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Seasonal Variation on the Proximate Composition of *Turbo brunneus**

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Abstract: This study is to find out the nutritive value of the meat of *T. brunneus* and to ascertain the relationship between seasonal variations in biochemical components and reproductive cycle. The monthly variations in the biochemical constituents were estimated in different body organs such as foot, gonad, digestive gland and mantle for both male and female gastropods. Carbohydrate content of gonad is high during May 2002 in males (5.30%) and females (6.14%). The percentage of lipid is high (4.85%) in ovary during May 2002 and low in October 2002 (3.10%). In testis, the values range from 3.0 (September 2002) to 4.20% (May 2002), respectively. The gonadal tissues show major variations in lipid values, whereas the percentage variation is negligible in mantle, which ranges from 1.64-1.74% in males and 1.59-1.78% in females. The lipid valued decreases from June to October and the values showed little fluctuations from the minimum value until December. But, in the digestive gland, the percentage is higher in September 2002 in males (3.06%) and October 2003 in females (2.96%) and low in May 2003 (2.4 and 2.12%) in both the sexes. The protein contents of the digestive gland shows a clear seasonal variation, which is negatively correlated with that of other body organs.

Key words: *T. brunneus*, monthly variations, biochemical constituents, food, gonad, digestive gland, mantle

INTRODUCTION

The molluscan forms have been recognized as seafood of high nutritive value and good delicacy since a very long time. There are many authentic records to prove that their exploitation as food by the fisher folk started from the prehistoric days. Now, molluscan meat has found its place in many culinary recipes and are favoured indices of gastropods will be helpful in assessing the storage products. Survey along the east coast of India has indicated that the non-conventional marine gastropod resources can be used as food, feed or fertilizer.

Turbinid gastropods are exploited for food in a number of Indo-Pacific countries (Alagarswami, 1987; Chantrapornsyl, 1995; Yamaguchi, 1995) around coastal areas of South Africa for a long time till archaeological records exit (Voigt, 1973; Lasiak, 1991). Edibility of *Turbo intercostalis* in India was earlier mentioned by Chari and Unny (1947). The island women of Pamban use to collect the snails and extract the flesh for making curry and soup. Even though *T. brunneus* are exploited in large quantities for its shell and meat, there has been no complete work on the body composition of this gastropod. The present study has been designed to study the biochemical constituents of different soft tissues. The aim of this study is to know its nutritive value, to ascertain whether *T. brunneus* undergoes seasonal variations in biochemical components and if so an attempt to relate this to that of its reproductive cycle.

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MATERIALS AND METHODS

Well matured snails of *T. brunneus* with a shell length of 40 to 50 mm were collected for a period of one year from May 2002 to April 2003 during low tide from the intertidal zone adjacent to the Tuticorin harbour. The collected snails were through to the laboratory and maintained in fibre glass tank, filled with filtered sea water, so as to allow them to empty their guts. The body organs were dried at 60°C protein and fat. The monthly variations in the biochemical constituents were estimated in different body organs such as food, gonad, digestive gland and mantle for both male and female gastropods.

The Biuret method as modified by Raymont *et al*. (1964) was employed to estimate protein. For the estimation of the total carbohydrate content, the procedure of Dubois *et al*. (1956) was adapted and the chloroform-methanol extraction procedure of Folch *et al*. (1956) was followed for lipid extraction.

RESULTS

Protein

The variation in the percentage of protein in different body organs of *T. brunneus* male and females is presented in Fig. 1a, b. The percentage of protein is comparatively higher in foot with a mean value of 54.69% in males and 54.70% in females and the seasonal variation is very limited. The mantle and the associated organs show high protein content during the month of April 2003 for males (47.21%) and females (48.36%) and minimum values are during November 1998 (45.61 and 45.5%) for both males and females, respectively. There is no marked seasonal variation in the protein content of the mantle (Fig. 1a, b).

The gonadal protein content exhibits a clear seasonal variation with high values during May 2002 i.e., 49.25% for males and 52.90% for females. Low values are October 2002. The protein content of

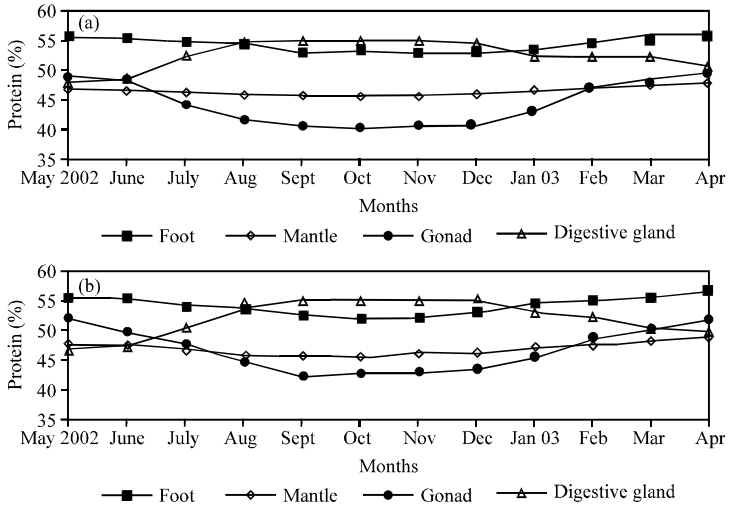

Fig. 1: Percentage composition of protein in different body components during different monts (a) male and (b) Female

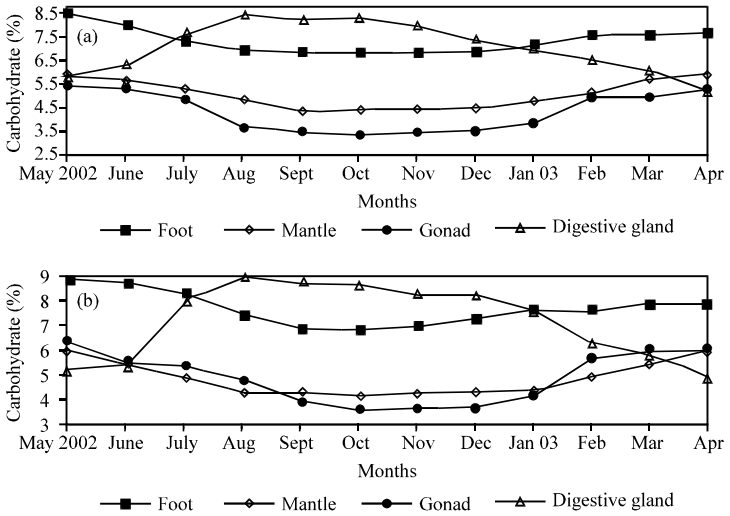

Fig. 2: Percentage composition of carbohydrate in different body components during different months (a) male and (b) female

the digestive glands shows an inverse relationship with that of other body constituents, low values are observed during May 2002 (48.33% for males and 47.5% for females) and high values during October 2002 (55.2%) in males and September 2002 (55.86%) in females.

Carbohydrates

The percentage of carbohydrate is higher in the foot muscle of both the sexes, with a mean value of 7.41% in males and 7.61% in females. The digestive gland also contains a considerable percentage of carbohydrate with value ranging from 5.10-8.62% in males and 4.89-8.85% in females (Fig. 2a, b). The carbohydrate content of the mantle shows only a little fluctuation, with a mean value of 4.91% in male and 4.75% in females. Carbohydrate content of gonad is high during May 2002 in males (5.30%) and females (6.14%). The value gradually declines and reaches a minimum of 3.00% in males (October 2002) and 3.52% in females (September 2002).

Lipid

The percentage of lipid is high (4.85%) in ovary during May 2002 and low in October 2002 (3.10%). In testis, the values range from 3.0 (September 2002 to 4.20% (May 2002) respectively. The gonadal tissues show major variations in lipid values, whereas the percentage variation is negligible in mantle, which ranges from 1.64-1.74% in males and 1.59-1.78% in females. In foot muscle, the percentage of lipid content is low, during November, December 2002 and February 2003. High percentage is observed in males during May 2002 (1.28%) and (1.36%) in females during April 2003. The lipid valued decrease from June to October and the values fluctuate only little from the minimum value until December. But, in the digestive gland, the percentage is higher in September 2002 in males (3.06%) and October 2002 in females (2.96%) and low in May 2002 (2.4% and 2.12%) in both the sexes (Fig. 3a, b).

The correlation coefficient values R between the gonad index and the biochemical composition of the gonads in both the sexes were highly significant ($F = p<0.001$).

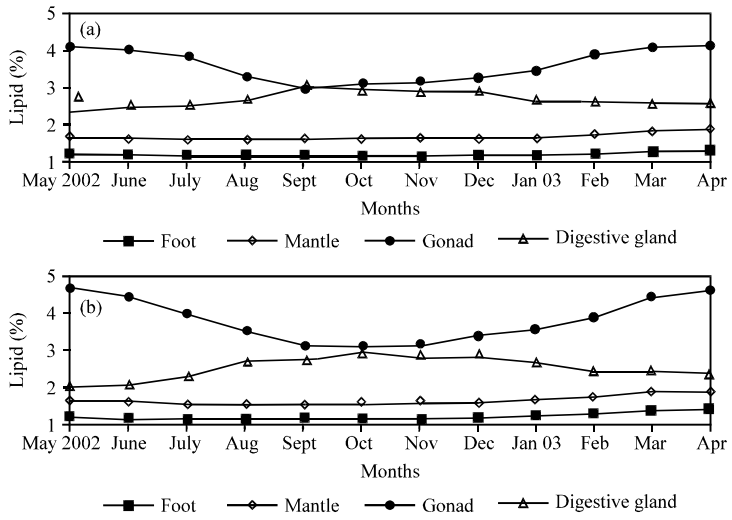

Fig. 3: Percentage composition of Lipid in different body components during different months (a) male and (b) Female

Table 1: ANOVA (one way) for the differences in percentage composition of protein in different body organs of male *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	837.0603	3	282.353400	52.68885	p<0.005	2.816464
Within groups	235.7909	44	5.358884			
Total	1082.8510	47				

Table 2: ANOVA (one way) for the differences in percentage composition of protein in different body organs of female *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	551.2406	3	183.746900	26.64127	p<0.005	2.816464
Within groups	303.4713	44	6.897074			
Total	854.7118	47				

Table 3: ANOVA (one way) for the differences in percentage composition of carbohydrate in different body organs of male *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	96.03504	3	32.011680	41.65105	p<0.005	2.816464
Within groups	33.81701	44	0.768568			
Total	129.85200	47				

Table 4: ANOVA (one way) for the differences in percentage composition of protein in different body organs of female *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	81.73439	3	27.244800	25.35841	p<0.005	2.816464
Within groups	47.27311	44	1.074389			
Total	129.00750	47				

ANOVA was done to find out the differences in protein, carbohydrate and lipid concentration in different body parts of both the male and female *T. brunneus*. The F values were found to be highly significant and is presented in Table 1-6.

This continues steadily for the subsequent moths and maximum values are attained during April and May. The value starts declining from June onwards and minimum values are reached during September to October. This can be correlated with the changes in gonad index and percentage of

Table 5: ANOVA (one way) for the differences in percentage composition of lipid in different body organs of male *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	42.707340	3	14.235780	224.6592	p<0.005	2.816464
Within groups	2.788108	44	0.063366			
Total	45.495450	47				

Table 6: ANOVA (one way) for the differences in percentage composition of lipid in different body organs of female *T. brunneus*

Source of variation	SS	df	MS	F	p-value	F crit
Between groups	47.216600	3	15.738870	111.6724	p<0.005	2.816464
Within groups	6.201267	44	0.140938			
Total	53.417870	47				

matured oocytes which show the same decreasing trend during the above said moths. The low values observed during November and December may be due to the minimum availability of food or because of heavy monsoon inflow which impedes the feeding activity of the snails.

DISCUSSION

A pronounced seasonal variation in the biochemical constituents in various organ systems of gastropods was reported by Shanmugam (1987), Maruthamuthu (1988) and Rajakumar (1995). Seasonal study on the biochemical composition of *T. brunneus* reveals a gradnal increase from the end of November onwards, but a sudden increase in the value is observed during January and February fluctuate widely and rapidly in response to fluctuating conditions affecting the animal. Reduced food intake during cold winter season has been observed in *Monodonta lineate* (Micallef, 1968) and *Melagraphia aethiops* (Zeldis and Boyden, 1979). In *T. brunneus*, variation in protein content of foot does not show much seasonal variation, as noted in abalones and many bivalves. But it cannot be completely ruled out as the months from October to December record much low value. The proteins content of the digestive gland shows a clear seasonal variation, which is negatively correlated with that of other body organs. This was observed by Webber (1970) in *H. cracheroidii*, Tagore (1989) in *Thais* sp. and Rajakumar (1995) in *Rapana rapiformis*. An inverse relationship is observed between the protein content of digestive gland and gonad during gonad maturation. McLachlan and Lombard (1980) reported that in *Turbo sarmaticus* the protein content is associated with gonad development and may be used to synthesize carbohydrate or lipid and also presence of high protein content indicate that it may be used under stress condition.

In *T. brunneus*, the major variation in Carbohydrate value shows that carbohydrate may be utilized in considerable quantity for various metabolic activities. In general, carbohydrate values for carbohydrate were 1.19% in male and 1.5-9.2% in females (Suryanarayanan and Nair, 1976; Patil and Mane, 1982). McLachlan and Lombard (1980) observed that carbohydrate values varied significantly with seasons and within different size groups of *Turbo sarmaticus*. They found that the mean values ranged from 10.20-17.03% in different size groups and the overall mean value was 11.67%.

According to Ansari *et al*. (1981), the carbohydrates of molluscs are mainly composed of glycogen and changes in the carbohydrate level may be due to the accumnlation of glycogen at different stages like gametogenesis and spawning. In *T. brunneus*, the maximum values observed for carbohydrate was high in foot (8.82%) followed by digestive gland (8.63%), gonad (6.14%) and mantle (5.82%). In *T. brunneus*, the carbohydrate value in gonad is not very less and it shows a clear seasonal variation. Barry and Munday (1959) recorded low carbohydrate in the gonad of *Patella vulgata*. In this study, the decrease in carbohydrate content in gonad is inversely related with the increase in digestive gland. It suggests that carbohydrate from the digestive gland may be used up when gonad starts maturing. The presence of low carbohydrate in the gonad-digestive gland complex as compared with viscera and foot

of *Morula granulata*, suggests that it may be used to non-reproductive physiological needs or may be converted to the gonadal lipids (Umadevi *et al*., 1985). Lambert and Dehnel (1974) found that the glycogen levels in digestive gland increased in the parallel with digestive gland index. The foot and the mantle show minor variation and the reduction in the values are due to the utilization of nutrients during reproductive activity. Lambert and Dehnel (1974) found that glycogen was used in the normal synthesis of gonadal material in *Thais*. Emerson and Duerr (1967) found that the glycogen utilization to be high during stress situation in *Littorina*. To conclude that the variation in carbohydrate level is much associated with gonad development in the snail *T. brunneus*. The small fluctuation in the November and December is attributed towards the low development of gonads or low feeding capacity due to various environmental factors. Nakaoka *et al*. (2006) have reported similar kind of variations in few turbinid and trochid gastropods.

Giese (1969) observed that lipid acts a reserve material and is utilized during stress situation. But, according to Ansari *et al*. (1981), lipid has little role to play as a reserve material and the percentage follows a steady rate throughout the seasonal cycle. In *T. brunneus*, the lipid value is higher in ovary with a maximnm value of 4.85% and in testis 4.20%. The ovaries contain high liquid values as in abalone and *Tegula* (Albercht, 1923; Webber, 1970). Mc Lachlan and Lombard (1980) observed that lipid values range from 3.90-7.40% during different seasons and in various size groups of *Turbo sarmaticus*.

In *T. brunneus,* the lipid values in foot is low (1.33%) and it shows minimum fluctuation from the mean value. This has been observed in *Haliotis carcheroidii* (Webber, 1970) and *Thais lamellosa* (Stickle, 1975). Giese (1969) stated that the molluscan foot can hardly be considered as a lipid storage organ. The lipid value of digestive gland is also higher and its reduction during gonad development indicates its role as an active storage depot. Owen (1966) stated that digestive gland acts as a storage site in most of the tropical mollusc. Lambert and Dehnel (1974) found the lipid level of both the digestive gland and gonad to be high enough that these components should be considered depots. Giese (1969) indicates that an inverse relationship, which exists between these components, provides indirect evidence that nutrients transfer is occurring. In the present study, an inverse relationship is observed in the lipid content of gonad and digestive gland, thereby the gonad percentage increases in the expense of digestive gland. But, McLachlan and Lombard (1980) have noted that as lipid values are very low and these small changes have little influence on energy values and the changes in energy values are maiuly as a result of changes in protein and carbohydrate in body tissues.

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