# METABOLIC RECOGNITION OF GLYCOGEN IN *INDONAIA CAERULEUS*

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**ABSTRACT:**
The environment and biological conditions have notable impact on the metabolic activities in all organisms. Glycogen is the main source of energy and its metabolism mostly get affected by influence of the environmental condition, especially the warmth in the atmosphere. Taken into consideration the environmental impact on the metabolic activities of an organism, we report here the habitat specific variations in glycogen content of freshwater bivalve *Indonaia caeruleus* collected from two diverse sites of Godavari river i.e. from upstream and downstream habitat at Paithan near Aurangabad having 55-60 mm shell span for determination of changes in the glycogen content during summer season. For biochemical analysis of glycogen, 100 mg tissue of the mantle, hepatopancreas, gonad, foot, gills, anterior adductor muscles and posterior adductor muscles of *Indonaia caeruleus* were used for the analysis. The glycogen content was estimated according to method proposed by **De-Zwaan and Zandee (1972)** using glucose as standard. The results are expressed as mg. content per 100 mg wet tissue. The data analysed shown in the form of table used for discussion and further recommendation.

**Keywords:** Metabolic, site specific, hepato-pancreas, mantle, adductor muscles.
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## 1. Introduction:

The freshwater bivalve molluscans are suspension feeders and the juvenile bivalves become a source of food for many fishes, aquatic birds and mammals; hence they become important component of lower level of aquatic food chain. Also, they perform efficient role in alteration of energy in food chains tied with their sessile mode of life. They are filter-feeders or collector-filters capable of collecting and filtering huge volume of the water thus they are able to detoxify hazardous substances in aquatic system. By removing organic materials, bivalves can significantly reduce the turbidity thus are capable of cycling significant quantities of nutrients. Hence, they remarkably impact the organization and functioning of the aquatic ecosystems. The significant role of freshwater bivalves in stream system is release of nutrients via excretion have been converted from particulate matter to a soluble form that is usable by primary producers. Being an element of ecological food chain, these animals are not able to drift from one place to other, and hence they remain under severe environmental stress which ultimately affects their physical status. Lipids are responsible for a variety of functions in molluscs and glycogen is the major polysaccharide serves for storage of reserve and energy. Glycogen is stored primarily in the digestive gland, with smaller stores in the mantle and foot mass. The translocation of different lipid fractions from one part of the cell to the other part play major role as an integral part of the cellular membrane structure. Any environmental or pesticidal stress may alter the course of events associated with the lipid synthesis and its translocation in the membrane structure. Apart from its structural role, lipid contribute to the energy production in metabolic eugenesis as they have very high calorific value. Hence glycogen analysis in molluscs is very important, as the quantity of this polysaccharide can be used as a parameter to indicate the nutritional status of the Molluscs. Physiological ecology of freshwater bivalves is based on taxonomy with notes on habitat, community composition, abundance and distribution on the basis of life cycles, growth, reproduction, population dynamics and energetics Modern physiological ecology of freshwater bivalves has more recently involved both in field and laboratory studies. In some marine and freshwater systems, bivalve molluscs are leading strainer- feeders and make up most of the biomass and exert a control over structure and function of that ecosystem. **(Dame, 1996; Strayer et al., 1999)**. Physiological ecology and energy metabolism during the reproduction in bivalve molluscs have been studied and reviewed by many investigators, because the physiological ecology of bivalves can give an insight on adaptation of an animal to function in its particular environment. Glycogen is the chief carbohydrate of the tissue just as glucose in the blood and other body fluids. Glycogen as reserve or storage carbohydrate is reversibly converted to blood glycose and normally serves to maintain blood sugar level, when supply of carbohydrates from intestinal absorption is inadequate glycogen synthesis and break down appear to occupy a central position being controlled by extrinsic and intrinsic factors there by altering the physiological state of the organism. Bivalves store energy in the form of glycogen (**Naimo et.al. 1998)**. Glycogen stores shows seasonal alterations, naturally during periods of gamete formation and declines rapidly in response to decreased food availability and environmental disturbance. **(Naimo and Monroe 1999; Patterson, Parker and Neves, 1997)**. Investigating seasonal fluxes in the glycogen content of bivalves may offer an added clarification for the deterioration in Unionid species diversity **(Strayer, 1999)**. If little glycogen stores overlap with periods of low food accessibility in a watercourse, bivalves may have abridged lenience for further pressures such as rivalry with exotic species or reduced food accessibility. In a dissimilar stream where food is not restrictive yet the same type of bivalve community would seem to be much more tolerant of species incursions or human intrusions. The interplay between energy storage, food availability and environmental stress may help to explain the variability in unionid **(Miller and Payne, 1998; Strayer, 1999)**. Hence to examine the glycogen content with respect to the collection sites & water parameters, as well as considering the scarcity of information on site dependent glycogen diversions and reproductive cycle of the field population of bivalves and abundant distribution of *Indonaia caeruleus* in upstream and downstream water from Godavari river at Paithan ,the present study has undertaken and the biochemical analysis was done to know the amount of glycogen channelized and utilized in the different body tissues and to study the site specific variations in glycogen as the glycogen in many species of bivalve molluscs have been found to vary with changes virtually by environmental variables **(Vedpathak,1989).**Changes in the biochemical contents are shown to depend on environmental conditions and utilization of these reserves during the gametogenic cycle and maturation of the animals.

**2. Material and Method:**

The adult freshwater bivalve molluscs *Indonaia caeruleus* having 55–60 mm shell length was collected from two different fixed sites i.e., site (A), upstream water and site (B) downstream water from Godavari River at Paithan near Aurangabad. These two collection sites are separated by a distance of 9.0 Kms from each other and each having a specific set of ecological factors during summer (April-May). Immediately after brining to the laboratory, the shells of the bivalves were brushed and washed with freshwater in order to remove algal biomass; mud and other waste materials. The cleaned animals were then allowed for defecation or depuration for 12 – 13 h in laboratory conditions, under constant aeration. During this period no food was given to animals and hence the animals opened their shell valves and protruded the mantle edges and siphons outside the shells to remove waste material from the viscera, thus cleaning the gills and mantle cavity. For biochemical analysis of glycogen, various body tissues like the mantle, hepatopancreas, gonad, foot, gills, anterior adductor muscles and posterior adductor muscles were removed and 100 mg of each wet tissue is taken for biochemical analysis. The glycogen content was estimated according to method proposed by **De-Zwaan and Zandee (1972)** using glucose as standard.

## 3. Result & Discussion:

In present study, the physico-chemical characteristics of the water was estimated from where these bivalves are collected in the month of April & May. The estimated values of these water parameters were, temperature (31.0 - 31.5$^0$C); pH (8.2 - 8.8); hardness in terms of bicarbonate (99 - 112 ppm) and dissolved oxygen content (5.620 – 6.422mg/l/h). The site-specific changes in the glycogen during summer season from mantle, hepatopancreas, gonad, foot, gills, anterior & posterior adductor muscles of the bivalves are given in the **Table:1** and the comparison of glycogen in these tissues is shown in **Fig.1(A) & Fig.1(B)**. The specimen bivalves collected from upstream water habitat has shown higher values of glycogen in foot and gonad while the lower glycogen content observed in their posterior adductor muscles. In the specimens collected from downstream water habitat, the glycogen found higher in foot and lower in their anterior adductor muscles. Seasonal glycogen analysis was verified to be specific and consistent for the identification of alterations in the glycogen level in different tissues of *Indonaia caeruleus*. **(Salve, S. K.2007) (Saokar, C. D.1994)**. The results confirm prior findings **(de Zwaan and Zandee 1972; Naimo and Monroe 1999)** that there is a significant difference in glycogen levels in different types of tissues of unionid bivalves. Bivalves generally stock carbohydrates in huge quantities during their growing period and practice them throughout the year **(Beukema, 1997)**. Under situations of food scarcity, it has been proposed that glycogen from muscular tissues serves as the primary energy basin for the formation of gametes in bivalves, such as *Glycymeris glycymeris* **(Galap et al.,1997)**. A drop of this reserve in storing tissues is also normally associated with an upsurge in gonadal fats **(Fernandez-Reiriz et al. 1996),(Mann, 1979)**.In the adductor muscle of *E. exalbida*, glycogen content improved throughout the gametes depositing incident and decreased in the rest of the year, suggesting that glycogen is used in these months but in a very low proportion Thus, these changes had not been detected in a straight calorimetric examination, **(Lomovasky et al. 2001)**. **Berthelin et al. (2000a)** investigated the organic composition of diversed body tissues counting the adductor muscles, gonad/mantle and digestive gland. In several species of bivalves, the somatic cells and shell progress is repressed during formation of gametes and depositing them. **(Harvey et al. 1993), (McLachlan et al.,1996)**. This indicates that the maximum and minimum build-up of glycogen content in different body tissue, is too functional significant in different seasons **(Dongre et al 2014)**, **(Vodakova Douda (2019).** Prior studies indicated that nutrients were limiting in both the water systems, so any nutrient contributed by the bivalves should be useful biologically.

## 4. Conclusion:

Thus, it can be concluded that the increasing temperature during summer season may plays an important role mostly repressive one, in regulation of metabolic rate and the organic reserve in the form of glycogen from different body tissues as it slows down the glycogen metabolism in *Indonaia caeruleus*. The scarcity of planktonic food also affects the glycogen content as the animal has to utilize this reserve form of food for its physiological activities necessary for its survival. Foot of *Indonaia caeruleus* plays important role to keep the animal safe from the sunlight by digging in the moisture. Moreover, this study demonstrated that individual bivalves differed significantly in the glycogen content in different body tissues. This tissue-specific glycogen evaluation can offer more comprehensive data for monitoring the health condition of the bivalve and can provide new valued evidence for future selection, where more than one type of tissue for the glycogen analysis can be counted. These findings also provide a new view of the evaluation of results from field studies where only one tissue was sampled as well as the status of gamete formation due to variations in glycogen.

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**Table 1:** Site-specific changes in *glycogen* from different tissues of *Indonaia caeruleus* during summer.

| Sr. No. | Tissues | Upstream water (mg/100mg) | Downstream water (mg/100mg) |
|---|---|---|---|
| 1. | Mantle | 7.7349 ± 0.4371 | 7.3764 ± 0.2365 |
| 2. | Hepatopancreas | 7.2398 ± 0.6484 | 7.7349 ± 0.6484 |
| 3. | Gonad | 9.8348 ± 0.6258 | 7.1032 ± 0.4731 |
| 4. | Foot | 10.7891 ± 0.4701 | 8.0593 ± 0.2365 |
| 5. | Gill | 4.5082 ± 0.2365 | 3.7766 ± 0.4097 |

| | | | |
|---|---|---|---|
| 6. | Anterior adductor muscles | 4.4900 ± 0.6326 | 3.1425 ± 0.2365 |
| 7. | Posterior adductor muscles | 4.4418 ± 0.6627 | 3.6887 ± 0.2365 |

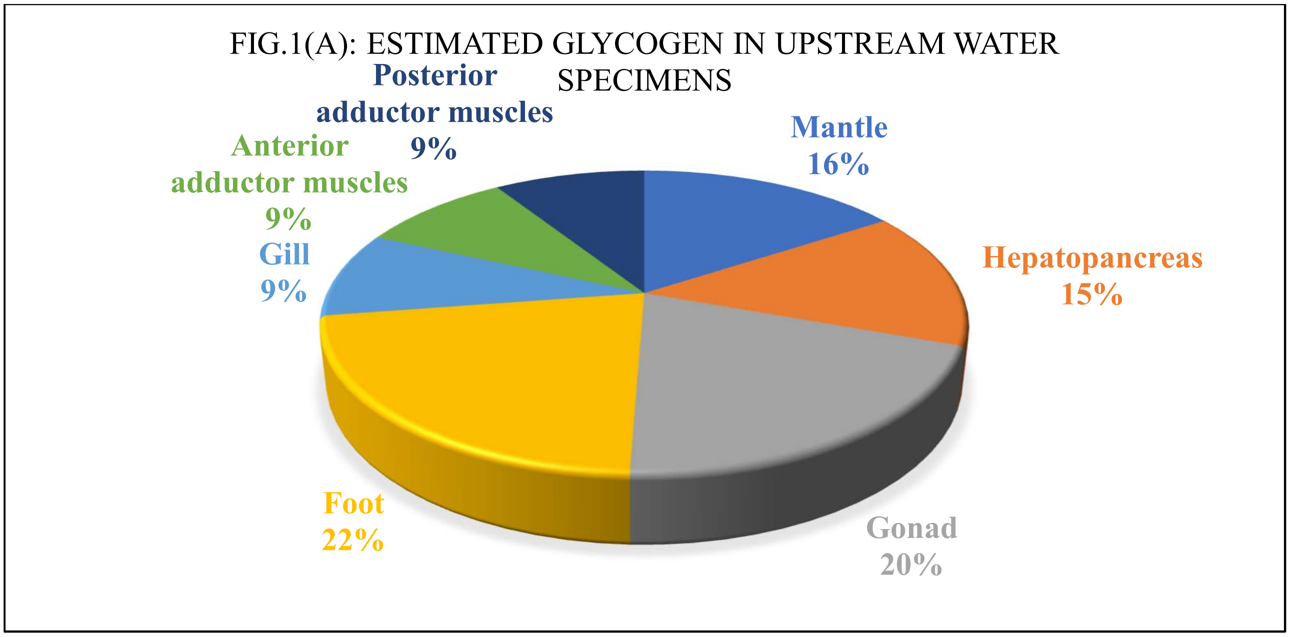


FIG.1(A): ESTIMATED GLYCOGEN IN UPSTREAM WATER SPECIMENS

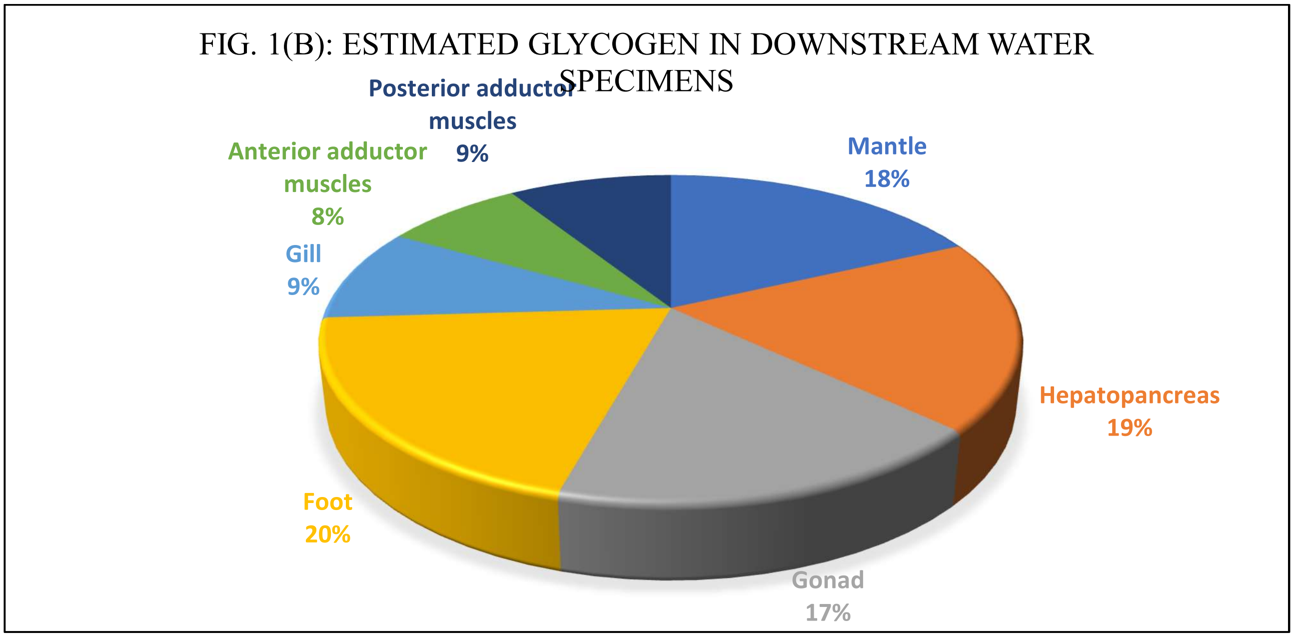


FIG. 1(B): ESTIMATED GLYCOGEN IN DOWNSTREAM WATER SPECIMENS