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Biochemical Analysis of Gastropod *Babylonia spirata*. L

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KEYWORDS

Babylonia spirata. L, proximate composition, biochemical analysis, nutrients.

ABSTRACT:

Introduction: *Babylonia spirata.* L, common name the Spiral Babylon, is a species of sea snail, a marine gastropod mollusk, in the family *Babyloniidae*. In the present work, *B. spirata* was assessed for its proximate composition and biochemical profile to gain the related knowledge. The results of the study emphazised that *B. spirata* is a nutritionally rich gastropod with high protein content, balanced amino acid composition, beneficial fatty acids, and significant amounts of vitamins and minerals. Compared to other marine molluscs, the nutritional profile of *B. spirata* suggested its potential as a valuable seafood resource.

Objectives: To evaluate the biochemical composition of *B. spirata* by analyzing its protein, carbohydrate, lipid, amino acid, fatty acid, vitamin, and mineral contents. To assess its nutritional value and potential as a valuable marine food resource.

Methods: The gastropod *B. spirata* was collected from trash fish at Kanyakumari coast landing centers and transported on ice to the laboratory, where shells were broken, edible portions removed, washed with deionised water, oven-dried at 50–55°C, powdered, and used for biochemical analyses. Moisture content was determined using AOAC (1980), protein by Lowry's method (1951), carbohydrate by the phenol-sulphuric acid method of Dubois *et al*. (1956), total lipid by Folch *et al*. (1957), and ash content by Velayutham and Indira (1996). Amino acid composition was analyzed following Ammu et al. (1994) and Sastry and Tummuru (1985), fatty acid profile by gas chromatography as per Kashiwa *et al.* (1997), vitamins using HPLC (Merck Hitachi L-74000) following Sadasivam and Manickam (1996), and minerals (calcium, phosphorus, magnesium, zinc, lead, and copper) according to APHA (1998).

Results: *B. spirata* showed high moisture and protein content, with low carbohydrate and fat, indicating it is a nutritious and low-fat seafood. It contains a good balance of essential and non-essential amino acids, improving its protein quality. Fatty acid analysis showed the presence of healthy fatty acids, including beneficial polyunsaturated fatty acids. The species also contains important vitamins such as A, B-complex, B12, and C, supporting overall health. Essential minerals like calcium, phosphorus, magnesium, zinc, and copper were present. Trace levels of lead suggest the need for monitoring environmental safety.

Conclusions: *B. spirata* can be considered a promising new food source due to its high protein and rich nutritional composition. Its content of essential amino acids, healthy fatty acids, vitamins, and minerals makes it valuable for human nutrition.

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www.jchr.org

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1. Introduction

Seafood is an excellent source of protein with high biological value*, superior to those in meat and poultry.About 14% of the animal protein consumed by humans belongs to marine fisheries* (Pigott and Tucker, 1990). Generally, the meat of fish and shellfish is considered as a good dietary product due to its high content of omega—fatty acids. *B. spirata* (Linnaeus, 1758) is a commercially important, edible marine whelk found in the Indian Ocean, commonly inhabiting sandy/muddy benthic zones. It is a carnivore harvested for food and shell-craft, particularly in Tamil Nadu and Kerala. It is often found in sandy coastal waters, notably along the Tamil Nadu coast in India. Cuddalore district in Tamil Nadu ranks fourth in fish landings with hundred tons per day (Devanathan and Srinivasan,2010). They are highly nutritious marine gastropod with high-quality protein, low fat, and significant essential amino acids. It's notable that the population of *B. spirata* has increased significantly after tsunami (Devanathan and Srinivasan,2010).

The spiral Babylon, *B. spirata* is smooth shelled, ovoid, with regular spiral rows of large, rounded or squarish brown patches on a white ground. The spire is of medium height with rounded whorls while, the body whorl is inflated and the suture is channelled with sharp edge. The columella is smooth, with somewhat strongly thickened callus. The aperture is large, ovate, and constricted posteriorly by a single, thick ridge extending spirally inward on the columellar side. The species is distributed in the Indian Ocean up to 150 m.

Globally six species of genus *Babylonia* are commercially important, viz, *B. areolata, B. japonica, B. formosae formosae, B. formosae habei, B. spirata* and *B. zeylanica*. These are very popular mainly in Southeast Asian countries. *B. spirata* (Linnaeus, 1758) and *B. zeylanica* (Bruguiere, 1789) began to be fished and exported from the country to China, Singapore, Thailand and Europe. These resources began to be regularly fished from Kerala since 1993 and number of fishing vessels targeting this resource increased over the years. Based on the valuable information obtained regarding the nutritional benefits and medicinal importance of B. *spirata* from fisherman of our local area, the present work was designed and performed to evaluate its nutritional aspects.

2. Objectives

The objective of this study was to analyze the nutritional composition of *B. spirata* by determining its proximate components such as moisture, protein, carbohydrate, lipid, and ash content. It also aimed to evaluate its biochemical profile, including amino acids, fatty acids, vitamins, and minerals, to understand its overall nutritional quality. Further, the study sought to assess its potential as a promising and sustainable new marine food source for human consumption, with consideration of food safety aspects.

3. Methods

3.1 Collection of samples

The gastropod *B. spirata* was collected among trash fishes from the landing centres of Kanyakumari Coast. The collected samples were transported to the laboratory in ice. Shells were broken and the edible portion was removed from the shell. It was thoroughly rinsed with deionised water to remove extraneous material and dried in a hot air oven at 50 to 55^0C. The well dried samples were powdered and it was used for the estimation of protein, carbohydrate, lipid, amino acids, fatty acids, vitamins and minerals.

3.2 Estimation of moisture content

The amount of moisture present in the sample was estimated by following the method of AOAC, (1980).

3.3 Estimation of Protein

The amount of protein present in the sample was estimated by following Lowry's method (Lowry *et al.,* 1951).

3.4 Estimation of Carbohydrate

For the estimation of total carbohydrate content, the procedure of Dubois *et al*. (1956) using phenol-sulphuric acid was followed.

3.5 Determination of Total Lipid

Total lipids of the tissue samples were analyzed by following the gravimetric method of Folch *et al.,* (1957).

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4671-4676 | ISSN:2251-6727

3.6 Determination of Ash content

Ash content was calculated using the method of Velayutham and Indira, 1996.

3.7 Estimation of Amino acid

The amino acid composition of dried sample was determined by following the method of Ammu *etal*., 1994 and Sastry and Tummuru, 1985.

3.8 Determination of Fatty acids

Fatty acids profile was prepared using the method of Kashiwa *et al.,* 1997 by Gas Chromatography.

3.9 Determination of Vitamins

The vitamins were estimated in the HPLC (Merk Hitachi L-74000) following the method described by Sadasivam and Manickam (1996).

3.10 Determination of Minerals

Sample was analyzed for calcium, phosphorus, magnesium, zinc, lead and copper concentrations according to APHA (1998).

4. Results

The present study evaluated the nutritional composition of the gastropod *B. spirata*, including proximate composition, amino acids, fatty acids, vitamins, and minerals.

4.1 Proximate Composition

The proximate composition of *B. spirata* revealed a high moisture content of 73%, which is typical of marine gastropods and indicates freshness but may reduce shelf stability. The protein content was 24.89%, demonstrating that *B. spirata* is a rich source of protein and could serve as an important dietary component for human nutrition. The carbohydrate content was 7.11%, which is relatively low, as expected in animal tissues. Lipid content was 4.09%, indicating that the species is a low-fat seafood with potential health benefits. The ash content (1.18%) reflects the presence of essential minerals. The results of proximate composition analysis expressed as standard deviation in percentage is presented in Table 1.

Table1: Analysis of Proximate composition of the Gastropod of B. *spirata*

Proximate components	Availability in Percentage	SD%
Moisture	73%	29.938
Protein	24.89%	
Carbohydrate	7.11%	
Lipid	4.09%	
Ash	1.18%	

4.2 Amino Acid Composition

The amino acid profile (Table 2) showed that *B. spirata* contains a good balance of essential and non-essential amino acids. Among essential amino acids, Isoleucine (2.035%), Methionine (1.365%), and Tryptophan (1.364%) were found in higher concentrations, which are important for growth, tissue repair, and metabolic regulation. Among non-essential amino acids, Aspartic acid (1.345%) was the most abundant, followed by Glycine (0.605%). These amino acids contribute to physiological functions and improve the nutritional quality of the protein.

Table 2: Amino acid content of *Babylonia spirata*

S.no	Essential Amino acid	%	Non - essential Amino acids	%
1	Threonine	0.215	Aspartic acid	1.345
2	Arginine	0.305	Glutamic acid	0.457
3	Histidine	0.203	Asparagine	0.215
4	Valine	0.554	Serine	0.305
5	Methionine	1.365	Glutamine	0.564
6	Isoleucine	2.035	Glycine	0.605
7	Leucine	1.235	Alanine	0.193
8	Phenylalanine	1.154	Cysteine	0.335
9	Lysine	1.093	Tyrosine	0.193
10	Tryptophan	1.364	Proline	0.564
SD %		**0.539**		

Journal of Chemical Health Risks

www.jchr.org

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4.3 Fatty Acid Profile

The fatty acid composition indicated the presence of saturated, monounsaturated, and polyunsaturated fatty acids. Among saturated fatty acids, Stearic acid (1.225%) and Palmitic acid (0.934%) were predominant. The monounsaturated fatty acid Oleic acid (0.883%) is known for its beneficial effects on heart health. Polyunsaturated fatty acids such as Linolenic acid (1.126%) and α-linolenic acid (0.504%) are essential fatty acids that play a key role in reducing inflammation and supporting brain function. The presence of PUFA highlights the nutritional and therapeutic value of *B. spirata*. The results are presented in table 3 expressed as Standard deviation percentage

Table 3: Fatty acid profile of *Babylonia spirata*.

Fatty acids		**(%)**	**SD%**
Saturated Fatty Acids (SFA)	Palmic acid	0.934	**0.460**
	Margaric acid	0.201	
	Stearic acid	1.225	
Mono unsaturated Fatty acids (MUFA)	Oleic acid	0.883	
Poly unsaturated Fatty acids (PUFA)	Linolenic acid	1.126	
	α Linolenic acid	0.504	
	Morotic acid	0.035	

3.4 Vitamin Composition

The vitamin analysis (Table 4) showed that ***Babylonia spirata*** contains both fat-soluble and water-soluble vitamins. Vitamin A (15.6 mg/100 g) supports vision and immunity. Water-soluble vitamins including Vitamin B1 (0.99 mg), B2 (1.25 mg), B3 (2.15 mg), and B6 (2.93 mg) are essential for metabolic processes.Vitamin B12 (0.35 mg), which is mainly present in animal-derived foods, is important for nerve function and red blood cell formation. Vitamin C (14.5 mg) contributes to antioxidant defense and immune health. The results are presented in table 3 expressed in Standard deviation.

Table 4: Vitamins observed in *Babylonia spirata*

Vitamins		**mg/100g**
Fat soluble vitamins	Vitamin A	15.6
Water soluble vitamins	Vitamin B_1	0.99
	Vitamin B_2	1.25
	Vitamin B_3	2.15
	Vitamin B_6	2.93
	Vitamin B_{12}	0.35
	Vitamin C	14.5
Standard deviation in mg		**6.654**

3.5 Mineral Profile

The mineral composition (Fig. 1) revealed the presence of important macro and trace elements such as calcium, phosphorus, magnesium, zinc, and copper. These minerals play crucial roles in bone formation, enzyme activation, and metabolic functions. The detection of trace levels of lead suggests the need for monitoring environmental contamination.

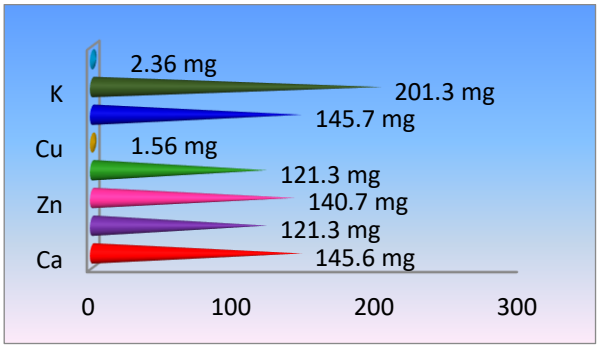

Fig. 1: Mineral profile of *Babylonia spirata*

5. Discussion

The present study highlights the nutritional significance of *Babylonia spirata*, demonstrating a

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4671-4676 | ISSN:2251-6727

strong relationship between its proximate composition and biochemical constituents. The high moisture content observed in this study is consistent with previous reports on marine gastropods, where moisture levels typically range between 70–80%, contributing to tissue softness and freshness but limiting shelf stability (AOAC, 2016; Gopakumar, 2002). The protein content recorded in *B. spirata* is comparatively high and aligns with earlier findings in molluscan species, indicating that gastropods are excellent sources of high-quality protein (Nair and Gopakumar, 2003). This high protein level shows a positive correlation with the amino acid composition, particularly the presence of essential amino acids such as isoleucine, methionine, leucine, and tryptophan. Similar amino acid profiles have been reported in other marine molluscs, where essential amino acids contribute significantly to growth, tissue repair, and enzymatic functions (FAO/WHO, 2013). The relatively higher concentration of isoleucine suggested that *B. spirata* protein is nutritionally balanced and suitable for human consumption.

The low carbohydrate content observed in the present study is typical of animal tissues, especially marine invertebrates, where carbohydrates play a minor role in energy storage (Sikorski, 1990). In contrast, the lipid content though low, is nutritionally important due to its fatty acid composition. The presence of monounsaturated fatty acids (oleic acid) and polyunsaturated fatty acids (linolenic acid and α-linolenic acid) indicates potential health benefits, including reduced cardiovascular risk and anti-inflammatory effects. Previous studies have emphasized that even low-fat seafood can be nutritionally valuable if it contains essential fatty acids (Simopoulos, 2002). Thus, a positive correlation exists between lipid content and fatty acid quality in determining the health benefits of *B. spirata*.

The ash reflects the mineral richness of the species and correlate well with the presence of essential elements such as calcium, phosphorus, magnesium, zinc, and copper. These minerals are known to support bone health, enzyme activation, and metabolic processes (Gibson, 2005). Similar mineral compositions have been reported in other molluscan shellfish, indicating their importance as dietary sources of micronutrients (FAO, 2004). However, the detection of trace levels of lead suggests environmental contamination, which is a common concern in marine organisms and highlights the need for continuous monitoring (WHO, 2007).

The vitamin profile further enhances the nutritional importance of *B. spirata*. The presence of fat-soluble Vitamin A and water-soluble vitamins (B-complex and Vitamin C) shows a strong correlation with metabolic and physiological functions. B-complex vitamins are directly involved in energy metabolism and protein utilization, while Vitamin B12, predominantly found in animal sources, plays a crucial role in red blood cell formation and neurological function (FAO/WHO, 2001). The presence of Vitamin C contributes antioxidant properties, which may act synergistically with polyunsaturated fatty acids to reduce oxidative stress (Halliwell and Gutteridge, 2015).

Overall, the results demonstrate a strong interrelationship among proximate composition, amino acids, fatty acids, vitamins, and minerals. These findings are consistent with the observations of *Periyasamy et al. (2011)*, who reported that reported that the gastropod *Babylonia spirata* from the southeast coast of India is nutritionally rich, with significant protein, amino acids, lipids, and carbohydrates. emphasizing its potential as a high-quality food source. These positive attributes of *Babylonia spirata* make it a promising candidate for dietary use and potential nutraceutical applications.

6. Conclusion

Malnutrition is a serious problem in many of the countries. Daily dietary intake of nutrients is most required by this population to maintain a steady health. Such malnutrition related problems can be overcome by establishing and uplifting molluscan culture so as to supply balanced nutrients to the population.

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Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(2), 4671-4676 | ISSN:2251-6727

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