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BIOCHEMICAL ALTERARTION IN BIVALVES DURING DIFFEERNT SEASONS FROM RATNAGIRI DISTRICT, WEST COAST OF MAHATASHTRA

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ABSTRACT: -

The protein content of studied bivalve was at relatively high level throughout the year. In the months of March and April, the protein content was high reaching its peak. Afterwards, it decreased during the monsoon period. In September, as the spawned wedge clams entered a phase of redevelopment, the protein content increased to some extent and again declined during the second peak of spawning. Generally, seasonal changes in the biochemical constituent are the characteristics of the seasonal activities of bivalves. Variations in biochemical constituents seem to be mainly influenced by reproductive cycle and availability of food. In marine molluscs, the reproductive cycle is governed by a number of factors such as salinity, temperature, day length and density of the surrounding medium. From our present findings, it could be seen that the protein content relatively high throughout the year except slight declines during the spawning periods. In general the level of protein build up during the gametogenesis is utilised during the peak of breeding season. Similarly an increase in protein content occurs again after the monsoon season, which may be utilised for the subsequent spawning. The lipid and glycogen content of studied bivalve shows a gradual increase from winder and a peak in the gravid population of May before spawning. In monsoon, the lipid content sharply decreased and remained at a low level upto July due to continuous spawning. During the phase of redevelopment and slow spawning the lipid content increased and afterwards declined again during the second peak of spawning, i.e., from October to November. Possibility of an increase in lipid content in bivalves during phytoplankton bloom has been reported. Lipid levels of almost same magnitude had been reported in the literatures from Indian and Algerian waters. Lipid level increased generally with the onset of gamatogenesis and reached to the maximum prior to spawning. These findings agree with the present study of lipid content, i.e., lipid accumulates in the developing gonads and depletes during spawning. Carbohydrate values fluctuated widely in all months. In general glycogen content showed variations with the breeding behaviour and development of the gonad. Carbohydrate percentage was at the peak in monsoon and it decreased in winter. In the post winter, the glycogen level was high again and the lowest value was recorded during the premonsoon season. Glycogen has long been considered to be the principle reserve of marine bivalves itshowed great variation in relation to its reproductive cycle. An inverse relationship between changes in protein and carbohydrate was recorded. Increase in the glycogen content in was during early gametogenicperiod .

KEYWORDS: *Marine,Bivalves, Protein, Glycogen, Lipid, Seasons, Ratnagiri.*

INTRODUCTION :

Food energy is used for building up body tissue, which further signifies that a balance diet is necessary for proper functioning of the body. In invertebrates changes in the biochemical constituents are pronounced which are cyclic in reproduction, since a great amount of energy must be channelized to the gonad during reproduction. Bivalve molluscs are potential sources of valuable biochemical and are abundantly available in India. However, their abundance and diversity have declined in the last 30 years and they are now among the most imperiled groups of animals in the world. Habitat destruction, including increased siltation, pollution, and river modification, loss of fish hosts, commercial exploitation, and introduced species, are among the causes of their decline (Bogan, 1993). The biochemical composition of mollusc is influenced by its size, growth and reproductive status. Bivalves play an important role in the ecosystem equilibrium and constitute an important economic end point. The bivalves have not been the subject of intense studies despite the presence of rich diversity of edible and commercial species in India Shetty et al. (2013). Biochemical indices are often very sensitive to stressors and the magnitude of the biochemical changes is often related to the severity of the toxicants (Livingston, 1985). The biochemical composition in the molluscs has been mainly studied to assess the nutritive status and also to supplement information on reproductive biology. The overall change in the biochemical composition during an annual cycle has been correlated to the events of the gonadal cycles of organisms. Significantly, proteins, lipids and carbohydrates variations are related to reproductive cycle of bivalves. This shows the nutrient is one of the most important energy sources of mussels Martinez(1991). In addition, biochemical assay provide both qualitative and quantitative changes of tissue level in the bivalve. Sometime specific responses shown by, for example, fishes to certain kind of toxicants such as heavy metals pesticides are particularly useful in fishery management and resources protection (Petering and Fowler, 1986, Thomos 1989 and Suryawanshiet al, 2015) Kulkarni (1993) and Patil (1993) studied cadmium chloride and summer induced changes in the biochemical composition of the marinewaterbivalve respectively. Devi (1996) studied bioaccumulation and metabolic effects of zinc and mercury on marine dreissinid bivalve, M. sallei.Munsiet al. (1997) studied the mixture of heavy metals on the biochemical composition of two penaeid shrimp post larvae. Reddy et al. (1986) studied the effect of summer on carbohydrate metabolism of the soft body parts of the marinewater bivalve Parreysiarugosa. India many investigators reported seasonal changes in biochemical content in marine bivalves such as Jaybal and Kalyani (1986) on M. meretrix , Mane (1997) on different species of bivalves from Ratnagiri coast and Salunkhe (1999) on S. cucullata from Deogad and Aachara coast of Sindhudurg district. Fatima et al. (1986) in P. viridis, Abad et al. (1995) in Ostreaedulis, Yennawar (1997) in S. cucullata,Patare (1998) in M. meretrix and Bhagde (2000) in P. viridis are the notable contributions for tropical bivalve molluscs. Arasuet al. (1995) reported changes in lipid peroxidation in the gill and muscle of P. viridis during exposure of cadmium and copper. Patil and Mane (1997) studied seasonal changes of different body parts of during exposure of mercury. Since limited amount of information is available on the marine bivalves, the present investigation has been undertaken to study seasonal variations in the biochemical composition like protein, lipid and glycogen values of bivalves like Crassostreacattuckensis, Saccostreacucullata, Pernaviridis, Katelysiaopima, Meretrixmeretrixfrom different habitats and places during different seasons from Ratnagiri district and to gather information on the uses of these bivalve as food or medicines for the local people.

MATERIAL & METHOD

The area selected for study were from Raigad districts on the animal habitats are rich in flora and fauna around and in as there is no any industry on both sides as well as in catchment area. The availability of bivalves for present study depend upon the topography of the ocean, weather condition and human activities like pollution, heavy water force, interfering by man etc. The localities in study area are selected as per the species abundance and water qualities in different geographic area in Ratnagiri district. The different species of bivalves like *C. cattuckensis, S. cucullata ,P. viridis , K. opima , M. meretrix* were selected for laboratory experiments from different places. They were brought to the laboratory and kept in plastic troughs containing five litres of dechlorinated tap water for three days to acclimatize to laboratory conditions. Water from the plastic trough was changed after every 12 hours. The healthy bivalves of approximately same size and weight were selected for the

experiments. Since the animals are micro feeders no special food was supplied during the experiment. The acclimatized bivalves were sacrificed to analyse the biochemical composition. The bivalves were dissected and their whole body mass of bivalves was taken. All wet weight were dried powders of different tissues were used for estimation of their protein, glycogen and lipid content. The biochemical analysis of the protein content of these samples was determined by the method described by Lowry et al. (1951), Glycogen was analysed following De Zawan and Zandee (1972) method, while lipid concentration were estimated by using Barnes & Black stock (1973) method. All values of the biochemical constituents were expressed in mg / 100 mg dry weight (%).

RESULTS

To estimate biochemical content from bivalve of Ratnagiri coast, three study areas were selected as Dapoli, Guhaghar&Ratnagiri. Study was carried out during peak of each season i.e. August for monsoon, December for winter & May for summer season. In Pernaviridis from Dapoli, protein was recorded 58.20, Glycogen found to 17.30 & lipid content was 6.0 during monsoon season. During winter season protein was 62.40, Glycogen was 23.48 & lipid was 8.50 while during summer season protein was 65.50, Glycogen was 30.10 & lipid was 11.20. In the Guhaghar region; protein was recorded 55.45, Glycogen was 15.60 & lipid found to 5.30 during monsoon season. During winter season protein was 57.30, Glycogen was 19.40 & lipid content was 7.00 while during summer season protein found to 60.20, Glycogen was 24.50 & lipid recorded 9.40. In the Ratnagiri region during monsoon season protein was recorded 53.300, Glycogen content 13.30 & lipid found to 5.0. During winter season protein was recorded 51.80, glycogen content 15.70 & lipid found to 6.50 while protein recorded 57.20, glycogen found to 20.90 & lipid content 8.80 during summer season.

In the *C. cuttukensis* from Dapoli region; during monsoon season protein was recorded 62.00, glycogen was found to 25.42 & lipid content 10.20. During winter season protein was recorded 66.70, glycogen found to 18.30 & lipid content 4.50 while during summer season protein was recorded 52.30, glycogen found to 40.0 & lipid content 6.90. In the Guhaghar region, during monsoon season protein was recorded 58.30, glycogen found to 23.30 & lipid content 9.97. During winter season protein was recorded 63.45, glycogen found 17.0 & lipid content 3.50 while during summer season protein was recorded 50.35, glycogen found to 37.70 & lipid content 5.80. In the Ratnagiri region, during monsoon season protein was recorded 64.40, glycogen found to 27.35 & lipid content 11.25. During winter season protein was recorded 68.60, glycogen found to 21.45 & lipid content 5.87 while during summer season protein was recorded 54.50, glycogen found to 44.65 & lipid content 8.58.

In *S.cucullata* from Dapoli region, during monsoon season protein was recorded 40.70, glycogen was found to 9.52 & lipid content 11.64. During winter season protein was recorded 43.70, glycogen found to 15.38 & lipid content 16.72 while during summer season protein was recorded 52.40, glycogen found to 19.46& lipid content 21.23.In the Guhaghar region, during monsoon season protein was recorded 38.35, glycogen found to 7.86 & lipid content 9.54. During winter season protein was recorded 42.42, glycogen found to 16.0 & lipid content 13.22 while during summer season protein was recorded 50.64, glycogen found to 17.45 & lipid content 19.10.In the Ratnagiri region, during monsoon season protein was recorded 44.30, glycogen was found to 11.11 & lipid content 13.48. During winter season protein was recorded 48.20, glycogen found to 17.22 & lipid content 18.36 while during summer season protein was recorded 57.40, glycogen found to 22.48& lipid content 24.35.

In *M. meretrix* from Dapoliregion; during monsoon season protein was recorded 33.42, glycogen was found to 22.56 & lipid content 20.63. During winter season protein was recorded 38.51, glycogen was found to 9.57& lipid content 10.86 while during summer season protein was recorded 24.62, glycogen was found to 21.74& lipid content 7.74.In the Guhaghar region, during monsoon season protein was recorded 30.34, glycogen was found to 19.66& lipid content 17.53. During winter season protein was recorded 35.62, glycogen was found to 7.56& lipid content 8.73 while during summer season protein was recorded 21.56, glycogen was found to 18.26 & lipid content 5.36.In the Ratnagiri region, during monsoon season protein was recorded 36.20, glycogen was found to 24.60 & lipid content 22.29. During winter season protein was recorded 42.66, glycogen was found to 12.35&lipid content 11.20 while during summer season protein was recorded 26.26, glycogen was found to 24.63 & lipid content 9.36.

In K. opima from Dapoli region, during monsoon season protein was recorded 54.68, glycogen was

found to 5.64 & lipid content 4.24. During winter season protein was recorded 63.15, glycogen was found to 7.10 & lipid content 5.63 while during summer season protein was recorded 51.23, glycogen found to 11.47& lipid content 8.38. In the Guhaghar region, during monsoon season protein was recorded 50.70, glycogen was found to 4.20& lipid content 5.87. During winter seasonprotein was recorded 61.21, glycogen found to 5.65 & lipid content 7.52 while during summer season protein was recorded 47.56, glycogen was found to 8.49 & lipid content 10.360.In the Ratnagiri region, during monsoon season protein was recorded 58.0, glycogen was found to 7.50 & lipid content 7.10. During winter season protein was recorded 66.33, glycogen was found to 9.86 & lipid content 8.16 while during summer season protein was recorded 54.44, glycogen found to 14.38& lipid content 11.46.

DISCUSSION

The chemical composition of any edible organisms is extremely important since the nutritive value is reflected in its biochemical contents. Many researchers devoted to study on the biochemical composition of bivalve molluscs . In the present study evaluated the seasonal variation of stored biochemical compositions such as protein, lipid, glycogen bivalves revealed an increasing trend in the biochemical levels from winter. This information is basic for understanding the seasonal variation of biochemical constituents of this species. The aspect of energy metabolism and reproduction has been reported for a number of species of bivalves due to their commercial importance and edibility values. But the relative influence of gonad development on the distribution and storage of biochemical constituents in different body parts has been examined by only a few cases. On the basis of the results of this study, we recommend that the analysis of the organic elements (proteins, glycogen and lipids) and the analyses and calculations of the percentage edibility and the condition index-being effective and important tools in biological science will provide quick and confirmative knowledge about the peak nutritive value and the reproductive output among bivalves and other Pernaviridis of Ratnagiri district from selected study areas; protein, glycogen & lipid content found to maximum during summer season followed by winter & monsoon. Amongst different study area no remarkable difference is found in the biochemical content of bivalves. The chemical composition of any edible organisms is extremely important since the nutritive value is reflected in its biochemical contents. The results obtained in the present study are supported by several investigators who reported a decline in protein in various organisms under influence of different stressors. Torreblacaet al. (1991) observed that in marinewater cry fish Procambarusclarkii there was considerable decrease in bivalves after exposure to cadmium. Many researchers devoted to study on the biochemical composition of bivalve mollusks like seasonal variations in the biochemical composition of Mytilusedulishave been reported by Bayne and Thompson (1970). Later many workers such as Nagabhushanam and Mane [1975), on K. opima and *M. edulis. Bidarkar* (1975) on marinewater mussels ,Yennawar (1997) on S. cucullata, Patare (1998) on M. meretrix and Bhagde (2000) on P. viridis reported change in the biochemical composition in different season.

In present study *C. cuttukensis and K. opima* showed increased protein during winter season followed by monsoon & summer whereas glycogen content in increased during summer followed by monsoon & winter while lipid content found to maximum during monsoon followed by summer & winter. In *S. cuculatta* from selected study areas showed protein, glycogen & lipid maximum during summer followed by winter & monsoon while *M. meretrix* showed protein content maximum during winter season followed by monsoon & summer, more or less similar quantity of glycogen was found in monsoon & summer with decreased percentage during winter season. Regarding lipid content, maximum during monsoon followed by winter & summer from selected study area showed increased protein & lipid content during summer season followed by monsoon & winter while glycogen content recorded maximum during summer season followed by winter & monsoon whereas saccostreacuculatta showed all studied biochemical increased during summer followed by winter & monsoon. Crassostrea cuttukensis showed protein increased during winter season followed by monsoon & summer, glycogen increased during summer season followed by monsoon and winter while lipid recorded maximum during monsoon followed by summer & winter (Slight change). Meretrixmeretrix showed increased protein duringwinter season followed by monsoon & summer while glycogen & lipid increased during monsoon season

but glycogen followed by summer & winter whereas lipid followed by winter & summer. *K. opima* showed increased protein during winter season followed by monsoon & slight decreased in summer while glycogen & lipid increased during summer & more or less equal concontration found in winter & monsoon season. Fatima et al (1986) on P. viridis. In present study *C. cuttukensis and K. opima* showed increased protein during winter season followed by monsoon & summer whereas glycogen content in increased during summer followed by monsoon & winter while lipid content found to maximum during monsoon followed by summer & winter. In S. cuculattafrom selected study areas showed protein, glycogen & lipid maximum during summer followed by winter & monsoon while *M. meretrix* showed protein content maximum during winter season followed by monsoon & summer, more or less similar quantity of glycogen was found in monsoon & summer with decreased percentage during winter season.

The aspect of energy metabolism and reproduction has been reported for a number of species of bivalve due to their commercial importance and edibility values. But the relative influence of gonad development on the distribution and storage of biochemical constituents in different body parts has been examined by only a few cases. Bayne and Thompson (1970) determined the biochemical composition of mantle, gonad and somatic tissues of *M. edulis*. In *M. edulis* the mantle tissue served as a site of storage of nutrients and gametes production. In spring there was a rapid growth of the gonad coincident with an increase in glycogen, lipid and protein, in summer the glycogen content decreased with spawning and protein showed the highest values. As with many others bivalves storage and release of metabolites from the whole body and different body parts of bivalves from India also correspond with the somatic growth and reproduction taking place in coordination with the existing local environments. From whole body of P. viridis the protein content remained high throughout the year but decreased during breeding season August, September and February Nagabhushanam and Mane (1978). Biological analysis of different body parts of P. viridis also showed that much of the energy for gonadal maturation and body maintenance, particularly in monsoon season, was dependent upon the protein content while the fat content showed little variation This coincided with the rise in salinity on the habitat Fatima and Barkati (1986) in P. viridis observed that contents paralleled the changes in tissues weight, which showed a decline during the spawning period (July to October). The results obtained in the present study indicate severe disturbance in the protein metabolism of the marine water bivalve. It suggests that the low level of protein level might be due to increased proteolysis activity or might be due to changes in the metabolic substrate during anaerobic condition produced in the bivalves by environmental stress. The protein levels in the body decreased continuously when increases the water temperature. When mussels at all time period might be due to temperature variation during different seasons and hence protein was more depleted from these body when it was compared with monsoon of bivalves. It is evident that decrease in the protein in the mussels in all probably caused metabolism restricted to lipogenesis and maintenance by utilizing protein substrate. The results obtained in the present study are supported by several investigators who reported decrease in protein of various organisms under influence of stresses. It is in the level of tissue protein may also be due to excessive proteolysis to overcome the metabolic stress, as deposited protein in the cytoplasm can easily be used to replace the loss of proteins that occur during physiological stress. The decrease of protein content, suggests possible utilization for metabolic purposes enhancement of proteolysis to meet the high-energy demand under metal pollution stress condition. The fall in the protein content during different seasons may be due to increase protein catabolism and decrease anabolism of protein.

On the other hand, the level of carbohydrate in all tissue suggests its mobilization to meet the energy demand warranted by the stress environment (Wasserman et al. 1970). Depletion of glycogen level might be due to the anoxia and hypoxia caused due to stress condition which is known to increased carbohydrate consumption (DeZawan and Zandee, 1972). Kabeer (1979) stated that decreases in glycogen content in metal exposed tissue could also be due to decreases glycogen synthesis. Decrease in glycogen content indicates disrupted carbohydrate metabolism. The pollutants give the heavy physical irritate stress causing rapid movement and increased respiration rate thus increased utilization of reserved glycogen to meet higher energy demand of body causing decrease in glycogen content (Bhagyalakshmi, 1981). Glycogen, the primary energy reserve in bivalves, drives many important physiological processes and could be used to ensure short-term

exposure to anoxia, emersion and reduced food supplies. The gradual increased content of glycogen from summer onwards could be due to the development of the gonads Shettigar and Seetharamaiah, (2013). In present study the results showed during summer season caused some how different trend was observed, revealing different type of substrate utilization to meet the energy demand.

Lipids play a nutritionally and physiologically important role in bivalves by providing an efficient source of high energy content and essential fatty acids (Waldock and Holland, 1984). Voogt (1983) stated that lipids in bivalves are multifunctional and in different species one or same of the functions during the maturation of gametes, drastic environmental conditions, starvation, population stress etc. can be more noticeable. In bivalve molluscs the conversion of glycogen into fatty via trios – phosphate entry in glycogen sequence and to the production of pentose sugar for nucleic acid synthesis is well documented by Gabbott (1976). Via, triose phosphate entry in glycogen sequence and to the production of pentose sugar for nucleic acid synthesis is well documented by Gabbott (1976). In the present study total lipid content of various tissues of bivalve was found to be increased during summer might be due to high water temperature. This suggests utilization of protein and synthesis of lipid from all the body parts upon high temperature in the outside medium. The study can conclude there is significant variation in the biochemical levels in the bivalves according to seasonal changes. The nutritional composition of the bivalves can be affected by environmental factors, such as fluctuations in the environmental conditions, or by internal factors, such as metabolic and physiological activities. It might be 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 bivalves are closely linked to the reproductive cycle and climate changes and are affected by the availability and composition of the natural diet. On the basis of these results, the marinewater mussels are good source for some important nutrients such as proteins, lipids, glycogen and vitamins. They have got important roles in food chain since they are consumed by fish, water birds, mammals and reptiles in the river. Gametogenesis starts by June–August and the calorific values showed a declining trend in Bhatye and Shirgaon along Ratnagiri. Present study showed that pre-monsoon (March–June) period is the ideal period for the maximum exploitation of this clam from Ratnagiri, when the calorific values are high. From this study, it appears that there are two distinct periods characterized by the variations in the proximate composition. From March to August, there was rapid development of the gonads. Spawning took place from September to January. The clams were observed to undergo a short period of resting and the next cycle of gametogenesis started again immediately. During the period of gonadal development, the protein and lipid values remained high. However, an inverse relationship between the protein and lipid values was evident from the data. As the spawning was initiated, these values decreased rapidly and an increase in carbohydrate was observed. In the resting period, i.e. February, again a slight increase in the protein and lipid values was observed. The carbohydrate value remained low during this period. The results thus obtained, were in accordance with the earlier observations done by other workers.

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Seasnal variation of Biochemical content.

From Ratnagiri District

Sr. No	Name of the species	Study Area	Seasonal Data of Biochemical content.								
			Monsoon			*Winter*			*Summer*		
			P	G	L	P	G	L	P	G	L
1	Perna viridis	Dapoli	58.20	17.30	6.00	62.40	23.48	8.50	65.50	30.10	11.20
		Guhaghar	55.45	15.60	5.30	57.30	19.40	7.00	60.20	24.50	9.40
		Ratnagiri	53.30	13.30	5.00	51.80	15.70	6.50	57.20	20.90	8.80
2	Crossostrea cuttukensis	Dapoli	62.00	25.42	10.20	66.70	18.30	4.50	52.30	40.00	6.90
		Guhaghar	58.30	23.30	9.97	63.45	17.00	5.50	50.35	37.10	5.80
		Ratnagiri	64.40	27.35	11.25	68.60	21.45	5.87	54.50	44.65	8.58
3	Saccostrea cuculatta	Dapoli	40.70	9.522	11.645	43.700	15.380	16.725	52.400	19.460	21.230
		Guhaghar	38.350	7.860	9.545	42.420	16.00	13.220	50.640	17.450	19.100
		Ratnagiri	44.300	11.110	13.480	48.200	17.220	18.360	57.400	22.48	24.350
4	Meretrix meretrix	Dapoli	33.420	22.560	20.635	38.510	9.570	10.860	24.620	21.740	7.745
		Guhaghar	30.340	19.660	17.530	35.620	7.565	8.735	21.560	18.260	5.365
		Ratnagiri	36.20	24.600	22.290	42.660	12.355	11.200	26.260	24.636	9.360
5	Katelysia opima	Dapoli	54.680	5.640	4.240	63.150	7.100	5.636	51.235	11.470	8.380
		Guhaghar	50.700	4.200	5.870	61.210	5.650	7.520	47.560	8.490	10.360
		Ratnagiri	58.00	7.500	7.100	66.335	9.860	8.160	54.440	14.380	11.465

P = Protein, G = Glycogen, L = Lipid

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