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Nutritional Status of Green Mussel *Perna Viridis* at Tamil Nadu, Southwest Coast of India

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Abstract

The biochemical compositions of green mussel *P.viridis* were analyzed. The percentage of protein was high followed by the carbohydrate and lipid. The total essential amino acids were found to be higher than the non-essential amino acids. Seven vitamins were detected and among that vitamin A and C were found to be high. Totally six macro minerals and 2 trace minerals were reported. The result showed that marine bivalve *P.viridis* is a valuable food source for human consumption, due to its high quality protein and well-balanced nutritional composition.

Keywords: Mussel; Essential amino acids; Vitamins; Minerals; Biochemical compositions

Introduction

Mussels of the genus *Perna* Philipsson belong to the Mytilidae or true mussels (Mollusca; Bivalvia; Lamellibranchia; Mytiloida; Mytilidae). This genus contains green and brown mussels and are distributed in tropical, subtropical, warm temperate and cold temperate regions, mostly from the southern hemisphere, but also from northern Africa and the northern coasts of South America [1,2]. In India both the green and brown mussels are widely distributed in the east and west coast of India along the inter-tidal zones [3]. These mussels are both ecologically and economically important throughout their ranges, and have long constituted an important source of human food [4-8].

The knowledge on nutritional composition of any edible organisms is enormously important because of the nutritive value is reflected to the biochemical contents [9]. The demand for protein rich food is increasing, especially in developing countries, stimulating the exploration of unexploited or non-traditional resources. Marine molluscs are commercially valuable species and easy to cultivate in coastal areas. Marine molluscs are important for marine ecology and human diet, since it is an important source of nutrients. Consumption of marine molluscs provides an inexpensive source of protein with a high biological value, essential minerals and vitamins. Additionally, the molluscs muscle contains little saturated fat and significant amount of Vitamin C. Molluscs is also a good source of minerals such as calcium, potassium, zinc, iron, phosphorus and copper.

Consumption of shellfish is considerably low but the bivalve mussels consumption in western coast area in India is more just like other sea foods. Shellfish contain significant amounts of "good" fats called omega-3 fatty acids. Shellfish such as mussel contains approximately 20 to 28 percent calories from fat [10]. The types of fat in mussels are also favorable. Shellfish also provide high quality protein with all the dietary essential amino acids for the maintenance and growth of human body. For this reason, shellfish should be considered a low-fat, high-protein food that can be included in a low-fat diet [10,11]. The demand for protein rich food is increasing day by day especially in developing countries with the growth of the human population. Marine fin fishes occupy an important place in human diet followed by crustaceans and molluscs to a much smaller extent [12].

As the world population is growing, the per capita consumption of seafood is also increasing rapidly. Because of health consciousness, the modern day man is interested in taking seafood more in view of its nutritional superiority than all other sources of food accessible to him. There is no considerable study on the nutritive value of green mussel *P. viridis*. In the present study the major biochemical components like total protein, carbohydrate, lipid, amino acids, vitamins and mineral contents of green mussel meat were assessed using standard methods.

Materials and Methods

The green mussel *P. viridis* were collected from the intertidal rocky coastal areas of Kanyakumari district in the west coast of India. Samples were brought to the laboratory and the shells were broken and the soft tissues were removed from the shell and dried at 50°C in an oven and used for biochemical analysis. The protein, lipid carbohydrate content of the samples was analyzed in triplicates. The proximate compositions of the experimental samples were determined by using standard methods; viz., protein [13], carbohydrate [14] and lipid [15]. The dried mussel meat samples were finely ground for estimating the amino acids using HPLC (Merck Hitachi L-7400) following the method of Baker and Han [16]. Fat soluble vitamin A and the water soluble vitamins B1, B2, B3, B6, and C were analysed in HPLC (Merk Hitachi L-74000) following the method described by Sadasivam and Manickam [17]. The vitamin B12 was estimated by following methods suggested in USP NF 2000 Asian edition. The minerals were estimated by following the method of Guzman and Jimeneza [18].

Results

Biochemical composition

The results of biochemical composition of *P.viridis* are shown in Table 1. While protein, carbohydrate and lipid content of green mussel

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Proximate composition	Mean% ± SD (W/W)
Protein	36.15 ± 1
Carbohydrate	24.54 ±1
Lipid	19.720 ± 2

Results are means ± standard deviation of triplicates.

Table 1: Proximate composition of *P.viridis* meat powder.

Essential amino acids	Mean % ± SD (W/W)	Nonessential amino acids	Mean % ± SD (W/W)
Phenyl alanine	0.993 ± 0.002	Glycine	0.813 ± 0.11
Lysine	1.015 ± 0.005	Serine	1.354 ± 0.02
Histidine	1.154 ± 0.011	Glutamic acid	1.93 ± 0.170
Methionine	2.145 ± 0.090	Cystine	1.134 ± 0.034
Arginine	1.193 ± 0.04	Glutamine	0.935 ± 0.02
Leucine	1.193 ± 0.04	Alanine	0.454 ± 0.104
Threonine	1.343 ± 0.07	Proline	0.934 ± 0.004
Iso leucine	1.125 ± 0.021	Asparagine	0.993 ± 0.01
Valine	1.093 ± 0.002	Tyrosine	1.094 ± 0.008
Tryptophan	1.235 ± 0.10	Aspartic acid	1.215 ± 0.075

Results are means ± standard deviation of triplicates.

Table 2: Amino acid content of *P.viridis* meat powder.

were 36.15 ± 1, 24.54 ± 1 and 19.720 ± 2 % respectively. The protein content of *P.viridis* was higher than the other biochemical parameters.

Amino acids

The percentage of essential and non-essential amino acids results are presented in Table 2. Among the ten essential amino acids methionine was found to be high as 2.145 ± 0.090% whereas phenyl alanine was found to be low as 0.993 ± 0.002%. The remaining amino acids like lysine, histidene, arginine, leucine, threonine, isoleucine, valine and tryptophan were in intermediate level. The non-essential amino acids glutamic acid level was high l (1.93 ± 0.170%) and alaninelevel was low (0.454 ± 0.104%) and rest of the non essential amino acids such as glycine, serine, cystine, glutamine, proline, asparagines, tyrosine and aspartic acid were in intermediate level.

Vitamins

The vitamin content of the meat of *P.viridis* is shown in Table 3. Among them, vitamin A (14.5 ± 1.1 mg/g) and C (13.6 ± 1.05 mg/g) were found in higher levels and other vitamins available in the order of >Vitamin B_6 > Vitamin B_3 > Vitamin B_{12} > Vitamin B_2 > Vitamin B_1.

Minerals

Totally 6 macro minerals and 2 trace minerals (Table 4) were detected. The macro mineral calcium, potassium, sodium and iodine were found to be high. Magnesium and iron were also detected in meager level. Trace metals like zinc and copper were in trace level.

Discussion

Seafood is an important in the diets of many individuals because of their unique nutritional composition. The shellfishes are known to be high in protein, low in fat and low in calories. Shellfishes are nutritionally valuable sources of various minerals and high quality protein [11,19-22]. Protein is essential for the sustenance of life and exists in largest quantity of all nutrients as a component of the human body [23]. Our present research revealed that the protein content is high when comparing to the carbohydrate and lipids. Therefore, the results suggest that the *P. viridis* can be considered as an alternative potential food crop capable of providing cheap animal protein. The findings here are in agreement with the report of Catedral et al. [24] in green mussel *P. viridis*. Giese [25] reported that protein to be the dominant organic constituent in molluscs. NOAA [26] reported that the protein ranges in shellfishes ranged between 0.4 to 26.3% at different part of the world. Salaskar [27] reported that the nutritional content of *P. viridis* varied between the summer and monsoon season.

Protein value obviously reflected to the essential amino acids concentration. Present study reveals that the mussel meat have high in essential amino acids (12.489%) than that of nonessential amino acids (10.856%). In general, the shellfish has a balanced amount of all essential amino acids required for an adult per day. Present study showed that among the total 20 amino acids Methionine, threonine and tryptophan were high. The result reveals that the green mussel *P. viridis* meat is a potential source of food due to high quality protein, as well as balanced essential amino acids. Ajaya Bhaskar [28] reported that the total amino acids in *Perna viridis* are 95.76% whereas *C. madrassensis* 98.4% and in *M. casta is* 65.17%. Arularasan et al. [29] reported the percentage of essential amino acids was more (80.97%) than those non essential amino acids (15.07%) in the Gastropod, *Strombus canarium*. Babu et al. [30] reported 96.8%, of total amino acid in mesogastropod, *Bursa spinosa* was among that it is having 50.01% of essential amino acids (EAA) 50.01% and 46.79% of nonessential amino acids and 3.2% of unidentified amino acids. Palpandi [12] reported that *Nertia crepidularia* had 68.5% essential amino acids and 31.01% of non-essential amino acids. Periyasamy et al. [31] reported that *B. spirata* had 9.91 mg/g of 10 essential and nonessential amino acids. Vitamins are organic chemical compounds are essential for promoting growth, reproduction and maintenance of normal body health and function. So far flesh of fish and shell fish is not considered to be important sources of vitamin A, but high content of Vitamin A was reported in fishes and shell fishes like eel, mackerel and bivalve. *P.viridis* meat showed the dominance of vitamin A and C. Ajaya Bhaskar [28] estimated the vitamin level from three species of bivalve namely *P. viridis, C. madrasensis* and *M. casta* and found vitamin B1, B2 and B6. Ozden and Erkan [32] reported that the vitamin B mainly present in muscle of

Vitamins	Mean mg/100g ± SD
Vitamin A	14.5 ± 1.1
Vitamin B_6	3.45 ± 0.95
Vitamin B_{12}	1.77 ± 0.07
Vitamin B_1	0.993 ± 0.00
Vitamin B_2	1.34 ± 0.09
Vitamin B_3	2.66 ± 1.06
Vitamin C	13.6 ±1.05

Results are means ± standard deviation of triplicates.

Table 3: Vitamin content.

Minerals	Mg/100g ± SD
Sodium	156.7 ± 3.2
Calcium	235.9 ± 1
Potassium	156.7 ± 4.1
Magnesium	24.6 ± 1.1
Iron	5.09 ± 0.01
Zinc	2.93 ± 0.99
Copper	1.225 ± 0.00
Iodine	112.7 ± 0.8

Results are means ± standard deviation of triplicates.

Table 4: Minerals content.

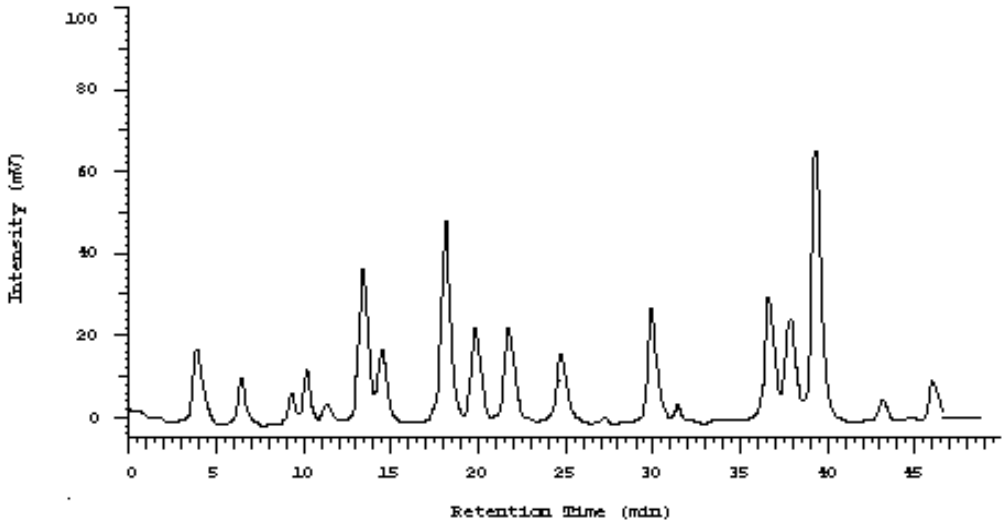

Figure 1: Amino acids in standard.

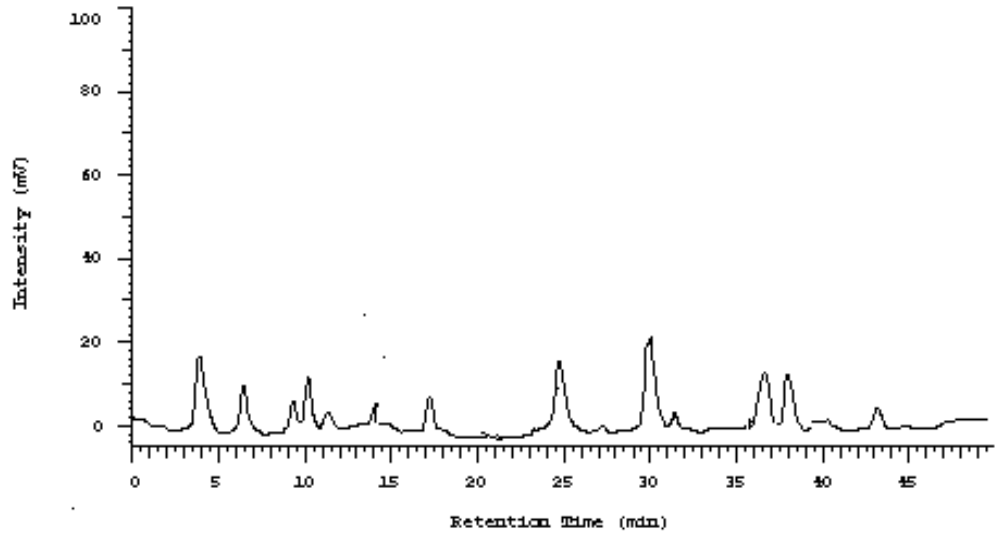

Figure 2: Amino acids in *P.viridis*.

gonad and eggs, while B2 was detected in the digestive gland, gonad and eggs. Shellfish covered in the present study showed complete vitamin profile as the levels required from good health (Figures 1 and 2).

Minerals also constitute important components of hormones, enzymes and enzyme activators in human nutrition [33]. Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and sulphur are important for human nutrition [34]. Mineral deficiencies can cause biochemical, structural and functional pathologies changes. Present study clearly indicate that calcium was more and copper was low in *P.viridis* whereas other macro-minerals potassium, sodium and iodine were in significant level; magnesium and iron were in negligible level. Coombs [35] reported more than 40% of soluble copper and zinc was present in oyster *Ostrea edulis*. The localized Zn and Fe in lysosomes of a number of cell types were reported in *Mytilus edulis* [36]. Rajagopal et al. [37] reported the importance of Ca, Mg, and K in the human nutrition. Gopakumar reported that the sea foods in general are excellent sources of I, Ca, P, Na, Fe, Zn and oysters are good sources of Fe and Cu. Minerals in different species of pearl shells of South China Sea were rich, in Ca, P and Zn contents [38].

Conclusion

In general, seafood is one of the most nutritionally balanced foods. The seafood diet helps to control weight and goes a long way towards preventing heart diseases. Studies on amino acid composition of commercial seafood in India are limited. This might be due to lack of awareness on the benefits of these nutrients particularly from molluscan meat. The results of the present study provide information about the amino acids and vitamin and mineral composition and also suggest the consumption of this bivalve, *P.viridis*. Therefore the balanced and healthy diet is a prerequisite for good health. In the present study clearly indicate that the mussel *P.viridis* can be a balanced diet and contribute good nutritional status.

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