland) were dried at 60 ℃ in an oven and used for biochemical analysis, such as protein, carbohydrate, lipid, amino acid and molecular size of muscle protein. **Results:** The results of proximate composition showed that the percentage of protein in the tissue was (53.86%), followed by the carbohydrate content(16.85%). The amount of lipid was 9.30%, and totally 10 essential and nonessential amino acids were analyzed in *B. spirata* and the content was 9.911 mg/g. The molecular weight of the gastropod sample was low as 2 kDa on SDS-PAGE. FT-IR analysis revealed the presence of amino acids signals at different ranges. **Conclusions:** The results of this research showed that *B. spirata* meat is a valuable food with high quality protein and well-balanced amino acids.

1. Introduction

Seafood is an excellent source of protein of high biological value. Finfish, shellfish and other aquatic organisms suitable for food and feed are of worldwide importance. They are excellent sources of high quality proteins, which are superior to those in meat and poultry. Man lives on land, which occupies a quarter of the surface of the planet, and takes most of his food from the land. Approximately 14% of the animal protein consumed by human beings comes from marine fisheries[1]. Biochemical assays and nutrients play a vital role in physical growth, development, maintenance of normal body function of 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.

Generally, fish and shellfish meat is considered to be highly nutritious, owing to its content of Omega-3 fatty acids, *i.e.*, essential amino acids and proteins. In addition to their dietary importance, proteins affect food texture, as also do small peptides and amino acids contribute to food flavor[2]. Even though large amount of marine gastropods are suitable for human consumption, our knowledge on its nutritive value is fragmentary. The proximate composition varies widely and depends 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[3]. The malnutrition problems in our country can be overcomed by effective utilization of nutrient rich molluscan seafood. Malnutrition is considered as a serious problem which is faced by 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.

Cuddalore district in Tamil Nadu ranks fourth in fish landings, with 100 tons per day. It is interesting to note that after tsunami there is an increasing trend of gastropod population especially *Babylonia spirata* (*B. spirata*)[4]. It is usually found in the depth of 32 feet. Fisherman used to catch this animal by using special net known as "katcha valai". Its flesh and operculum has medicinal values and also rich in nutrition.

Infrared and Raman spectroscopy can be used to study the vibration and rotational energies of molecules. In the study of molecular vibration, infrared spectroscopy has contributed more to this field than Raman spectroscopy

*Corresponding author: Periyasamy N. Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai -608 502, Tamil Nadu - India.
E- mail: vnltamil@gmail.com

due to the rapid developments in infrared instrumentation. Infrared spectral analysis of biological materials was utilized to investigate their chemical constituents. These are recognized even when the availability of material is less[5,6]. Electrophoresis of protein samples in the polyacrylamidegel is an indispensable analytical tool and in some cases, a preparative tool for the protein scientist. Electrophoresis can be used to separate and compare complex protein mixtures, and to evaluate purity of a protein during physic characteristics, such as sub-unit composition, isoelectric point, size and charge.

The gastropod (*B. spirat*) meat is used for the preparation of good recipes, such as stews, soups, salads, appetizers and hotpot mixed with other seafood. Because of health consciousness, nowadays people are interested in taking more seafood in view of its relatively higher nutrition. The present study was carried out to analyze the proximate composition and amino acid profiles from gastropod in *B. spirata*.

2. Materials and methods

2.1. Preparation of experimental materials

The gastropods (*B. spirata*) were collected from Thazhanguda (Lat. 11° 45' N; Long. 79° 45' E) southeast coast of India. They were brought to the laboratory, the animal shell was broken and body muscles (expected digestive gland) were dried at 60 ℃ in an oven and used for biochemical analysis.

2.2. Estimation of total protein

The Folin - Ciocalteu phenol method[7] was adopted for the estimation of total protein in the tissue.

2.3. Estimation of total carbohydrate

The total carbohydrate content was estimated by using the procedure of Dubois *et al*[8] with phenol - sulphuric acid.

2.4. Estimation of total lipid

The chloroform-methanol extraction procedure of Folch *et al*[9] was used for extracting lipid from various body parts.

2.5. Estimation of amino acid

The experimental gastropods (*B. spirata*) were dried at 60 ℃ for 24 hours in an oven and the dried samples were finely ground for estimating the amino acids in high performance liquid chromatography (HPLC) (Merck hitachedL-7400) following the method of Baker and Han's[10].

2.6. FTIR spectrophotometry (fourier transform-infrared spectrum analysis)

The lyophilized samples of *B. spirata* (10 mg) were mixed with 100 mg of dried potassium bromide (kBr) and compressed to prepare a salt disc. The disc was then read spectrophotometrically (Bio- Rad FTIR-40- model, USA). The frequencies of different components present in each sample were analyzed.

2.7. Determination of molecular size of muscle protein

Molecular size of muscle protein was determined using SDS-PAGE gel following the method of Sambrro *et al*[11]. Glass plates were assembled and 20 mL of 15% resolved gel was prepared and poured immediately to the notch plate. It was overlaid with butanol. After polymerization was completed, over lay was poured off and the top layer was washed with deionized water. Then 8 mL of stack gel was overlaid. Approximate volume of 1*SDS gel loading buffer and sample was taken and was heated at 100 ℃ for 3 min. Then it was fixed in electrophoresis apparatus and 15 μ L of sample and marker (6.5 - 97.4 kDa) was loaded respectively in the well. The gel was run and stained with Coomassie brilliant blue.

3. Results

3.1. Estimation of protein, carbohydrate, lipid and amino acids

The protein, carbohydrate and lipid contents were found in *B. spirata* and the proportions the them are 53.86%, 16.85% and 9.3%, respectively. The percentage composition of essential and non-essential amino acids is shown in Table 1. The ratio of amino acids (essential and non-essential) is 9.91 mg/g in *B. spirata*. Among the amino acids isoleucine ranked the first in the list by contribution of 3.081 mg/g on dry matter basis and other amino acids were found fluctuating between 0.012 and 3.081 mg/g (Figure 1, 2).

Table 1

Amino acid composition of the muscle of *B. spirata*.

S. No.	Amino acids	Ratio (mg/g)
1	Isoleucine	3.081
2	Valine	2.066
3	Lysine	1.012
4	Phenylalanine	1.011
5	Leucine	0.889
6	Methionine	0.766
7	Proline	0.665
8	Tryptophan	0.221
9	Glutamic acid	0.112
10	Alanine	0.088
	Total	9.911

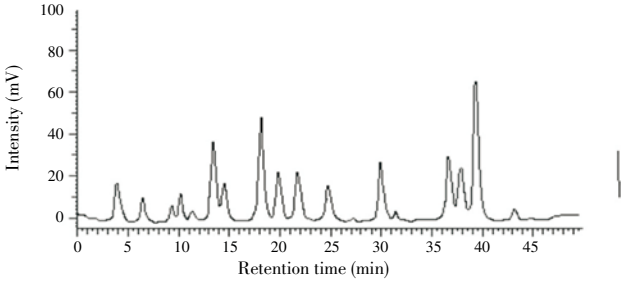

Figure 1. Standard graph amino acids.

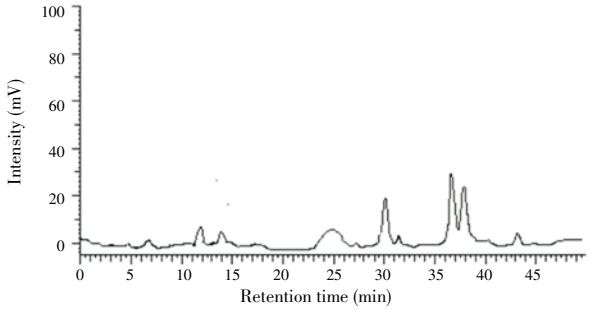

Figure 2. Estimation of amino acids in *B. spirata*.

3.2. FTIR spectral analysis

FTIR spectrum of the lyophilized sample showed that 8 major peaks were shown at 2 860.27, 1 484.93, 1 342.47, 1 218.14, 1 152.18, 933.63, 899.25, 860.39 cm^{-1}, whereas the spectrum of the sample of *B. spirata* showed that all remaining peaks were very close and at 3388.75, 2958.90, 2925.32, 1643.07, 1539.73, 1402.05, 673.97, 615.76, 536.99 and 465.75 cm^{-1} (Figure 3).

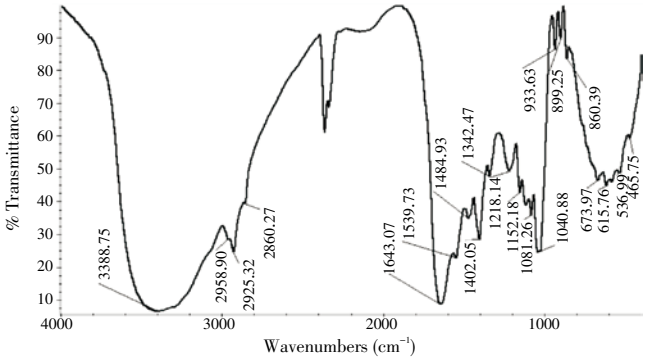

Figure 3. The FTIR spectrum of lyophilized sample of *B. spirata*.

3.3. SDS-PAGE

Crude protein sample of *B. spirata* yielded 6 bands ranging from 2.0 kDa to 110.0 kDa with well defined. Gastropod sample was compared with standard protein molecular weight marker 6.5 – 97.4 kDa (Figure 4).

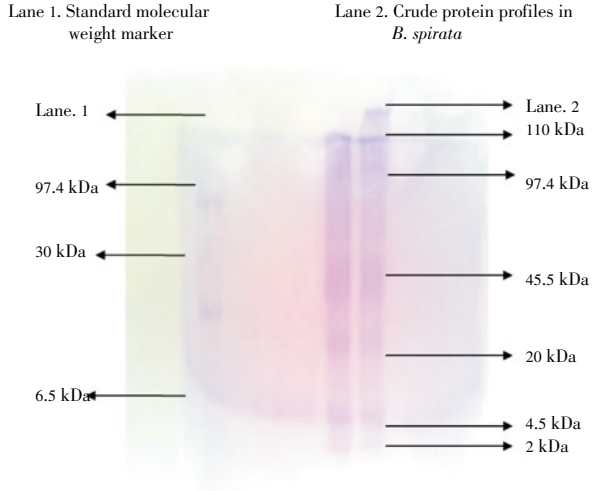

Figure 4. The SDS-PAGE analysis of *B. spirata*.

4. Discussion

Biochemical studies are very important from the nutritional point of view. The biochemical constituents in animals are known to vary with season, size of the animal, stage of maturity, temperature and availability of food *etc*. Protein is essential for the sustenance of life and accordingly exists in the largest quantity of all nutrients to form the components of the human body[12]. The acceptability and easy digestibility of fish proteins make it very valuable in combating protein malnutrition, especially in children. The protein of fish has a high biological value with its capacity of promoting grow. Fish occupy an important part in the world protein supply, accounting for about 10% of the total protein supply. About 60% of the population in the developing countries depends on 40% or more of their total animal protein supplies from fish. The average protein content of fish approximately ranges from 8 g to 23 g per 100 g of wet edible protein.

The phylum mollusca is the biggest and has more than 85 000 representatives. The molluscs are reported to contain a high amount of protein ranging from 40% to 78%[13-15]. The protein ranges of *Cellona rota* fluctuate from 42.33%-82.45%[16]. Krishnakumary reported that the protein values in *Cerithium rubus* varied from 38.34%-65.93% in males and 39.59%-57.65% in females[18]. The recent study reported by Devanathan and Srinivasan showed that the nutritive values of *B. spirata* protein level is 48%-68%[4]. The protein value of the present investigation revealed that the maximum level of protein content in *B. spirata* is 53.86%. The protein content in the *Onchidium verraculatum* is in mantle (14.21%) and in foot (11.34%), which is lower than in another pulmonate snail *Pythia plicate*. Thivakaran observed the protein value (35.94%) of the *Littorina quadricentus*[18]. Tagore reported that the protein value in *Thais biserials* ranges from 18.5%-43.61%[19]. Ansellm *et al*[20] reported that in molluscs generally the carbohydrates reserve may be utilized under unfavorable conditions and the great variation found in the tissue indicates that the level of mobilized carbohydrate reserves may fluctuate widely and rapidly in response to fluctuation in conditions of the protein of the animal and the carbohydrates (2.54%-2.94%) obtained from male *Babylonia zeylanica* (*B. zeylanica*). Carbohydrates constitute only a minor percentage of total biochemical composition. Carbohydrates in fishery products contain no dietary fiber but only glucides, the majority of which consist of glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides[12]. In the present study the percentage of carbohydrates(16.65%) is in body tissue. When compared with the other gastropods species, it was higher than that (3.04% to 2.98%) of *Plicate plica*. Nirmal found that the level of lipid was 10.38% in *B. zeylanica* and 1.97% in *Pleuroploca trapezium*[21]. In the present study lipid content is 9.3% in *B. spirata*. Thirumavalavan has reported that the range of lipid is 3% to 10% in *B. spirata*[22]. Rajakumar reported that the range is 0.85%-2.12% in male *Rapana rapiformis* and 0.95%- 2.96% in females[23]. In *Chicoreus ramosus* the lipid values were assessed to be 2% in the foot muscle[24].

Biological value of protein is obviously reflected upon its essential amino acids concentration. In general, the shellfish have a balanced distribution of all essential amino acids required by an adult per day. There are 20 amino acids found in fish proteins. Some of these are listed as essential amino acids, *i.e*., arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. The lowest level of any of essential amino acids

in a protein source, which limits the utilization of that protein, makes it the "first limiting amino acid"[25]. The present study showed that, in *B. spirata*, isoleucine (3.081 mg/g) is maximum, followed by valine (2.066 mg/g) and lysine (1.012 mg/g). Both essential and nonessential amino acids are 9.911 mg/g. The total composition of amino acids in molluscan *Perna viridis* is 95.76%, *Crassostrea madrasensis* 98.4% and *Meretrix casta* 65.17%[26]. Babu *et al*[27] reported that the total essential and nonessential amino acids are 50.01 mg/g and 46.79% in *Bursa spinosa* (mesogastropod) respectively. Sudhakar *et al*[28] found that shellfish, the hard and soft shell crabs totally contributed to maximum amount of essential amino acid (51.09%), and the minimum was in soft shell crabs (43.627%). Palpandi reported the amino acids (totally 6) content of *Nertia crepidularia* is 68.506% and 31.012% in four essential and two non essential amino acids respectively[29]. Electrophoresis on SDS-PAGE revealed a six bands protein corresponding to the molecular weight. The presence of six bands indicates that the protein in *B. spirata* has similar molecular weight. Whereas the FTIR spectrum of the *B. spirata* sample also recorded the number of peaks lying between 465.75 cm^{-1} and 3388.75 cm^{-1}. The present research showed that gastropod *B. spirata* meat is a valuable food with high quality protein and well-balanced essential amino acids.

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