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BIOCHEMICAL VARIATION IN DIFFERFENT BODY PARTS OF FRESH WATER BIVALVE *LAMELLIDENS MARGINALIS*

Suryawanshi G. D.
Department of Zoology, Yogeshwari Mahavidyalaya, Ambajogai, Dist. Beed-431517 (M.S.). India.

ABSTRACT
We examined the seasonal patterns of biochemical composition in bivalve, *Lamellidens marginalis* from Nagapur dam, Marathwada. In the present study, variations in organic constituents were observed in different body parts of the species. In all body parts of the bivalve the protein was found maximum during monsoon season (June) and was found minimum during summer season (May) of dry tissue weight. There is great fluctuation in the values of glycogen present in the body tissues during different seasons. During summer season, minimum carbohydrate (May) was found, whereas during monsoon maximum carbohydrate (June) was found. While, lipid was found maximum during summer season (May) and was minimum during monsoon season. This shows the mobilization of biochemical constituents in body tissues during different seasons. The bivalve mollusc shows maximum variation of biochemical constituents as it undergoes different stages like development, maturation and spawning during different seasons and 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.

KEYWORDS: Freshwater bivalves, Glycogen, Lipid, *L. marginalis*, Protein.

INTRODUCTION

The proposal originates from the recent reports of the factors currently threatening species are influenced by human and environment. If human activity continues to expand at current rates, at least 20% of all species will have disappeared in less than thirty years' time. Although the co-dependency of spatial planning and climate change has largely been accepted, spatial planners and the climate change community have had mostly isolated (research) agendas so far. The program aims to generate internationally competitive scientific results and to provide a knowledge base that interactively supports practitioners on how to cope with climate change. The mission of the program is to introduce climate change and climate variability as one of the guiding principles for spatial planning in the India. The Government of India is providing lot of facilities to man for blue revolution by which little bit problem of food supply will be solved. During the study the experiments which will carry on the aspects on the identification of the factors responsible for the decline of the freshwater mussels, in order to develop a restoration plan for the species. Food is important source of energy for all living organisms. 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. The studies on biochemical response of a bivalve to stressors have led to the better understanding as to how bivalve cope with the stressor at the biochemical level. Biochemical indices are often very sensitive to sub lethal toxicants and the magnitude of the biochemical changes is often related to the severity of the toxicants (Livingston, 1985). Thomas *et al.*, (1987) reported some of the biochemical responses, which indicated specific relation and other pathological effects, and therefore can provide information on the mode of toxicity.

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, and Thomos 1989, Suryawanshi *et al*, 2015). Heavy metal stress alters protein content in the aquatic animals and it has been found that generally the protein content from the whole body and different body parts, increased in fish *Tilapia mossambica* due to metals toxicity. Shivaprasadrao and Ramanarao (1979). Jacobson and Turner (1980) studied interaction of cadmium and certain other metals with proteins. Rao *et al.*, (1987) and Vedpathak and Mane (1988) studied the effect of fluoride and summer on the freshwater bivalve *I. caeruleus* respectively. Kulkarni (1993) and Patil (1993) studied cadmium chloride and summer induced changes in the biochemical composition of the freshwater bivalve *L. marginalis* respectively. Devi (1995, 1996) studied bioaccumulation and metabolic effects of zinc and mercury on marine dreissinid bivalve, *M. sallei.* Munsi *et 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 freshwater bivalve *Parreysia rugosa*. Muley and Mane (1987) reported sublethal effect of summer on the tissue composition of *L. marginalis*. Mane and Gokhale (1990) observed biochemical changes due to acute toxicity of fluoride to *L. marginalis* and found significant changes in protein content from mantle, gill, hepatopancreas, gonad and foot. Napolitund *et al.,* (1992) studied the lipid composition of egg and adductor muscle in giant scallops *P. magellanicus*. Arasu *et 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) and Suryawanshi *et al,* (2017) studied seasonal changes of different body parts of *L. marginalis* during exposure of heavy metals. The present study was taken up to understand the distribution and seasonal variations of biochemical in *Lamellidens marginalis* inhabiting fresh water at Nagapur dam near Parali (V), Maharashtra.

MATERIALS AND METHODS

The bivalves *Lamellidens marginalis* were collected for laboratory experiments from Nagapur dam at Parali (V) Marathwada. They were brought to the laboratory and kept in plastic troughs containing five liters 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 bivalve *L. marginalis* were sacrificed to analyze the biochemical composition. The bivalves were dissected and their mantle, foot, gill and digestive gland were separated and whole body mass of remaining bivalves was taken. All tissues were dried powders of different tissues were used for estimation of their protein, glycogen and lipid content. The amount of total protein in tissue was estimated by using Lowry's method (Lowry *et al.,* 1951). Glycogen was estimated by Anthrone reagent method (Dezwaan and Zandee, 1972). Vanillin reagent method of Barnes and Blackstock (1973) was used to estimate the amount of total lipids in the tissue. The amount of biochemical was obtained were statistically analyzed for confirmation of the results and expressed in µg/g dry tissue. The cholesterol was used as a standard for lipid estimation.

RESULTS

The changes in biochemical composition of mantle, foot, gill, hepatopancreas and whole body of freshwater bivalves *L. marginalis* were studied with respect to the mg/ 100 mg of protein, glycogen and lipid in dry tissues. In the present study the protein **(Table-1)** level was found to be depleted in various tissue i. e. mantle, foot, gill, hepatopancreas, gonad and whole body. In monsoon, winter and summer at every last month the low amount in protein content was from 45.32 to 37.00, 45.32 to 36.02 and 45.32 to 35.30 respectively in mantle. The depletion in foot was from 55.28 to 42.12, 55.28 to 40.0 and 55.28 to 30.32 in monsoon, winter and summer respectively. Further it was also observed that the low amount in protein content in gill was from 51.52 to 40.42, 51.52 to 35.39 and 51.52 to 30.39 in monsoon, winter and summer respectively. The low amount in protein in hepatopancreas was observed from 53.54 to 40.45, 53.54 to 40.35 and 53.54 to 35.78 in monsoon, winter and summer respectively. The low amount in gonads was observed from 47.17 to 34.35, 47.17 to 33.37 and 47.17 to 30.11 in monsoon, winter and summer respectively. While, the amount of protein in whole body of bivalve was from 58.59 to 47.81, 58.59 to 46.88 and 58.59 to 35.46 respectively in monsoon, winter and summer. The depleted protein content of the bivalve *L. marginalis* was observed during summer followed by winter and monsoon. The most pronounced change was observed in summer season. Further, the amount of glycogen level was found in all tissues after time period which is shown in **(Table-2)** of every last month of monsoon, winter and summer, the low amount in glycogen content was from 11.08 to 8.26, 11.08 to 7.95 and 11.08 to 6.70 respectively in mantle. The depletion in foot was from 6.40 to 4.83, 6.40 to 3.12 and 6.40 to 2.85 in monsoon, winter and summer respectively. Further it is also observed that the low amount in glycogen content in gill was from 6.75 to 4.15, 6.75 to 4.80 and 6.75 to 3.35 respectively.

The low amount in glycogen in hepatopancreas was observed from 8.68 to 5 .18, 8.68 to 4.30 and 8.68 to 3.61 in monsoon, winter and summer respectively. The low amount in gonads was observed from 7.65 to 5.10, 7.65 to 5.00 and 7.65 to 3.18 in monsoon, winter and summer respectively. Whereas, low amount in whole body from 9.21 to 6.33, 9.21 to 6.32 and 9.21 to 5.56 respectively. The average glycogen content of the bivalve *L. marginalis* was low amount in summer followed by winter and monsoon. The glycogen content of mantle, foot, gill, hepatopancreas and whole body was depleted. The most pronounced change was observed in summer.

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Table 1: Changes in the Protein in different body parts of *L. marginalis* during different seasons

Body parts	Monsoon					Winter				Summer			
	control	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
Mantle	45.52 ±0.725	43.53 ±0.178 (4.38%)***	41.02 ±0.982 (9.89%)**	38.94 ±0.578 (14.46%)	37.00 ±0.145 (18.72%)	41.78 ±0.812 (8.22%) ***	40.57 ±0.931 (10.88%) ***	36.67 ±0.910 (19.45%)***	36.02 ±0.188 (20.87%)***	38.48 ±0.120 (15.47%) ***	38.00 ±0.778 (16.53%)***	36.35 ±0.321 (20.15%)***	35.30 ±0.791 (22.46%)***
Foot	55.28 ±0.741	50.11 ±0.572 (9.36%)***	48.18 ±0.721 (12.85%)***	45.72 ±0.770 (17.30%)***	42.12 ±0.120 (23.81%)***	45.77 ±0.666 (17.21%)***	42.01 ±0.099 (24.01%)***	40.91 ±0.987 (26.00%)***	40.00 ±0.781 (27.65%)***	41.37 ±0.120 (25.17%)***	39.72 ±0.179 (28.15%)***	37.17 ±0.158 (32.77%)***	30.32 ±0.78 (45.16%)***
Gill	51.52 ±0.631	49.62 ±0.670 (3.7%)*	47.47 ±0.221 (7.87%)***	45.16 ±0.192 (12.35%)***	40.42 ±0.299 (21.55%)	41.75 ±0.318 (18.97%)***	40.50 ±0.731 (21.39%)***	38.39 ±0.751 (25.49%)***	35.39 ±0.667 (31.31%)***	38.19 ±0.712 (25.88%)***	35.32 ±0.333 (31.45%)***	32.72 ±0.079 (36.50%)***	30.39 ±0.812 (40.24%)***
Hepato Pancreas	53.54 ±1.002	49.79 ±1.701 (7.0%)*	45.45 ±0.275 (15.12%)***	44.00 ±1.002 (17.82%)**	40.45 ±0.371 (24.45%)***	47.91 ±0.198 (10.52%)***	45.11 ±0.591 (15.75%)***	43.25 ±0.751 (19.22%)***	40.45 ±0.921 (24.45%)***	41.56 ±0.781 (22.57%)***	40.00 ±0.781 ***	38.00 ±0.791 (29.03%)***	35.78 ±0.135 (33.18%)***
Gonads	47.17 ±0.157	45.44 ±1.081 (3.67%)	39.34 ±0.718 (16.60%)***	37.39 ±0.812 (20.74%)***	34.35 ±0.182 (27.18%)***	44.72 ±0.872 (5.20%) ***	39.92 ±0.823 (15.37%)***	37.61 ±0.781 (20.27%)***	35.37 ±0.751 (25.02%)***	37.10 ±0.912 (21.35%)***	34.87 ±0.181 (26.08%)***	33.18 ±0.198 (29.66%)***	30.11 ±0.215 (36.17%)***
Whole body	58.59 ±0.178	55.10 ±0.717 (5.96%)	52.51 ±0.181 (10.38%)***	50.60 ±0.919 (13.64%)***	47.81 ±0.198 (18.40%)***	52.69 ±0.81 (10.07%)***	52.01 ±0.109 (11.24%)***	49.71 ±0.189 (15.16%)***	48.88 ±0.185 (16.58%)***	45.45 ±0.781 (22.43%)***	40.55 ±0.556 (30.80%)***	39.01 ±0.556 (33.42%)***	35.46 ±0.182 (39.48%)***

(Bracket values represent percentage differences) (*,p-<0.05, **,p<0.01 and ***, p<0.001 compared to control group of bivalves)

Table 2: Changes in the glycogen in different body parts of *L. marginalis* during different seasons

Body parts	Monsoon					Winter				Summer			
	Control	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
Mantle	11.08 ±0.19	10.58 ±0.23 (4.51%)*	9.60 ±0.01 (13.36%)***	9.10 ±0.18 (17.88%)***	8.26 ±0.37 (25.46%)***	10.40 ±0.18 (6.13%)	9.29 ±0.25 (16.15%)***	8.69 ±0.20 (21.58%)***	7.95 ±0.18 (28.25%)***	8.75 ±0.26 (21.03%)***	7.93 ±0.25 (28.43%)***	7.27 ±0.11 (34.39%)***	6.70 ±0.14 (39.54%) ***
Foot	6.40 ±0.23	5.76 ±0.25 (10.0%)*	5.66 ±0.19 (11.57%)	5.48 ±0.14 (14.38%)**	4.83 ±0.28 (24.54%)**	4.68 ±0.19 (26.88%)***	4.11 ±0.30 (35.79%)***	3.46 ±0.05 (45.94%)***	3.12 ±0.13 (51.25%)***	3.99 ±0.14 (37.66%)***	3.47 ±0.06 (45.78%)***	3.23 ±0.02 (49.54%)***	2.85 ±0.11 (55.47%)***
Gill	6.75 ±0.22	6.24 ±0.17 (7.56%)*	5.94 ±0.22 (12.00%)*	4.87 ±0.28 (27.86%)***	4.15 ±0.57 (38.52%)**	6.05 ±0.08 (10.38%)**	5.60 ±0.13 (17.04%)**	5.06 ±0.17 (17.04%)***	4.80 ±0.11 (28.89%)***	5.48 ±0.17 (18.32%)**	4.31 ±0.15 (30.52%)***	4.19 ±0.18 (37.93%)***	3.35 ±0.06 (50.38%)***
Hepato Pancreas	8.68 ±0.30	8.23 ±0.29 (5.19%)	7.03 ±0.09 (19.01%)***	6.14 ±0.11 (29.27%)***	5.18 ±0.21 (40.33%)***	6.90 ±0.18 (20.51%)***	5.14 ±0.15 (40.79%)***	4.80 ±0.14 (44.71%)***	4.30 ±0.18 (50.47%)***	5.54 ±0.07 (22.57%)***	4.64 ±0.13 (46.55%)***	3.97 ±0.14 (54.27%)***	3.61 ±0.18 (58.42%)***
Gonads	7.65 ±0.32	6.95 ±0.18 (%)	6.10 ±0.15 (%)	5.80 ±0.07 (%)	5.10 ±0. 20 (%)	6.82 ±0.11 (%)	6.15 ±0.06 (%)	5.63 ±0.13 (%)	5.00 ±0.14 (%)	4.30 ±0.30 (%)	3.90 ±0.25 (%)	3.40 ±0.19 (%)	3.18 ±0.20 (%)
Whole body	9.21 ±0.06	8.41 ±0.17 (8.69%)**	8.03 ±0.17 (12.82%)***	7.31 ±0.14 (20.63%)***	6.33 ±0.17 (31.28%)***	8.35 ±0.19 (9.34%)*	7.95 ±0.35 (13.69%)**	6.90 ±0.15 (25.09%)***	6.32 ±0.25 (31.38%)***	7.58 ±0.37 (17.70%)**	6.78 ±0.15 (26.39%)***	6.14 ±0.17 (33.34%)***	5.56 ±0.11 (39.64%)***

(Bracket values represent percentage differences) (*,p-<0.05, **,p<0.01 and ***, p<0.001 compared to control group of bivalves)

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Table 3: Changes in the lipid in different body parts of *L. marginalis* during different seasons

Body parts	Monsoon					Winter				Summer			
	control	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
Mantle	7.43 ±0.292	7.55 ±0.293 (1.62%)	7.63 ±0.317 (2.70%)*	7.89 ±0.725 (6.33%)*	8.05 ±0.229 (8.35%)	7.24 ±0.285 (2.83%)	7.70 ±0.578 (3.64%)	7.87 ±0.295 (5.93%)	7.94 ±0.385 (6.87%)	7.85 ±0.351 (5.66%)	8.07 ±0.378 (8.62%)	8.17 ±0.135 (9.96%)	8.25 ±0.481 (11.04%)
Foot	7.63 ±0.266	7.87 ±0.112 (3.15%)*	7.88 ±0.155 (3.28%)	8.01 ±0.135 (4.99%)*	8.15 ±0.418 (8.13%)	7.97 ±0.237 (4.46%)	8.03 ±0.378 (5.25%)	8.20 ±0.217 (6.82%)	8.27 ±0.417 (8.39%)***	8.05 ±0.432 (5.51%)**	8.15 ±0.496 (6.82%)***	8.27 ±0.517 (8.39%)***	8.33 ±0.882 (9.18%) ***
Gill	7.55 ±0.488	7.63 ±0.516 (1.06%)	7.79 ±0.496 (3.18%)	7.99 ±0.502 (5.30%)	8.15 ±0.859 (7.95%)	7.88 ±0.278 (4.38%)	7.99 ±0.611 (5.83%)	8.17 ±0.593 (8.22%)	8.27 ±0.535 (9.54%)	7.96 ±0.178 (5.44%)	8.11 ±0.851 (7.42%)	8.17 ±0.196 (8.22%)	8.34 ±0.516 (10.47%)
Hepato Pancreas	8.24 ±0.396	8.45 ±0.282 (2.55%)	8.58 ±0.496 (4.13%)	8.69 ±0.653 (5.47%)	8.91 ±0.631 (8.14%)	8.63 ±0.203 (7.74%)	8.79 ±0.151 (6.68%)	8.85 ±0.188 (7.41%)	8.91 ±0.159 (8.14%)	8.77 ±0.183 (6.44%)	8.89 ±0.488 (7.89%)	9.06 ±0.855 (9.96%)	9.17 ±0.859 (11.29%)
Gonads	7.69 ±0.178	7.75 ±0.851 (0.79%)	7.81 ±0.342 (1.57%)	8.11 ±0.493 (5.47%)	8.45 ±0. 515 (9.89%)	7.87 ±0.5.18 (2.34%)	7.99 ±0.415 (3.91%)	8.17 ±0.513 (6.25%)	8.27 ±0.551 (7.55%)	7.98 ±0.185 (3.78%)	8.16 ±0.851 (6.12%)	8.29 ±0.617 (7.81%)	8.42 ±0.692 (9.50%)
Whole body	6.99 ±0.306	7.15 ±0.185 (2.29%)	7.27 ±0.851 (4.01%)	7.55 ±0.461 (8.02%)	7.89 ±0.623 (9.88%)	7.29 ±0.179 (4.30%)	7.43 ±0.661 (6.30%)	7.69 ±0.815 (10.02%)	7.99 ±0.321 (14.31%)	7.92 ±0.032 (13.31%)	8.13 ±0.196 (16.31%)	8.24 ±0.066 (17.89%)	8.39 ±0.859 (20.03%)

(Bracket values represent percentage differences) (*,p-<0.05, **,p<0.01 and ***, p<0.001 compared to control group of bivalves).

On the other hand, the high amount in lipid content was found in all tissues which is shown in **(Table-3)** in monsoon, winter and summer. The high amount of lipid content was from 7.43 to 8.05, 7.43 to 7.94 and 7.43 to 8.25 respectively in mantle. The high amount in lipid in foot was from 7.63 to 8.15, 7.63 to 8.27 and 7.63 to 8.33 in monsoon, winter and summer respectively. Further it is also observed that the amount in lipid content in gill was from 7.55 to 8.15, 7.55 to 8.17 and 7.55 to 8.34 respectively. The amount in lipid in hepatopancreas was observed from 8.24 to 8.91, 7.55 to 8.91and 7.55 to 9.17 in monsoons, winter and summer respectively. The amount in gonads was observed from 7.69 to 8.45, 7.69 to 8.27 and 7.69 to 8.42 in monsoon, winter and summer respectively. Whereas, amount in lipid observed in whole body at 6.99 to 7.89, 6.99 to 7.99 and 6.99 to 8.39 levels respectively. A gradual high amount in lipid content was observed in mantle, foot, gill, and hepatopancreas of *L. marginalis* during summer. The most pronounced change was observed in summer animals.

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. 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. Giese (1969), Gabbott (1976), and Dezwaan (1983) have reviewed much of the literature on biochemical changes in bivalve molluscs, particularly the carbohydrates. Ansell et al., (1964) determined seasonal changes in biochemical composition and adductor muscle, mantle, siphon, visceral mass (gonad), digestive gland and foot from hard clam, M. mercenaria. 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. It is quite evident that the frequency of changes in the composition of the biochemical constituents of animals varies with environmental changes and seasons. 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. In the present study it was observed protein and glycogen was high amount in June and low in September in monsoon. Whereas in winter it was more amount was observed in October and low in January. On the other hand the lipid it was high in May and low in February in summer season. While, overall protein and glycogen amount were high in June/July might due to the rainfall was noted during these months and influx bring heavy load of land drainage and created turbidity that is likely to be impregnated with healthy food or essential nutrients. Thus, monsoon influx in the dam water creates drastic siltation on the mussel beds if the food levels in the environment increase. Further in present study it was observed that the low amount in May might be due to high water temperature in summer season. Generally, high and low amount of content of

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biochemical were found in mussels collected during month of June and May respectively, which coincide with the peak of monsoon and summer in this region.

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 metals. Torreblaca et al., (1991) observed that in freshwater cryfish Procambarus clarkii there was considerable decrease in various tissues after exposure to cadmium. Kulkarni (1993) observed increased content in the different body parts of freshwater bivalve molluscs L. marginalis after exposure of sublethal concentration of cadmium. Patil (1993) also observed the protein increased from different body parts of freshwater mussel L. marginalis after exposure to mercury. Torreblanca et al., (1992) studied the changes in the biochemical composition of gills, hepatopancreas and muscle after exposure to 0.25 mg/hg/l in P. clarkii. They observed significant decreases in protein concentration and caloric concentration in gills over the 96h period. Glycogen/lipid and glycogen/protein ratios increased after 48 h and 96h of mercury exposure, lipid and caloric concentration in the hepatopancreas were significantly lower and glycogen concentration in muscle was depleted as consequence of 96h mercury exposure. The results obtained in the present study indicate severe disturbance in the protein metabolism of the fresh water bivalve L. marginalis. 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. 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.

Further the level of biochemical 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). 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. The glycogen levels in their body parts decreased continuously when increases the water temperature. When mussels at all time period showed that more decrease was in hepatopancreas followed by gonad and gill. In winter showed the decrease trend was from gonad followed by hepatopancreas and foot. In summer the glycogen was more decreases in gonad and hepatopancreas alternate time period followed by gill and foot. Further amongst body parts the hepatopancreas, gonad and gill was more affected might be due to temperature variation during different seasons and hence protein was more depleted from these body organs when it was compared with control of bivalves. It is evident that decrease in the glycogen from gonad, hepatopancreas and gills 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 glycogen of various organisms under influence of stresses. 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. Whereas, lipid content was high in somebody parts in summer season 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.

Further, we can conclude the present study 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 freshwater 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.

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