International Journal of Zoology Studies
www.zoologyjournals.com
ISSN: 2455-7269
Received: 28-03-2026, Accepted: 28-04-2026, Published: 13-05-2026
Volume 11, Issue 2, 2026, Page No. 65-67

Biochemical study of pestiferous land snail *Macrochlamys petrosa* from Amravati district of Maharashtra

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Abstract
The present study investigates seasonal variations in biochemical constituents—glycogen, proteins, and lipids—in different body tissues of the terrestrial snail *Macrochlamys petrosa*. Specimens were collected monthly and grouped into pre-reproductive, reproductive, post-reproductive, and aestivation phases. Biochemical analysis of foot, mantle, hepatopancreatic gonadal complex, and albumen gland revealed significant seasonal fluctuations. Glycogen and protein levels were highest during the pre-reproductive phase and declined during reproductive activity, indicating utilization for gametogenesis. Lipid reserves also showed a similar trend, with depletion during reproduction and accumulation prior to aestivation. These findings demonstrate a strong correlation between biochemical reserves and reproductive cycle, highlighting adaptive physiological strategies of *M. petrosa* in response to environmental changes.

Keywords: Macrochlamys petrosa, biochemical composition, glycogen, proteins, lipids, reproductive cycle, aestivation

Introduction

Reproductive cycles in invertebrates are closely associated with environmental fluctuations, particularly in tropical regions where organisms exhibit distinct seasonal patterns (Giese, 1959) [5]. Biochemical constituents such as carbohydrates, proteins, and lipids play a crucial role in supporting reproductive activities and survival during adverse conditions.

Studies on marine and freshwater molluscs have demonstrated significant seasonal variations in biochemical composition linked with reproductive cycles (Giese, 1969; Nagabhushanam and Mane, 1973) [6, 15]. However, similar studies on terrestrial pulmonate gastropods are limited. These organisms exhibit unique physiological adaptations such as aestivation, during which stored biochemical reserves are utilized.

The land snail *Macrochlamys petrosa* is a minor pest affecting agricultural and horticultural crops. Due to limited information on its reproductive physiology and biochemical dynamics, the present study aims to analyze seasonal variations in glycogen, protein, and lipid contents in different tissues and correlate them with its reproductive cycle.

Materials and Methods

Collection and Maintenance: Specimens of *M. petrosa* were collected monthly from Amravati (Maharashtra, India). Snails were maintained under laboratory conditions in moist soil and fed daily with plant leaves and carrot.

Tissue Preparation: Healthy snails were dissected, and tissues including foot, mantle, hepatopancreatic gonadal complex, and albumen gland were isolated. A total of 15–20 specimens were analyzed monthly.

Biochemical Estimation

1. **Glycogen:** Estimated by the method of Kemp *et al*. (1954) [7] and expressed as mg/100 mg dry weight.
2. **Proteins:** Determined using the Lowry *et al*. (1951) [9] method.
3. **Lipids:** Estimated using the method of Barnes and Blackstock (1973).

Mean values and standard deviations were calculated.

Observations and Results

Reproductive Cycle: The reproductive cycle of *M. petrosa* was divided into:

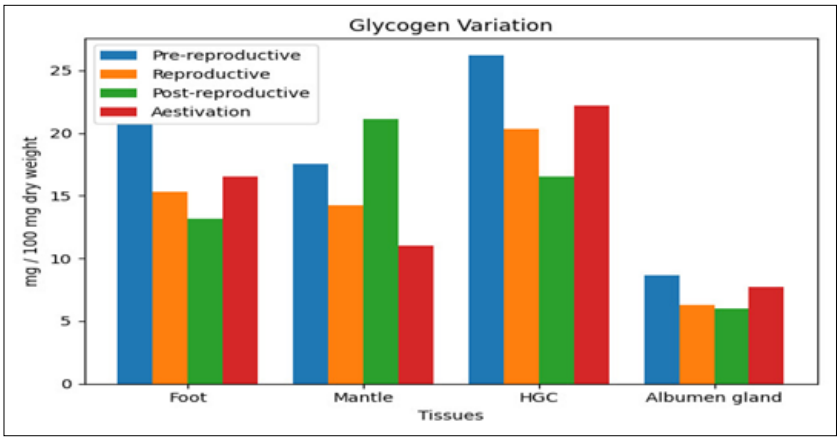
1. Pre-reproductive (June–July)
2. Reproductive (August–September)
3. Post-reproductive (October–November)
4. Aestivation (December–May)

Maximum egg laying occurred during July –September. Snails remained in aestivation from December to May.

Glycogen Content: Glycogen levels showed significant seasonal variation (Table 1). Maximum accumulation occurred during the pre-reproductive phase, particularly in the hepatopancreatic gonadal complex (26.24 ± 1.15 mg/100 mg). Minimum values were observed during post-reproductive phase.

Table 1: Seasonal variation in glycogen content (mg/100 mg dry weight)

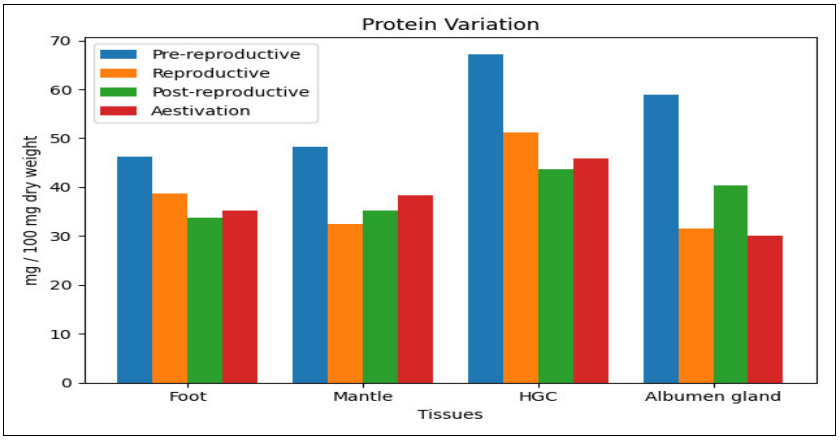
Tissue	Pre-reproductive	Reproductive	Post-reproductive	Aestivation
Foot	20.67 ± 0.27	15.31 ± 0.38	13.14 ± 0.85	16.54 ± 1.23
Mantle	17.52 ± 1.01	14.22 ± 0.75	21.10 ± 1.04	11.02 ± 1.07
HGC	26.24 ± 1.15	20.36 ± 1.33	16.57 ± 1.40	22.17 ± 1.56
Albumen gland	8.63 ± 1.22	6.28 ± 1.72	6.00 ± 0.80	7.71 ± 1.52



Protein Content: Protein levels were highest during pre-reproductive phase, especially in hepatopancreatic gonadal complex (67.23 ± 1.19 mg/100 mg), and decreased during reproductive and post-reproductive phases (Table 2).

Table 2: Seasonal variation in protein content (mg/100 mg dry weight)

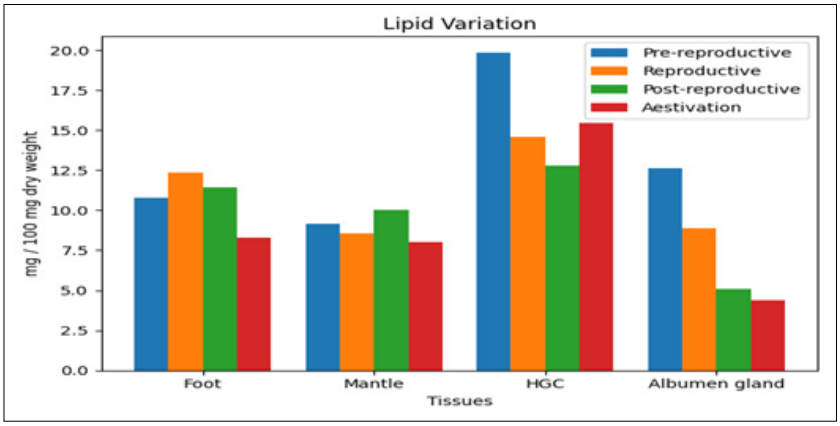
Tissue	Pre-reproductive	Reproductive	Post-reproductive	Aestivation
Foot	46.31 ± 1.14	38.76 ± 1.18	33.81 ± 1.23	35.16 ± 0.21
Mantle	48.16 ± 1.27	32.53 ± 0.10	35.13 ± 0.05	38.37 ± 1.07
HGC	67.23 ± 1.19	51.17 ± 1.19	43.60 ± 1.15	45.82 ± 1.22
Albumen gland	58.87 ± 0.21	31.49 ± 1.10	40.27 ± 1.17	30.11 ± 0.61



Lipid Content: Lipid content showed moderate variation (Table 3). Maximum levels were recorded during pre-reproductive phase, particularly in hepatopancreatic gonadal complex (19.86 ± 2.77 mg/100 mg), and decreased during reproductive phase.

Table 3: Seasonal variation in lipid content (mg/100 mg dry weight)

Tissue	Pre-reproductive	Reproductive	Post-reproductive	Aestivation
Foot	10.79 ± 1.81	12.38 ± 1.38	11.41 ± 1.74	8.31 ± 0.99
Mantle	9.14 ± 1.79	8.55 ± 1.32	10.01 ± 1.44	8.02 ± 1.32
HGC	19.86 ± 2.77	14.56 ± 0.21	12.79 ± 1.18	15.42 ± 0.05
Albumen gland	12.63 ± 0.75	8.89 ± 0.45	5.11 ± 0.28	4.38 ± 0.75



Discussion

The present study demonstrates that biochemical reserves in *M. petrosa* are closely linked with its reproductive cycle. Glycogen serves as a primary energy source and accumulates during pre-reproductive phase, followed by depletion during reproductive activity. Similar observations have been reported in other gastropods (Blackmore, 1969; Lambert and Dehnel, 1974) [2, 8].

Protein levels also showed a decline during reproductive phase, indicating their utilization in gametogenesis and egg capsule formation. This is consistent with earlier studies on molluscs (Nagabhushanam and Kulkarni; 1971 Nanaware and Virute, 1976) [14].

Lipids act as an additional energy reserve and are utilized during reproductive processes such as vitellogenesis. Depletion of lipids during breeding and accumulation prior to aestivation suggests their role in energy storage and survival.

Overall, the study confirms that reproductive activity in *M. petrosa* is an energy-intensive process supported by biochemical reserves accumulated during non-reproductive periods.

Conclusion

Seasonal variations in glycogen, protein, and lipid content in *Macrochlamys petrosa* are strongly correlated with its reproductive cycle. Maximum accumulation of biochemical reserves occurs during pre-reproductive phase, followed by utilization during reproduction and partial recovery before aestivation. The hepatopancreatic gonadal complex plays a key role in storage and mobilization of these reserves. These findings contribute to understanding the physiological adaptations of this pest species.

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