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***Research Article** (Open Access)*

SEASONAL CHANGES IN PROXIMATE COMPOSITION OF THREE GASTROPOD SPECIES FROM THE COASTAL WATERS OF VISAKHAPATNAM, ANDHRA PRADESH, INDIA

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ABSTRACT
Seasonal changes in proximate composition of three gastropod species such as *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* were studied during the year 2017-2018. The soft tissues of the 3 species were subjected to biochemical analysis for estimation of protein, carbohydrate, lipid, moisture and ash content. It is evident from the present results *Purpura bufo* showed maximum protein content, whereas minimum was observed in *Turbo bruneus* and *Nerita atramentosa. Purpura bufo* showed maximum carbohydrate content in all seasons and minimum was recorded in *Nerita atramentosa* and *Turbo bruneus*. Similarly, the maximum lipid content was observed in *Purpura bufo* in all seasons followed by *Nerita atramentosa* and minimum was recorded in *Turbo bruneus*. High moisture content was observed in *Nerita atramentosa, Turbo bruneus* and minimum was noticed in *Purpura bufo.* Likewise the maximum ash content was recorded in *Turbo bruneus, Nerita atramentosa* and minimum was observed in *Purpura bufo.*

Keywords: *Proximate Composition, Nerita atramentosa, Turbo bruneus, Purpura bufo*

INTRODUCTION
Malnutrition is a serious issue encountered by many developing countries. In India 20-30% population were not getting sufficient nutrients. By utilizing molluscans as a source of food and proper utilization of aquatic organisms and fishery cultures by supplying balanced nutritious food to overcome malnutrition problems. Seafood is an important contributor to many individual diets due to their unique nutritional composition. Molluscans are protein rich and delicious food. In the coastal areas, the gastropod molluscs play a major source of food as it is the cheaper protein source for coastal and fishermen community. Gastropod molluscs provide high quality protein with all essential amino acids and essential fatty acids for the growth of human body. Hence their meat was considered as low fat, high protein food which can be included in low fat diets (Ab Lah *et al.,* 2017; Bamidele *et al.,* 2018; Fernandes *et al.,* 2019; Cumplido *et al.,* 2020; Felici *et al.,* 2020; Nkansah *et al.,* 2021; Yumima *et al.,* 2022; Aouji *et al.,* 2023). Due to the importance of fatty acids and their significance in life, marine invertebrates were studied in many habitats (Ackman, 2000). Molluscs have a great demand due to their fatty acid components. Polyunsaturated fatty acids (PUFA) plays an effective role in nutrition and health especially cardiovascular diseases (Valenzuela *et al.,* 2022). The grade of the protein is evaluated by its amino acid composition, which helps to estimate the nutritive value of the organism.
The molluscs and shellfish are rich in fatty acids and their proportions of saturated and unsaturated fatty acids. Shellfish contains significant amount of omega 3 fatty acids with essential amino acids which contribute to healthy diet (Valenzuela *et al.,* 2022). The biochemical composition of marine

invertebrates was mainly influenced by water temperature, availability of nutrients and reproduction cycles (Orban et al., 2002). The general quality of the meat is the outcome of its biological, chemical and organoleptic features, such as the shape of the shells, the shape of the meat, the typical taste and the lack of undesirable parts (Ersoy and Şereflişan, 2010).

In Tuticorin and Rameswaram, edible gastropods like *Chicoreus ramosus, C. virgineus, Xancus pyrum* and *P. trapezium* are eaten as boiled or fried products by poor fishers. In Tuticorin, since the famine of 1877, the chank divers have began to use the chank meat as a food product. It has become a popular food for individuals residing in the Tuticorin and Ramnad districts. While in India the significance of edible gastropods as food is not understood by most people but the gastropod meat is very much liked in other countries. The percentage of saturated and unsaturated fatty acids contributes to good diet (Ersoy and Şereflişan, 2010). Adequate amounts of essential protein were required for long survival rate, development and reproduction. The tissue proteins contain 20 distinct essential and non-essential amino acids for normal functioning of cells and organs. For this reason, molluscs were considered as low-fat and high protein diet (Bamidele *et al.,* 2018; Felici *et al.,* 2020; Nkansah *et al.,* 2021; Yumima *et al.,* 2022; Aouji *et al.,* 2023).

Investigations on the major biochemical constituents' scuh as protein, carbohydrate and lipid in the selected gastropods are very much limited. Hence in this study an attempt was made to evaluate the biochemical constituents in three different sea snails i.e. *Turbo bruneus, Nerita atramentosa* and *Purpura bufo.*

MATERIALS AND METHODS

Matured gastropods of *Nerita atramentosa, Turbo bruneus and Purpura bufo* (approximately 30 to 50 mm shell length) were collected during low tide levels from the intertidal areas off Visakhapatnam, Andhra Pradesh, India. The collected gastropods were brought to the laboratory of Department of Marine Living Resources and were immediately cleaned with the distilled water to remove any adharent particles on the surface of the body. The seasonal difference in major biochemical composition was estimated for the above selected species. Muscle tissues were weighed and kept in an oven at 60^0C for 24 hours. This facilitates to get the consatant weights of the dried tissue. Triplicate readings were taken and the results were tabulated.

Statistical analysis

Seasonal changes in biochemical constiuents of three different gastropod species were tabulated and the values were expressed in Mean±SD.

Protein

Protein was assessed by the Biuret method as modified by Raymont *et al.,* (1964). 0.5 mg of dried material was taken and homogenized in a hand homogenizer with 1 ml of distilled water, 2 ml of biuret reagent was added two times and the grinded tissue was cleaned prior to transfer to the centrifuge tube. The tubes were set for 30 minutes for further incubation and later the sample was centrifuged at 2500rpm for 10 minutes and the supernatant fluid was moved to another tube. The reading of the supernatant was then evaluated using the UV-VIS Double Beam Spectrophotometer (UVD-2960) at a wavelength of 540 nm against the blank reading and then the percentage of protein was calculated.

% of protein = standard value x OD value/weight of tissue x 100

Carbohydrate

The method of Dubois *et al.,* (1956) was followed to estimate the complete carbohydrate content. 20 mg of dried tissue powder was drawn and 1.0 ml of distilled water was added, followed by 1.0 ml of 4 percent phenol solution and 5 ml of concentrated sulphuric acid at room temperature for 30

minutes. The color developed was read by UV-VIS Double Beam Spectrophotometer (UVD-2960) at a wavelength of 490 nm against the blank reading and then the percentage of carbohydrate was calculated

% of carbohydrate= standard value x OD value/weight of tissue x 100

Lipid

The lipid content of gastropod tissue was extracted using chloroform and methanol from Folch et al. (1957). 50 mg of finely powdered tissue was taken to the test tube where 5 ml of chloroform methanol (3:1) was added and covered with aluminum foil and permitted for overnight digestion. The mixture was then filtered by a micro filter and the filtrate was dried in rotary vaccum evaporator in a pre-weighed beaker. Percentage of lipids was calculated using the following formula.

% of lipid = weight of lipid/weight of tissue x 100

Moisture

The moisture content of gastropod tissue was estimated by hot air oven using AOAC method (1980). 10g of minced tissue was spread evenly in a petri dish and heated in a hot air oven at 100±2°C for 16-20 hours. The sample was cooled to room temperature and weighed. Heating, cooling and weighing were repeated. The percentage of moisture was calculated by using the following formula.

% of moisture = weight loss/actual weight of the sample x 100

Ash

The Ash content of the snails was evaluated by the AOAC method (1990). 5g of sample was placed in crucible and heated up to 550°C in furnace overnight. The grey colored ash was cooled down and weighed. The percentage of ash content was estimated by using the following formula.

% of ash = weight of ash/weight of sample x 100

RESULTS AND DISCUSSION

The seasonal changes in the biochemical composition of *Nerita atramentosa*, *Turbo bruneus* and *Purpura bufo* are studied, for this the percentage of protein, lipid, carbohydrate, moisture and ash contents were recorded.

Protein content

It is evident from the present results, the maximum and minimum percentage of protein content in *Nerita atramentosa* was observed as 18.79±1.59 and 13.11±1.23. Similarly, maximum and minimum % of protein content was observed as 19.38±1.65 and 13.65±1.22 respectively for *Turbo bruneus*. The maximum and minimum % of protein content was observed as 21.94±1.83 and 16.63±1.28 respectively for the *Purpura bufo*. Among the three species, *Purpura bufo* showed high protein content and low protein content was observed in *Turbo bruneus* and *Nerita atramentosa* (Figure 1).

Carbohydrate content

It is evident from the present results, the maximum and minimum % of carbohydrate content in *Nerita atramentosa* was observed as 3.40±0.27 and 1.37±0.18. Similarly, maximum and minimum % of carbohydrate content was observed as 3.61±0.42 and 1.48±0.15 for *Turbo bruneus*. The maximum and minimum % of carbohydrate content was observed as 12.99±1.21 and 7.05±0.92 for *Purpura bufo*. *Purpura bufo* showed maximum carbohydrate content in all seasons and minimum carbohydrate content was observed in *Nerita atramentosa* and *Turbo bruneus* (Figure 2).

Lipid content

It is evident from the present results, the maximum and minimum % of lipid content in *Nerita atramentosa* was observed as 5.24±0.42 and 2.16±0.11. Similarly, maximum and minimum % of lipid content was observed as 5.48±0.38 and 2.24±0.24 for *Turbo bruneus*. The maximum and minimum % of lipid content was observed as 6.34±0.47 and 3.14±0.15 for *Purpura bufo.* High lipid content was observed in *Purpura bufo* in all seasons followed by *Nerita atramentosa* and minimum was observed in *Turbo bruneus* (Figure 3).

Moisture content

It is evident from the present results, the maximum and minimum % of moisture content in *Nerita atramentosa* was observed as 82.22±2.64 and 70.56±1.87. Similarly, maximum and minimum % of moisture content was observed as 81.26±1.98 and 67.74±1.98 for *Turbo bruneus*. The maximum and minimum % of moisture content was observed as 71.92±1.54 and 57.24±2.32 for *Purpura bufo*. High moisture content was observed in *Nerita atramentosa*, *Turbo bruneus* and minimum was observed in *Purpura bufo* (Figure 4).

Ash content

It is evident from the present results, the maximum and minimum % of Ash content in *Nerita atramentosa* was observed as 2.01±0.22 and 0.68±0.06. Similarly, maximum and minimum % of Ash content was observed as 2.17±0.21 and 0.78±0.05 for *Turbo bruneus*. The maximum and minimum % of Ash content was observed as 1.49±0.24 and 0.78±0.06 for *Purpura bufo*. The ash content was high in *Turbo bruneus, Nerita atramentosa* and minimum was recorded in *Purpura bufo* (Figure 5).

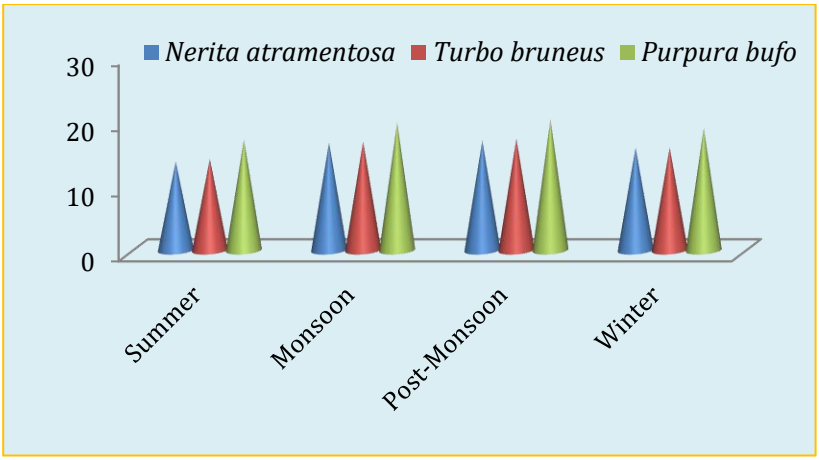

Figure 1: Seasonal variations in protein content of *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* (2017-2018).

In the present investigation, the protein content recorded in three species of gastropods was quite comparable to the study reported by Babu *et al.*, (2010) who recorded protein content in *B. Spinosa* foot to be 22.1%, mantle 19.25%, gonad 27.95% and other body tissue to be 24.18%. Cumplido *et al.*, (2020) studied the biochemical composition of four edible marine gastropods *Odontocymbiola magellanica, Buccinanops deformis, Buccinanops cochlidium and Trophon geversianus* and stated that all the four gastropods showed high percentage of protein content during the reproductive cycles. *T. patagonica* marine gastropod showed high protein content (28.8±15.4%) and a low lipid (1.36±0.43%) and carbohydrate (1.7±0.8%) content (Nieto-Vilela *et al.*, 2021). Similarly, in the present study the observed values of protein contents in three species were ranging between

13.11±1.23 to 18.79±1.59, 13.48±1.19 to 19.38±1.65 and 16.62±1.37 to 21.94±1.83 for the *Nerita atramentosa, Turbo bruneus and Purpura bufo* respectively.

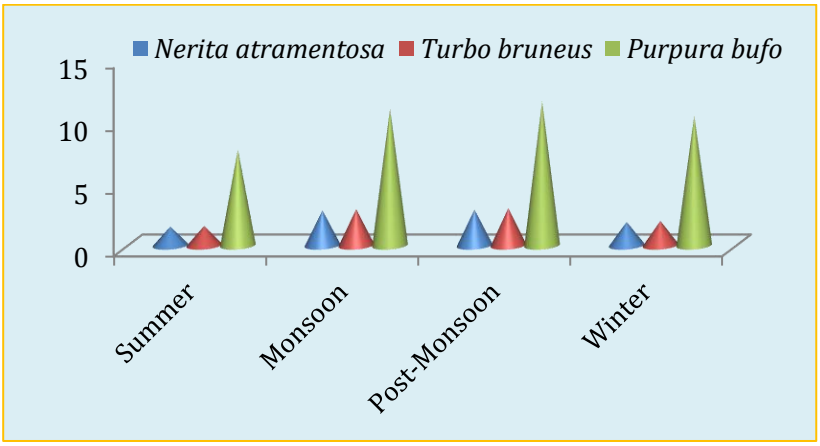

Figure 2: Seasonal variations in carbohydrate content of *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* (2017-2018).

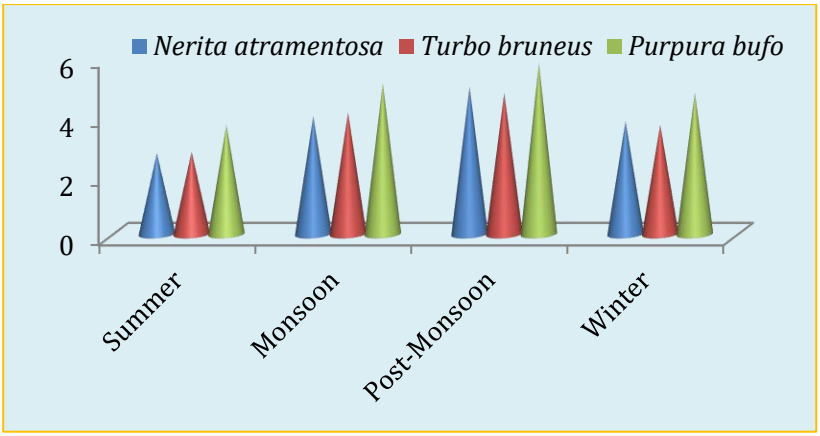

Figure 3: Seasonal variations in lipid content of *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* (2017-2018).

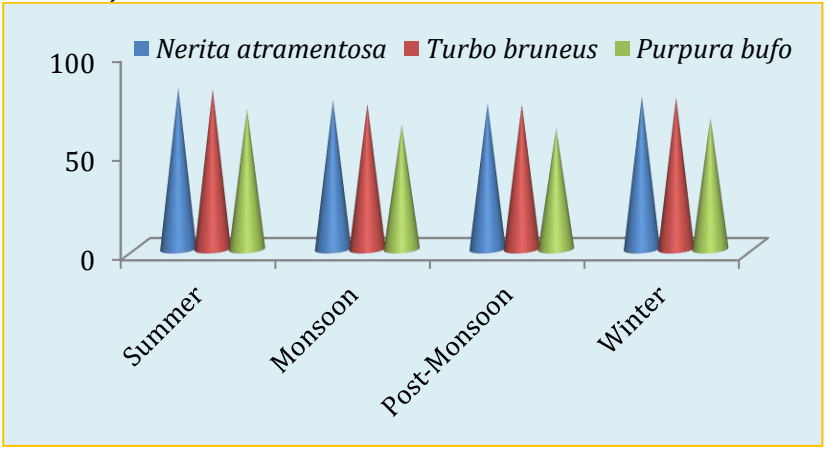

Figure 4: Seasonal variations in moisture content of *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* (2017-2018).

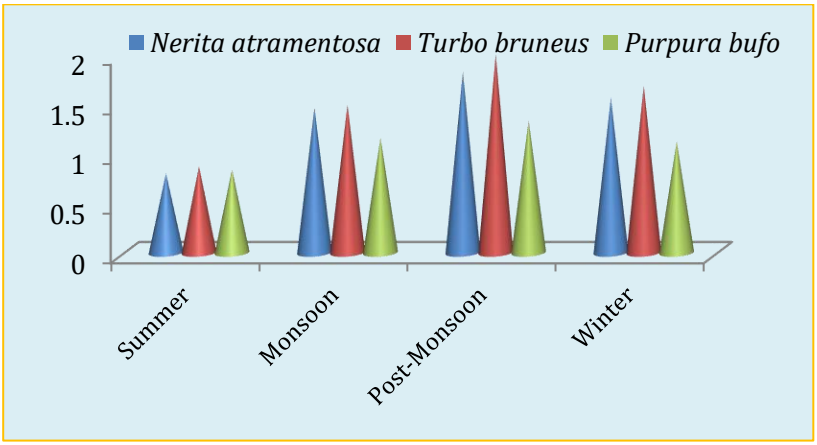

Figure 5: Seasonal variations in ash content of *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* (2017-2018).

Darwin *et al.,* (2017) recorded proximate composition in *P. bufo* from the Visakhapatam coast. According to their observation the protein content was maximum (22.45±1.02%), followed by carbohydrate (20.3±0.87%) and lipid (4.56±0.54%). The total protein content of the soft tissue of the sea snails *H. colosseus* was found to be 20.70±0.61%. The total carbohydrate and lipid contents were observed to be 1.50±0.10% and 0.37±0.01%, which revealed that the protein composition was high, followed by carbohydrate and lipid (Thu, 2020). In *T. bruneus*, the carbohydrate content was high in the foot with 8.825 per cent, followed by gonad 6.14 per cent and mantle 5.82 per cent. Similarly, in the present study the observed values for Carbohydrate content in three species were ranging between 1.37±0.18 to 3.40±0.27; 1.48±0.15 to 3.61±0.42 and 7.05±0.92 to 13.29±1.08 for *Nerita atramentosa, Turbo bruneus* and *Purpura bufo* respectively. In the current research, carbohydrate levels are noted to be high in muscle tissue during monsoon and low in the summer season. As per the observations in the present study the reported carbohydrate values were greater than the lipid contents. Similar trends of results were recorded by Darwin *et al.,* (2017); and Thu *et al.,* (2020).

Okuzumi and Fujii (2000) reported that lipids are efficient source for energy than the carbohydrates and proteins. Palpandi *et al.,* (2010) revealed lipid values at minor percentages of the total proximate composition and it was found to be high in mantle (3.390±0.76%) followed by foot (2.76±0.92%) and body tissues (2.65±0.88%) on dry weight basis in *C. melo.* In the present study the observed values of lipid contents in three species were ranging between 2.16±0.11 to 5.62±0.38; 2.11±0.19±0.15 to 5.57±0.33 and 3.14±0.15 to 6.53±0.49 for the *Nerita atramentosa, Turbo bruneus and Thais bufo* species respectively.

Sini Margret *et al.,* (2013) studied the moisture and ash content in the body tissues of four gastropods viz., *Babylonia zeylanica, B. spirata, Murex virgineus, and Turbo radiates.* The moisture contents were 82.33%, 72.8%, 76.2% and 66.76% respectively. Akinjogunla et al., (2017) recorded the moisture content in Mangrove Oyster, *Crassostrea gasar* both in dry and wet seasons as 80.15±0.34 and 79.11± 0.44 respectively. Similarly, in the present study the observed values of moisture contents in three species were ranging between 70.56±1.87 to 82.22±2.64; 67.74±1.98 to 81.41±2.54 and 57.24±2.32 to 71.92±1.54 for the *Nerita atramentosa, Turbo bruneus and Purpura bufo* species respectively. Akinjogunla et al., (2017) recorded the ash content in Mangrove Oyster, *Crassostrea gasar* both in dry and wet seasons as 2.43±0.03 and 3.75±0.04 respectively. Similarly, in the present study the observed values of ash contents in three species were ranging

between 0.68±0.06 to 2.01±0.22, 0.78±0.05 to 2.35±0.14 and 0.75±0.09 to 1.53±0.28for the *Nerita atramentosa, Turbo bruneus and Purpura bufo* species respectively.

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CONFLICT OF INTEREST
The authors declare no conflict of interest.

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