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EFFECT OF CEREBRALECTOMY ON BIOCHEMICAL CONTENT IN THE GONAD OF THE FRESHWATER BIVALVE MUSSEL, *LAMELLIDENS CORRIANUS*, IN DIFFERENT SEASON

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ABSTRACT
Lamillidens corrianus (Shell length 95-110mm) from Nandrabad pond, Aurangabad in different seasons were collected and were acclimatized in laboratory condition for 2 to 3h and surgerical operation were made for removal of cerebral ganglion unilaterally and bilaterally after lapse of 24h. The animals were placed into 3 groups. The biochemical constituent like protein content was determined after 7 days during each season from gonad. The protein content was significantly $p < 0.001$ increased in winter and significantly $p < 0.001$ decreased in summer in control group animal except in bilaterally cerebralectomized group. The lipid content was significantly $p < 0.001$increased in post -monsoon and a significant $p < 0.001$decrease in winter in control group animal except in unilaterally cerebralectomized group. The glycogen content was significantly $p < 0.001$increased in winter and a non-significant decrease in monsoon in control group animal except in unilaterally cerebralectomized group. The seasonal variation in biochemical constituents have been studied in detail in gonads of *Lamillidens corrianus*.

INTRODUCTION

Seasonal changes in protein, glycogen, and lipid content may be of great importance in relation to energy metabolism necessary for growth and reproduction (Jayabal and Kalyani, 1986; Navarro *et al*., 1989; Lodeiros *et al*., 2001). It has been reported that when the organism reaches reproductive maturity, growth slows down as a result of the reproductive investment, and the biochemical composition may change according to the reproductive requirements (Lodeiros *et al*., 2001). 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 (Robinson *et al*., 1981; Sundet and Vahl, 1981; MacDonald and Thompson, 1986; Villalaz, 1994), mussels (Zandee *et al*., 1980) and clams (Robert *et al*., 1993; Urrutia *et al*., 2001). The scallops *Argopecten ventricosus* (Villalaz, 1994), *Chlamys islandica* (Sundet and Vahl, 1981), and *Placopecten magellanicus* (Robinson *et al.,* 1981) stored glycogen and lipids in their adductor muscles and digestive gland, respectively, and used them up in gonadal maturation. The mussel *Mytilus edulis* (Zandee *et al.,* 1980) stored glycogen in mantle and digestive gland during the period of food availability to be used in the gametogenic period. Alternatively, some bivalves (*i.e., Abra alba, Meretrix meretrix)* can obtain energy directly from mental (Jayabal and Kalyani, 1986, Lucas, 1996).

Biochemical component (lipids, proteins, or carbohydrates) fluctuations have been observed in bivalves and related to the reproductive cycle showing which components were the most important source of energy (Martinez, 1991). Bivalves generally store carbohydrates in large amounts during their growing season and use them over the rest of the year (Beukema, 1997); although proteins may be an energy reserve in some bivalve species (Galap *et al*., 1997; Brockington, 2001). Lipid variation has principally been related to gamete development (Martinez, 1991) with the highest huge levels of lipids during the period when gonads are ripe. Quite few variety of literature is available on the relationship between the biochemical content and reproduction in different aquatic invertebrate animals (Wen *et al*., 2006; Laura *et al*., 2008; Kermit *et al*., 2009). Very few literatures are available on the effect of cerebralectomy on biochemical constituent and reproductive cycle (Lubet, 1959, 1965; Nagabhushanam and Mane, 1975). Hence the present study was undertaken to evaluate the impact of cerebralectomy on biochemical content and reproductive cycle in gonad of bivalve freshwater mussel *Lamellidens corrianus*.

MATERIALS AND METHODS

The *Lamellidens corrianus* collected from the pond situated at Nandrabad, 19 km away from Aurangabad during different seasons. The collection of 15 individuals of shell length 95-110mm was brought and acclimatized to the laboratory condition for 2 to 3h. The surgical operations were performed so as to remove cerebral ganglion unilaterally and bilaterally within 30 second. The animals were divided into 3 groups,

non-operated served as the control and the other two groups served as the experimental. The gonads from the three groups of animals were dissected, dried in oven and powdered for subsequent quantitative estimations of proteins, glycogen and lipids. Standard method was employed for estimation of Protein (Lowry *et al*., 1951) Anthrone method (DeZawaan and Zandlee, 1972) for estimation of glycogen and Vanilline method (Barnes and Balakstock, 1973) for estimation of lipids. The values are expressed in mg/100mg of dry tissue.

RESULTS

Impacts of cerebralectomy were studied to determine the biochemical content in gonad of freshwater bivalve mussel, *Lamellidens Corrianus*. The mussel gonads were analyzed to observe the effect of cerebral Ectomy unilaterally and bilaterally respectively. The data were exposed to various statically analysis. Students't' test was used to find out significance. The level of significance was used in the present study ($p < 0.001$, $p < 0.01$ and $p < 0.05$).

Protein

In the gonad of control mussel, the protein level was observed in summer the content was 1.008+ 0.0191showed a significant increase as compared to experimental mussels. In unilateral group mussel the content was0.6332+ 0.0331 and in bilaterally cerebralectomized mussel the protein content was 0.04845+0.0222 respectively

In Monsoon the protein content in control mussel was 74.02% shown an increase level in protein as compared to summer season. In experimental mussel the protein level showed a significant ($p < 0.001$) increase in unilaterally cerebralectomized mussel by 38.93%and a significant ($p < 0.001$) decreased in bilaterally cerebralectomized mussel by 38.32 %.

In post monsoon the protein content was again showed a significant increase by 40.45% in control mussel. In experimental mussel the protein content was significantly decreased by 70.91% and 59.92 %($p < 0.001$) Where as the protein content was maximum in winter season in control mussel as compared to other seasons. But in bilaterally cerebralectomized mussel the content of protein showed a significant increase of 84.30%, in gonad of the freshwater mussel, Lamellidens corrianus.

Glycogen

In the gonad of the control mussel, the glycogen level was found to be 3.0116 ± 0.280, 2.9353 ± 0.4526, 3.289 ± 0.0287 and 11.5913 ± 0.4139 (Table 2) was observed in summer, monsoon, post-monsoon and winter season respectively. The glycogen content in the unilateral cerebralectomized experimental group mussels was found to be decrease in summer, post -monsoon and winter by 34.63%,90.08% and 50.285% was observed .In bilaterally cerebralectomized group mussels the glycogen content was maximum in summer and post- monsoon seasons by 69.32% and 40.48%. Whereas, the glycogen content was minimum in monsoon and winter seasons by 94.26% and 87.78%, when compared to control group mussel respectively.

Lipids

In the gonad of the control mussel, the lipid content was found to be 3.2292 ± 0.7314, 4.2471 ± 0.0496, 5.5452 ± 0.0496 and 2.1989 ± 0.0496 (Table 3) was observed in summer, monsoon, post- monsoon and winter seasons respectively. The lipid content in the experimental unilateral cerebralectomized mussels group found to be decrease in summer, monsoon and winter season by 87%, 55.37%and 70.36% respectively. Where as in post-monsoon season the lipid content showed a significant ($p < 0.001$) increase by 70.56%. In the bilaterally cerebralectomized mussel group the lipid content was found to be maximum in monsoon and post-monsoon season by 92.14%and 67.48% and the lipid content was minimum in summer and winter seasons by 93.50%and 68.48%, when compared to control group mussels, respectively.

DISCUSSION

In the present study we observed the impact of cerebralectomy for determining biochemical contents protein, glycogen and lipids in gonad of freshwater mussel, *Lamellidens corrianus*. The relative content of protein, glycogen and lipids vary seasonally. These changes are principally related to the reproductive cycle and the season maximum shell growth. Similar characteristics have been observed in other bivalves such as *Anomalocardia squamosa* (Morton, 1978*), Donax trunculus* (Ramon *et al*., 1995), *Lyropecten (Nodipecten) nodosus* (Lodeiros *et al*., 2001), *Macoma balthica* (Ankar, 1980), *Mercenaria mercenaria* (Peterson and Fegly, 1986), *Placopecten magellancius* (MacDonald and Thompson, 1986) and *venus verrucosa* (Arneri *et al.,* 1998). 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. 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). Similar conclusions were reported by (Nagawanshi, 1997) from the same pond, 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 (Beukema and De Bruin, 1977; Mann, 1979; Griffiths and King, 1979; Newell and Branch, 1980; Zandee *et al.,* 1980; Jayabal and Kalyani 1986; MacDonald and Thompson, 1986; Navarro *et al.,* 1989; Sukhotin, 1992; 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

Table 1: Changes in Protein content in gonad of *Lamellidens corrianus* after cerebralelectomized animals, UCEl and BCEl groups the values are compared with control group in different seasons

S. No	Seasons	Control Group	UCEl Group	BCEl Group
1	Summer	1.0082 ±0.0191(13.65) ***	0.6332±0.0331(61.80)***	0.4854±0.0222(47.05) ***
2	Monsoon	5.3149 ±0.1106(74.04) ***	10.7078±0.1120 (41.12) ***	5.2494±0.1105 (85.56) ***
3	Post-Monsoon	7.1125 ±0.1105(40.45) ***	5.5494±0.1105 (36.22) ***	4.7672±0.1104(59.92)***
4	Winter	17.5077±0.4421(11.75) ***	15.254±0.1100(69.62)***	17.8225±0.1098(84.30)

Bracket values represents % difference (*p<0.05, **p<0.01, ***p<0.001) and compared to control group. The original values are expressed in mg/100 mg dry weight basis (mean ± S.D.); UCEL- unilaterally cerebralectomized group mussel. BCEL- bilaterally cerebraletomized group mussel

Table 2: Changes in glycogen content in gonad of *Lamellidens corrianus* after cerebralelectomized animals, UCEl and BCEl groups the values are compared with control group in different seasons

S. No	Seasons	Control Group	UCEl Group	BCEl Group
1	Summer	3.01116±0.0280(94.45)	2.6352±0.0281(84.50)***	4.1013±0.0486(69.32) ***
2	Monsoon	2.9353±0.4526(85.95)	6.4195±0.0970(39.30) ***	2.8531±0.0970(+94.26) ***
3	Post-Monsoon	3.289±0.0287(16.78) ***	3.071±0.0280(90.08)	6.9742±0.0280(40.18) ***
4	Winter	11.5913±0.4139(14.40) ***	7.1727±0.0606(50.28) ***	11.2208±0.0560(87.78) ***

Bracket values represents % difference (*p<0.05, **p<0.01, ***p<0.001) and compared to control group. The original values are expressed in mg/100 mg dry weight basis (mean±S.D.); UCEL- unilaterally cerebralectomized group mussel. BCEL- bilaterally cerebralectomized group mussel

Table3: Changes in lipid content in gonad of *Lamellidens corrianus* after cerebralelectomized animals, UCEl and BCEl groups the values are compared with control group in different seasons

S.No	Seasons	Control Group	UCEl Group	BCEl Group
1	Summer	3.2292±0.7314(71.78)	2.9140±0.1000(87)*	3.1239±0.0497(93.50)
2	Monsoon	4.2471±0.0496(71.04)***	2.5623±0.0497(55.37)***	4.3875±0.1313(92.41)**
3	Post-Monsoon	5.5452±0.0496(32.30)**	10.7740±0.0497(70.56)***	7.4053±0.0496(67.48)***
4	Winter	2.1989±0.0496(61.76)***	1.4812±0.0098(68.48)***	2.0989±0.0049(68.48)***

Bracket values represents % difference (*p<0.05, **p<0.01, ***p<0.001) and compared to control group The original values are expressed in mg/100 mg dry weight basis (mean±S.D.); UCEL- unilaterally cerebralectomized group mussel: BCEL- bilaterally cerebraletomized group mussel

condition, 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 and Mane1975.

Glycogen is the primary energy store in bivalves (Banye, 1976 and Gabbott, 1983), and the relative amount of stored glycogen in bivalve tissue is considered a good indicator of body condition (Galtsoff, 1964; Walne, 1970). Under laboratory condition the bivalves' energy store has been decline without proper feeding (Clavin, 1931; Pora *et al.,* 1969, Banye and Thompsons, 1970). The glycogen content in the gonads, of *L. corrianus,* decline in monsoon season in control group mussel. Might, be due to starvation, reproductive stage and drastic environmental conditions and low metabolic rate. In the winter the glycogen content increases in the gonads.

Lipid is an important dietary constituent, serve as reserve energy when food supply is scanty. In stressful environmental conditions, after glycogen lipid is use as energy source (Shigmates and Takeshita, 1959; Chourpagar and Kulkarni, 2011). In the present study the lipid content decline in winter indicate that at the time of fully maturity of gonads the other biochemical content increased and lipid content lower and increased in post monsoon due to the ripening and matured released of gametes.

In The present study, fluctuations in the level of protein, glycogen and lipids content in all the seasons in all the mussel group of due to storage and utilization of the few organic constituents have been closely linked to complex interaction between food supply and temperature and between growth and reproductive cycle. In addition to this starvation effect was also observed. It is tentatively suggested that the cerebral ganglion in perhaps elaborate some factors which trigger the metabolic demand and control reproduction.

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