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Nutritional Quality in Freshwater Mussels, *Parreysia* spp. of Periyar River, Kerala, India

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Abstract

Nutritional quality aspects of freshwater mussels Parreysia spp. were studied in different seasons for a period of 12 months from February 2010 to January 2011 from Periyar River, in the Western Ghat region of Kerala, India. The aim of this work was to investigate the seasonal changes in macronutrient contents of mussels. Fluctuations in the macronutrient content have been found throughout the seasons. Accumulation of proteins and lipids during the pre and post monsoon seasons, decrease in the same during monsoon and winter season was observed. Carbohydrate content was decreased during pre and post monsoon season, while increased during the monsoon and winter seasons.

Keywords: Freshwater mussels, macronutrients, *Parreysia corrugata*, Periyar River, Western Ghats.

Introduction

Freshwater mussels live at the bottom of streams, rivers, ponds, and lakes. They remain partially buried in the mud or sand, taking water into their bodies. These are filter feeders; take their food from water, and releasing the rest of the filtered water back into water bodies. These mussels depend upon algae and zooplankton as their food and play important role in cleaning water bodies. Mussels store large amounts of minerals and nutrients in their body and act as good nutrient source for human and other animals.

The distribution and biology of these mussels are influenced by various ecological factors like temperature, pH, inorganic salts, food abundance, type of soil, presence of microorganism, flow of water and seasonal variation in the physicochemical parameters. The inorganic constituents of water have effect on the diversity of the bivalves, the texture of the sediment and the quantity of organic matter seemed to have played a role in their distribution. *Parreysia spp.* is able to survive even in the presence of sandy soil and lesser organic matter[1].

Numerous studies are present on marine bivalves at large, only a few studies have been done on freshwater forms. Lipid composition and storage strategy in molluscs, particularly of bivalves and gastropods, have been studied since lipids constitute a major fraction of molluscan tissues[2]. Lipid composition and metabolism have been extensively studied in marine bivalves; a few investigations have been done on freshwater forms[3-7].

Proteins, lipids and carbohydrates variations are related to reproductive cycle of bivalves. This shows which nutrient is the most important energy source of mussels[8]. Accumulation of carbohydrates generally takes place in large amounts during their growing season and uses them during their rest of the life[9]; proteins may also be an energy store in some bivalve species[10-11].

Freshwater bivalves are less known and rarely consumed in Kerala. No literature is available on the study of nutritional contents of these mussels. The present study aims to quantitatively estimate proteins, carbohydrates and lipid contents of *Parreysia spp.*

Material and Methods

The mussels were collected for a period of 12 months from February 2010 to January 2011. They were handpicked and brought to the laboratory alive. They were identified based on the literature available. For the present study, 2 species *Parreysia corrugata*, and *Parreysia corrugata* sub sp. *nagpoorensis* were used. The whole body meat was isolated, blotted to remove excess water and dried in oven at 60^0C till constant weight was obtained. All tissues were ground into fine powder using mixer grinder and were used for the estimation of proteins, lipids, carbohydrates and ash contents.

Protein was estimated following the method of Lowry *et al.*[12]. To a 10mg of sample 1 ml of 1N NaOH was added and kept in boiling water bath for 30 minutes for protein extraction. Thereafter, it was cooled to room temperature and neutralized with 1 ml of 1N HCL. The extracted sample was centrifuged at 2000 rpm for 10 minutes, and an aliquot of the sample (1 ml) was further diluted with distilled water (1/9 v/v). From the diluted sample, 0.5 ml was taken and made up to 1 ml with 0.1N NaOH. To this, 5 ml of mixed reagent (alkaline copper reagent)

and 0.5 ml of FC reagent was added. After 30 minutes, O.D. was read at 660 nm using spectrophotometer.

Lipid was estimated by the method of Bligh and Dyer[13]. 50 mg of dried tissue sample was mixed well with 15 ml of chloroform-methanol mixture (1:2 v/v) and 4ml of distilled water. The homogenate was centrifuged at 2000 rpm for 10 minutes. The supernatant was taken in separating funnel and 5ml each of distilled water and chloroform was added and mixed well and left for overnight separation. The lower layer was collected in pre weighed ceramic bowl, dried in nitrogen stream and weighed.

The inorganic ash contents were determined by placing 1gm of dry sample in crucible and combusted at 600^0C in muffle furnace for 6-8 hours. The crucibles were cooled and weight of the ash was expressed in grams. The carbohydrate contents were estimated by simple subtraction method.

Results and Discussion

Protein: Protein was the most dominant biochemical constituent in the present study. Although glycogen is regarded as major for of energy reserve in bivalves[14], protein reserve may be used simultaneously with carbohydrate, or even as the primary energy source[15-16]. Protein values were observed to be significantly higher during post monsoon and pre monsoon season. They were ranging between 34.4%-59.0% in *Parreysia corrugata*, 36.0%-56.0% in *P.corrugata sub spp. nagpoorensis.* The proteins were decreased in monsoon and winter seasons. According to Lee[17] the protein maxima and minima correspond to the development/ spawning and regression/ resting phases, respectively. This could be mainly because of increase food availability and secondly it happened to be just prior to the spawning period. This increased protein content may be a mechanism of maturation of gonad and storage of reserves to meet spawning requirements[18-19]. Low protein values recorded in monsoon were could be mainly due to increased rate of ammonia excretion and also spawning activity especially during post spawning season which are in conformity with earlier reports[20].

Lipid: Lipid is an important dietary constituent, serve as reserve energy when food supply is scanty. In the present study lipids were found to be 3.8%-7.2% in *P. corrugata,* 2.0%-8.8% in *P.corrugata sub spp. Nagpoorensis.* In stressful environmental conditions, after glycogen lipid is used as energy source[21-22]. Lipid variation has been related to gamete development with the highest levels of lipids accumulation during the gonadal ripening. Lipids also exhibited large fluctuations in all months of the year. But in monsoon months as temperature and salinity decreases sharply lipids also decreases sharply. The increase in lipid contents may be due to the lipogenesis occurring in the ovary for production of gametes. In case of mussels lipids shows inverse relation with carbohydrates. As, lipid increases carbohydrate decreases.

In the present study the lipid content decline in winter indicate that at the time of fully maturity of gonads the other biochemical content increased and lipid content lower and increased in post monsoon due to the ripening and matured released of gametes. On the other hand, specific differences in lipid composition in mussels are also affected by its diet, vegetation, environmental temperature, salinity and dirtiness of water. Most importantly diet plays a major role in it.

Carbohydrates: Carbohydrate is second major biochemical content in bivalves. Here the carbohydrates were ranging between 12.44%-43.77% in *P.corrugata*, 21.6%-43.7% in *P.corrugata* sub spp. *nagpoorensis*, Carbohydrates were found to be increased during monsoon and winter season. Glycogen is the primary energy store in bivalves[23-24], and the relative amount of stored glycogen in bivalve tissue is considered a good indicator of body condition[25-26]. The glycogen content in the gonads, decline in monsoon season in mussel. Might, be due to starvation, reproductive stage and drastic environmental conditions and low metabolic rate. In the winter the glycogen content increases in the gonads.

The nutrients protein, glycogen and lipids vary seasonally. These changes are generally related to the reproductive cycle. Similar characteristics have been observed in other bivalves such as Anomalocardia squamosa[27], Donax trunculus[28], Lyropecten (Nodipecten) nodosus[29], Macoma balthica[30], Mercenaria mercenaria[31], Placopecten magellancius[32] and venus verrucosa[33].

Table-1
Biochemical composition in the whole body of *Parreysia corrugata* (gm/gm of dry tissue)

Months	Protein	Lipid	Ash	Carbohydrate
Feb'10	0.344	0.06	0.2544	0.3416
Mar'10	0.41	0.068	0.1233	0.3987
Apr'10	0.4	0.07	0.1882	0.3418
May'10	0.48	0.054	0.2448	0.2212
Jun'10	0.58	0.072	0.1322	0.2158
Jul'10	0.36	0.06	0.1882	0.3918
Aug'10	0.4	0.038	0.1506	0.4114
Sep'10	0.47	0.042	0.1617	0.3263
Oct'10	0.59	0.064	0.2216	0.1244
Nov'10	0.48	0.041	0.2584	0.2206
Dec'10	0.44	0.044	0.2651	0.2509
Jan'11	0.37	0.038	0.1543	0.4377

Table-2
Biochemical composition in the whole body of *Parreysia corrugata subsp. nagpoorensis* (gm/gm of dry tissue)

Months	Protein	Lipid	Ash	Carbohydrate
Feb'10	0.36	0.052	0.2379	0.3501
Mar'10	0.42	0.06	0.1928	0.3272
Apr'10	0.44	0.054	0.2427	0.2633
May'10	0.45	0.058	0.1512	0.3408
Jun'10	0.52	0.07	0.1409	0.2691
Jul'10	0.4	0.022	0.1427	0.4353
Aug'10	0.39	0.02	0.153	0.437
Sep'10	0.44	0.042	0.1335	0.3845
Oct'10	0.56	0.088	0.136	0.216
Nov'10	0.46	0.038	0.154	0.348
Dec'10	0.45	0.04	0.2093	0.3007
Jan'11	0.38	0.045	0.2022	0.3728

Conclusion

In the present study, fluctuations in the levels of protein, carbohydrate and lipids content in all the seasons due to storage and utilization of the few organic constituents have been closely linked to complex interaction between food supply and temperature and between growth and reproductive cycle. It has been found that during the reproductive maturity growth of the organisms slows down as a result of the reproductive investment, and the biochemical contents change according to the reproductive needs[34].

In general, the biochemical composition of the whole body indicates the mussel quality. Therefore, proximate biochemical composition of a species helps to assess its nutritional and edible value in terms of energy units compared to other species.

From the above findings it can be concluded that the freshwater mussels are good source of nutrients. They are the good nutritional sources for aquatic animals and birds. They play a good role in the aquatic food chain. Although not eaten by native people, even in the future, they may be eaten as edible freshwater food after studying pathologically[35].

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