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Nutritional Analysis of Freshwater bivalves, *Lamellidens spp.* from River Tunga, Karnataka, India

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Abstract

The aim of this work was to investigate the size and seasonal variation of protein, carbohydrate, and lipid contents in freshwater bivalves Lamellidens spp. The bivalves were studied for a period of 12 months from January 2010 to December 2010 from river Tunga, in the Western Ghat region of Karnataka, India. The current study showed that bivalves accumulate proteins and lipids during the pre and post monsoon seasons. Drastic decrease in protein and lipid content was observed during the monsoon season while winter showed a mild decrease in the same. Inversely, carbohydrate content decreased during pre and post monsoon season, while increasing during the monsoon and winter seasons.

Keywords: Freshwater bivalves, *Lamellidens*, nutrients, Tunga River, Western Ghats.

Introduction

Freshwater bivalves play an important role in lotic and lentic ecosystems and their presence or absence in stream has manifold implications for aquatic ecosystems. The mussels are ecologically important because of their widespread distribution and biological filtration activity[1-2] and also economically, used as food and production of freshwater pearls[3]. The freshwater mussels are widely distributed throughout India. The bivalves have not been the subject of intense studies despite the presence of rich diversity of edible and commercial species in India.

Biochemical component (lipids, proteins, or carbohydrates) fluctuations have been observed in bivalves and related to the reproductive cycle, showing which component was the most important source of energy. Marine bivalves indicated that seasonal cycle of energy storage and biochemical cycles are closely related to reproductive activity[4]. According to Gabbott[5], seasonal metabolic activities in molluscs result from complex interactions among food availability, environmental conditions, growth and gametogenic cycle. In general, energy is stored prior to gametogenesis, when food is abundant, in the form of carbohydrate, lipid and protein. The particular importance of these substrates, where they are stored and the timing of their use varies among species, as well as among populations of the same species[6]. Bivalves generally store carbohydrates in large amounts during their growing season and use them over the rest of the year[7]; although proteins may be an energy reserve in some bivalve species[8-9]. Lipids have been reported to function most importantly as energy storage substances and physical properties of biological membranes[10]. Lipid variation has principally been related to gamete development[11] with the highest levels of lipids during the period when gonads are ripe.

Nutritional analyses of many marine bivalves have been well documented. However, only a limited amount of information is available on the freshwater forms and no such information is available on freshwater bivalves from Karnataka. So an attempt was made to find out the nutritional value of bivalves from river Tunga.

Material and methods

Sample collection and preservation: The study was carried out from river Tunga, near Teerthahalli in Shimoga district of Karnataka, India. The samples were collected every month by random free hand collection and brought to the laboratory alive. The bivalves were identified mainly based on external as well as internal shell characters using standard methods given by Preston[12] and other available literature[13]. The present study was carried on three Lamellidens species *L.jenkinsianus*, *L.generosus* and *L.marginalis*. The mussels were further grouped based on their size into less than 80mm and more than 80mm. The meat was separated from the shell and dried at 60 °C for 48hrs after which the sample was powdered and stored until further use.

Nutrient analysis: Protein: Protein was estimated following the method of Lowry *et al.*[14]. To a 10mg of sample 1 ml of 1N NaOH was added for protein extraction in water bath for 30 minutes. Thereafter, it was cooled at 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: Lipid was estimated by the method of Bligh and Dyer[15]. 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. After overnight separation the lower layer was collected in pre weighed ceramic bowl, dried in nitrogen stream and weighed.

Inorganic Ash: 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.

Carbohydrate: The carbohydrate content was obtained by calculation.

Results and Discussion

Nutritional analysis observed during experimental period has been given in table 1-3. Seasonal variation in the nutritional contents of the whole body tissues of *L.jenkinsianus* was found to be, proteins (40.8%-61.2%), lipids (4.7%-8.6%), carbohydrate (15.39% -40.7%) and ash content (10.3%-32.1%) of dry tissue weight. In *L.generosus* protein (42%-62.4%), lipids (4.7%-8.7%), carbohydrate (19.0% -37.4%) and the ash content (9.7%-25.6%) of the dry weight was found. While in *L.marginalis* proteins (42.6%-59.6%), lipids (4.2%-6.8%), carbohydrates (19.3%-38.7%) and ash content (14.4%-25.8%) of total dry weight was observed.

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

MONTHS	PROTEIN		LIPID		CARBOHYDRATE		ASH	
	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm
Jan'10	0.482	0.483	0.063	0.0472	0.2008	0.2033	0.2542	0.2665
Feb'10	0.465	0.455	0.0689	0.0619	0.2205	0.1612	0.2456	0.3219
Mar'10	0.468	0.449	0.0761	0.0611	0.2366	0.2246	0.2193	0.2653
Apr'10	0.54	0.482	0.0808	0.0712	0.1979	0.2318	0.1813	0.215
May'10	0.583	0.544	0.0826	0.0729	0.1989	0.1985	0.1355	0.1846
Jun'10	0.612	0.584	0.0867	0.0783	0.1605	0.1539	0.1408	0.1838
Jul'10	0.421	0.408	0.0562	0.0573	0.3807	0.4004	0.1421	0.1343
Aug'10	0.432	0.425	0.0487	0.049	0.407	0.4059	0.1123	0.1201
Sep'10	0.45	0.455	0.0512	0.0525	0.3556	0.3359	0.1432	0.1566
Oct'10	0.58	0.568	0.0761	0.0541	0.24	0.2134	0.1039	0.1644
Nov'10	0.45	0.431	0.0471	0.0489	0.3563	0.279	0.1466	0.2411
Dec'10	0.486	0.463	0.0487	0.0512	0.2287	0.2464	0.2366	0.2394

Table2
Biochemical composition in the whole body of *Lamellidens generosus* (gm/gm of dry tissue)

MONTHS	PROTEIN		LIPID		CARBOHYDRATE		ASH	
	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm
Jan'10	0.43	0.44	0.059	0.0672	0.2608	0.2705	0.2502	0.2223
Feb'10	0.445	0.48	0.0599	0.0589	0.258	0.2126	0.2371	0.2485
Mar'10	0.51	0.44	0.0624	0.0594	0.2744	0.3173	0.1532	0.1833
Apr'10	0.538	0.52	0.0712	0.0664	0.2345	0.2694	0.1563	0.1442
May'10	0.562	0.536	0.0765	0.0559	0.2347	0.2783	0.1268	0.1298
Jun'10	0.624	0.596	0.0877	0.0765	0.1904	0.2012	0.0979	0.1263
Jul'10	0.452	0.512	0.0542	0.0652	0.3597	0.2695	0.1341	0.1533
Aug'10	0.44	0.458	0.0521	0.0564	0.3535	0.3247	0.1544	0.1609
Sep'10	0.467	0.45	0.0581	0.058	0.3317	0.335	0.1432	0.157
Oct'10	0.598	0.582	0.0681	0.0567	0.1951	0.2347	0.1388	0.1266
Nov'10	0.456	0.442	0.0618	0.0623	0.3393	0.338	0.1429	0.1577
Dec'10	0.44	0.42	0.0569	0.0477	0.2467	0.3747	0.2564	0.1576

Table-3
Biochemical composition in the whole body of *Lamellidens marginalis* (gm/gm of dry tissue)

MONTHS	PROTEIN		LIPID		CARBOHYDRATE		ASH	
	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm	<80mm	>80mm
Jan'10	0.46	0.44	0.0461	0.0459	0.3386	0.2664	0.1553	0.2477
Feb'10	0.484	0.48	0.0564	0.0577	0.2673	0.2291	0.1923	0.2332
Mar'10	0.485	0.48	0.0516	0.0598	0.2737	0.2455	0.1897	0.2147
Apr'10	0.468	0.52	0.0594	0.0499	0.3242	0.2747	0.1484	0.1554
May'10	0.545	0.549	0.0569	0.0501	0.2154	0.2341	0.1827	0.1668
Jun'10	0.596	0.592	0.0527	0.0536	0.1947	0.1935	0.1566	0.1609
Jul'10	0.456	0.426	0.0423	0.045	0.3363	0.36	0.1654	0.169
Aug'10	0.404	0.453	0.0542	0.0534	0.3875	0.3327	0.1543	0.1609
Sep'10	0.44	0.458	0.0479	0.0552	0.3345	0.2994	0.1776	0.1874
Oct'10	0.55	0.546	0.0608	0.0608	0.245	0.2388	0.1442	0.1544
Nov'10	0.44	0.432	0.0611	0.0689	0.3389	0.343	0.16	0.1561
Dec'10	0.48	0.447	0.0492	0.0467	0.3143	0.2474	0.1565	0.2589

In the present study it was observed that the composition of the various nutrients did not depend on the size of the bivalves but rather on other factors discussed below.

From the tables 1-3, it was found that the concentrations of proteins and lipids increases during the pre and post monsoon seasons while drastically decreasing during the monsoon season. Accumulation of protein and lipid during the pre-monsoon season corresponds with the proliferation of gonads[16]. Percentage of these constituents also increases with the maturation of gonads[17].

As a rule the carbohydrates remain at a high level until the beginning of proliferation of gonads. Carbohydrate is found to be at maximum during summer season, which shows the development of gonads to attain maturation. During the rapid proliferation of these gonads, the reserve supply is used, and by the end of the reproductive cycle the amount of carbohydrate is at a minimum.

Spawning occurs during the monsoon season which is represented by a large depletion in the protein and lipid contents. Soon after spawning, after a short period of relative inactivity during which the un-spawned sex cells are reabsorbed, the mussels begin to accumulate and store carbohydrates in their tissues.

Accumulation and depletion of these stored reserves in bivalves also depends on the environmental influences on metabolic activities, and the quantity and quality of available food[18-19] and has been well described by several authors[20-23].

Lipids have also been shown to provide energy during winter, when carbohydrate reserves are depleted[24-25]. All the body organs show minimum protein values in winter season, which may be due to sedentary life without much activities.

Conclusion

The present study revealed that, there is significant variation in the nutritional contents in the bivalves according to seasonal changes. The nutritional composition of the bivalves can be affected by external (exogenous) factors, such as fluctuations in the environmental conditions (temperature and food availability), or by internal (endogenous) factors, such as metabolic and physiological activities[26].

The spawning cycle and food supply are the main factors responsible for this variation. It is well known that seasonal variations in nutritional contents of adult bivalves are closely linked to the reproductive cycle and climate changes and are affected by the availability and composition of the natural diet[27-28].

On the basis of these results, the freshwater mussels are good source for some important nutrients. Although not eaten by native people, they have got important roles in food chain since they are consumed by fish, water birds, mammals and reptiles in the river. Even, in the future, they may be eaten as edible freshwater food after studying pathologically.

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