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RESEARCH ARTICLE

SEASONAL METABOLIC VARIATION OF PROTEIN AND GLYCOGEN IN FRESHWATER BIVALVE *LAMELIDENS MARGINALIS* (LAMARCK, 1819)

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ABSTRACT

Proteins are important organic substances required by an organism in tissues building and repair. Under extreme stress conditions, proteins have been known to act as the energy supplier in metabolic pathways and biochemical reactions. In the present investigation Protein is found maximum in gonads throughout summer season, increasing in rainy and minimum in winter season followed by mantle, hepatopancreas, Add. Muscle and gill i.e., Gonad> Mantle> Hepatopancreas> Add. muscle>Gill. Glycogen are important organic substances required by an organism in cellular process. Under extreme stress conditions, glycogen have been known to act as the energy supplier in metabolic pathways and biochemical reactions. In the present investigation glycogen is found maximum in gonads throughout summer season, increasing in rainy and minimum in winter season followed by mantle, hepatopancreas, Add. Muscle and gill i.e., Gonad> Mantle> Hepatopancreas> Add. muscle>Gill .

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INTRODUCTION

Proteins are most abundant intracellular macro-molecules and constitute over half the dry weight of most organisms. They occupy a central position in the architecture and functioning of living matter. They are intimately connected with all phases of chemical and Physical activity that constitutes the life of the cell. Therefore they are, essential to cell structure and cell function. The interplay between enzymatic and non-enzymatic proteins governs the metabolic harmony (Lehinger, 1984). They are also involved in major physiological events to maintain the homeostasis of the cell. Therefore, the assessment of the protein content can be considered as a diagnostic tool to determine the physiological process of the cell (Kapil and Ragothaman, 1999; Munshigeri, 2003). Proteins are essential nutrients for the human body. They are one of the building blocks of body tissue, and can also serve as a fuel source. As a fuel, proteins contain 4 kcal per gram, just like carbohydrates and unlike lipids, which contain 9 kcal per gram. Proteins are polymer chains made of amino acids linked together by peptide bonds. During human digestion, proteins are broken down in the stomach to smaller polypeptide chains via hydrochloric acid and protease actions. This is crucial for the synthesis of the essential amino acids that cannot be biosynthesized by the body (Genton *et.al,* 2010).

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The chief carbohydrate in the tissues is glycogen, while glucose is an utilizable sugar found in the tissues and the body fluids. Glycogen is reversibly converted to glucose under the influence of hormonal mediated enzyme activities. The equilibrium in glycogenesis and glycogenolysis tends to maintain blood sugar at a steady state. The oxidation of glucose is mediated by catabolic pathways viz., glycolysis, Krebs cycle, electron transport system and hexose mono-phosphate shunt, which constitute the major segments of carbohydrate metabolism. Thus carbohydrate metabolism gained importance in the physiology of animals. According to Prosser, (1984) the synthesis and degradation of glycogen will not occur simultaneously at any significant rate. The other probability for occurrence of depletion in glycogen levels might be due to dephosphorylation of phosphorylase 'a' and specific protein phosphatases. Glycogen is a multibranched polysaccharide of glucose that serves as a form of energy storage in animals (Sadava *et. al.,* 2011). The polysaccharide structure represents the main storage form of glucose in the body.

MATERIAL AND METHOD

Bivalves *Lamellidens marginali*s sample (75-80 mm in shell length) were obtained from fishermen's catch. In the present study they were collected from Godavari River (Nanded) of Maharashtra in India in the year 2014. Immediately after bringing to laboratory, hard shells of these freshwater bivalves were brushed and washed with fresh and clean water to remove algal biomass, mid and other waste material. The cleaned animals were then kept for depuration for 12 hrs in laboratory conditions under constant aeration. For protein analysis, animals were dissected and soft body tissues like mantle, hepatopancreas, gonad, Adductor muscle and gill were removed. 100 mg of each wet tissues were taken for biochemical analysis. Protein was determined by the method proposed by Lowry et al., (1951), using Bovine Serum Albumin (BSA) as standardand values of proteins were expressed in terms of mg protein/gm wet weight of tissue. Bivalves *Lamellidens marginalis* sample (75-80 mm in shell length) were obtained from fishermen's catch. In the present study they were collected from Godavari River (Nanded) of Maharashtra in India in the year 2014. Immediately after bringing to laboratory, hard shells of these freshwater bivalves were brushed and washed with fresh and clean water to remove algal biomass, mid and other waste material. The cleaned animals were then kept for depuration for 12 hrs in laboratory conditions under constant aeration. For glycogen analysis, animals were dissected and soft body tissues like mantle, hepatopancreas, gonad, Adductor muscle and gill were removed. 100 mg of each wet tissues were taken for biochemical analysis.Estimation of glycogen was done by Anthrone method using glucose as standard (Seifer *et.al.,* 1950) and values of glycogen were expressed in terms of mg glycogen/gm wet weight of tissue.

RESULTS AND DISCUSSSION

Protein estimation observed during experimental work has been given in Fig 1. for *Lamellidens marginalis*.

Protein content in *Lamellidens marginalis:*

- **Gonad protein: -** The seasonal changes in the protein content in gonad of *L. marginalis* are shown in (Figure No. 1). The percentage of protein was found to be maximum in summer and varies from 11.1121±0.5214 to 14.1320±0.7204, increasing in rainy season and varies from 6.1317±0.7324 to 10.1320±0.4105, whereas it is minimum in winter season and varies from 3.2472±0.6214 to 6.3600±0.2201.
- **Mantle protein: -** The seasonal changes in the protein content in mantle of *L. marginalis* are shown in (Figure No. 1). The percentage of protein was found to be maximum in summer and varies from 10.1242±0.3302 to 13.1257±0.9306, increasing in rainy season and varies from 4.1520±0.8319 to 9.4361±0.4621, whereas it is minimum in winter season and varies from 3.1341±0.2253 to 5.1463±0.3424.
- **Hepatopancreas protein: -** The seasonal changes in the protein content in hepatopancreas of *L. marginalis* are shown in (Figure No. 1). The percentage of protein was found to be maximum in summer and varies from 8.1622±0.4371 to 10.1533±0.6314, increasing in rainy season and varies from 4.1281±0.4264 to 8.5248±0.6132, whereas it is minimum in winter season and varies from 3.4204±0.4100 to 6.4207± 0.7342.
- **Add. Muscle protein: -** The seasonal changes in the protein content in Add. Muscle of *L. marginalis* are shown in (Figure No. 1). The percentage of protein was found to be maximum in summer and varies from 8.1021±0.2010 to 11.0900±0.7380, increasing in rainy season and varies from 8.1301±0.1021 to 10.1436±0.3071, whereas it is minimum in winter season and varies from 4.1310±0.3621 to 6.3210±0.3421.
- **Gill protein: -** The seasonal changes in the protein content in gill of *L. marginalis* are shown in (Figure No. 1). The percentage of protein was found to be maximum in summer and varies from 9.1271±0.3631 to 11.2421±0.3320, increasing in rainy season and varies from 7.6521±0.5432 to 9.2611±0.6730, whereas it is minimum in winter season and varies from 3.5461±0.2321 to 5.1021±0.2326

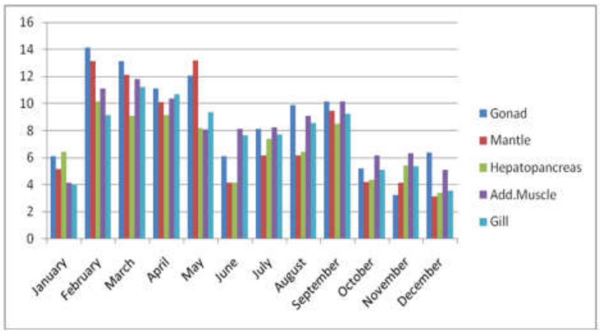

Fig 1. Monthly variation in protein content of Lamellidens marginalis

The present study revealed that, there is significant variation in the biochemical composition in different body tissues according to seasonal changes. Seasonal changes in protein content may be of great importance in relation to energy metabolism necessary for growth and reproduction (Lodeiros *et al.,* 2001). Organic constituents like protein act as key substances for different metabolic activities. Protein is the main organic nutrient used to build up different body tissues. All the tissues show increasing order protein contents in rainy season, which is correlated with highest body activities of animal during this season. And due to increase inflow and turbidity of water and to cope up with new environmental change. It might be due to favourable environmental lots of food availability and the period of growth with the gonadal development. Similar conclusions were reported in *M. edulis*, in British water by Williams, 1969 and Mane and Nagabhushanam, 1978. The protein seems to be its only alternative resource of energy under conditions of food scarcity. During May 1st and 2nd fortnight the drastic environmental condition results in recovery of gonad tissue. Protein content decrease in gonad and hepatopancreas, during this period was seen in *L. corrianus* from Godavari River by (Muly, 1988). Thus, food availability may be the important source of nutrients required for the gonadal repining process. Seasonal variation in temperature and availability of food appear to be closely related to energy available for growth and reproduction in other bivalve species (Smaal *et.al.,* 1997). In E. exalbida from Ushuaia Bay, shell growth in spring (Lomovasky *et.al.,* 2002). Whereas the protein content showed a significant increase in Winter February 2001, however, it might be due to favorable environmental condition, lots of food availability and the period of growth with the gonadal development. The relative content of protein vary seasonally. These changes are principally related to the reproductive cycle and the season maximum shell growth. Similar characteristics have been observed in other bivalve Lyropecten (Nodipecten) nodosus (Lodeiros *et.al.,* 2001). The protein seems to be its only alternative resource of energy under conditions of food scarcity. However, it cannot be certain without further studies and proper investigation about the possible advantage of using protein as an energy reserve and the mechanisms of regulation (e.g., anti-freezing proteins). In Summer May 2000 the protein content was significantly low due to drastic environmental condition the rise in temperature, scarcity of food availability, starvation effect and endogenous role of hormone as the removal of cerebral ganglion maybe responsible of decrease in protein content. Glycogen estimation observed during experimental work has been given in Fig 1 for *Lamellidens marginalis*.

Glycogen content in *Lamellidens marginalis:*

Gonad glycogen: - The seasonal changes in the glycogen content in gonad of *L. marginalis* are shown in (Figure No. 1). The percentage of glycogen was found to be maximum in summer and varies from 11.1032±0.4331 to 13.1122±0.6102, increasing in rainy season and varies from 5.2630±0.4519 to 11.1130±0.5217, whereas it is minimum in winter season and varies from 4.3384±5133 to 6.0321±0.5340.

Mantle glycogen: - The seasonal changes in the glycogen content in mantle of *L. marginalis* are shown in (Figure No. 1). The percentage of glycogen was found to be maximum in summer and varies from 11.1245±0.2203 to 13.1146±0.7314, increasing in rainy season and varies from 4.2410±0.9226 to 8.6217±0.3730, whereas it is minimum in winter season and varies from 4.0213±0.1238 to 5.2351±0.2135.

Hepatopancreas glycogen: The seasonal changes in the glycogen content in hepatopancreas of *L. marginalis* are shown in (Figure No. 1). The percentage of glycogen was found to be maximum in summer and varies from 9.2320±0.5212 to 10.0210±0.5241, increasing in rainy season and varies from 5.2140±0.3152 to 9.4001±0.3301, whereas it is minimum in winter season and varies from 4.1001±0.5200 to 5.3105± 0.6221.

Add. Muscle glycogen: The seasonal changes in the glycogen content in Add. Muscle of *L. marginalis* are shown in (Figure No. 1). The percentage of glycogen was found to be maximum in summer and varies from 8.1130±0.4320 to 10.3411±0.3216, increasing in rainy season and varies from 8.1301±0.1231 to 10.1213±0.2032, whereas it is minimum in winter season and varies from 4.2310±0.3310 to 6.2303±0.2050.

Gill glycogen: - The seasonal changes in the glycogen content in gill of *L. marginalis* are shown in (Figure No. 1). The percentage of glycogen was found to be maximum in summer and varies from 8.1130±0.4320 to 10.3411±0.3216, increasing in rainy season and varies from 7.4312±0.4315 to 9.4301±0.5410, whereas it is minimum in winter season and varies from 4.1142±0.3250 to 5.2513±0.5141.

The present study revealed that, there is significant variation in the biochemical composition in different body tissues according to seasonal changes. Seasonal changes in protein content may be of great importance in relation to energy metabolism necessary for growth and reproduction (Lodeiros *et al.,* 2001). Organic constituents like glycogen act as key substances for different metabolic activities. All the tissues show increasing order glycogen contents in rainy season, which is correlated with highest body activities of animal during this season. And due to increase inflow and turbidity of water and to cope up with new environmental change. It might be due to favourable environmental lots of food availability and the period of growth with the gonadal development. Similar conclusions were reported in *M. edulis*, in British water by Williams, 1969 and Mane and Nagabhushanam, 1978. Bivalves generally store carbohydrates in large amounts during their growing season and use them over the rest of the year (Beukema, 1997); Glycogen is the primary energy store in bivalves (Garbbott, 1983). In the entire body organ it is observed that glycogen acontents are significantly accumulated is found to be more during summer season.

The relationship of the energy transfer between different tissues, their capacity of reserve amounts under food availability, and their positive relationship with the high temperature and gonadal maturation have been shown in different species of bivalve molluscs such as scallops (Urrutia *et. al.,* 2001). The relative content of glycogen vary seasonally. These changes are principally related to the reproductive cycle and the season maximum shell growth. Similar characteristics have been observed in other bivalve Lyropecten (Nodipecten) nodosus (Lodeiros *et.al.,* 2001).

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