Yolk utilization in a mangrove crab Sesarma brockii (de man)

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ABSTRACT

It was observed that in Sesarma brockii water and ash contents of the eggs increased, while the biochemical constituents like protein, carbohydrate and lipid decreased with embryonic development. This reflects the depletion of energy sources in the egg as shown by reduction in dry weight (28.530 to 10.720 cal. g dry weight). The cumulative yolk utilization efficiencies of the egg during development were 65.99, 19.22, 23.11, 18.64, 18.03 and 77.95% for the dry matter, organic substances, energy content, protein, carbohydrate and lipid contents respectively. The gross efficiency and energy loss during the embryonic development was 76.88 and 23.12% respectively. Results of the present investigation clearly indicates that lipid is the main food reserve used for embryonic development.

Introduction

Although a few works have been carried out on yolk utilization in brachyuran crabs there is no information available on the embryogenic energetics of mangrove crabs (Amsler and George, 1984; Rao et al., 1984; Pillai and Subramoniam, 1985; Babu, 1987; Kannupandi et al., 1999). Hence, an attempt was made in the present study to understand the changes in chemical composition, ash and calorific content during the embryonic development of mangrove crab, Sesarma brockii.

Materials and methods

Gravid females of S. brockii were collected by hand picking from the supertidal and intertidal areas of Pichavaram mangroves. The crabs were brought to the laboratory and maintained in filtered seawater (25 ±1 ppt; 28 ±1°C). The number of eggs in each brood ranged from 22,000 to 24,000. The egg mass from each crab was slowly released from the secondary egg-bearing pairs of pleopods into a glass slide and the connections between the eggs were removed. The developmental stages of the eggs were noted by observing them under a binocular microscope (10 X 10) and the eggs were separated into stages. For the current study, the following four developmental stages - Blastula, Gastrula, Eye placode and Heartbeat were arbitrarily chosen following the method of Amsler and George (1984). In addition to this, the freshly hatched first zoea was also taken for studying the biochemical changes. Water content was then calculated as the difference between wet weight and dry
weight of the sample.

Ash content was estimated by the method of Paine (1964). Protein, carbohydrate and fat were determined by standard methods of Raymont et al. (1964), Dubios et al. (1956) and Folch et al. (1956) respectively. The data were statistically analysed using one-way analysis of variance (ANOVA).

**Results and discussion**

**Water content**

The study showed an increase in water content of the eggs from stage I to V (Fig. 1). Such an increase in the water content of a developing egg is more common in aquatic organisms than terrestrial forms (Kannupandi et al., 1999). In the present study, water content increased from 48.30 (in eggs) to 80.33% (in larvae). Many researchers reported an increase in water content with advancement in embryonic development and it may be due to the continuous uptake of water from the environment and accumulation of metabolic water during early development of crabs (Amsler and George, 1984; Kannupandi et al., 1999; Veera Ravi, 1999).

**Ash content**

Initial ash content increased from stage I to stage V (Fig. 2) and ‘F’ value was statistically significant (P < 0.05). Similar increasing trends have been reported for crabs like Callinectes sapidus (Amsler and George, 1984) and Paratelphusa hydrodromus (Pillai and Subramoniom, 1985), Oziotelphusa senex senex (Rao et al., 1984), Thalamita crenata (Kannupandi et al., 1999). The increase in ash content indicates active absorption of water and salts from the environment across the embryogenic membrane. Addition of salt during the stages of development is gained either from the yolk or absorbed along the concentration gradient in the marine environment (Kannupandi et al., 1999).

In the present study, total protein, carbohydrate and lipid content decreased during embryonic development (Fig. 2). The protein content of the yolk is important for the tissue differentiation and organization particularly for the cuticle layers, muscles, digestive and nervous systems (Babu, 1987). Kannupandi et al. (1999) reported that the protein in developing eggs are progressively depleted for the possible utilization of protein during embryogenesis to meet the metabolic energy demand.
The total carbohydrate content decreased in all stages from stage I to V. In the early stages of development, carbohydrate content was higher than the advanced stages. So from this it is evident that carbohydrate is utilized for drawing energy at later stages of embryogenesis. (Amsler and George, 1984; Pillai and Subramoniam, 1985).

The lipid content also decreased from stage I to V. The progressive reduction of lipid suggested the possible utilization of the same for embryogenesis. A similar decreasing trend was reported by Amsler and George, 1984; Rao et al., 1984; Pillai and Subramaniam, 1985; Babu, 1987 and Veera Ravi, 1996.

In the present study, there was a decreasing trend in the total protein, carbohydrate and lipid contents as the stage advanced from I to V. The main energy source for the embryonic metabolism in S. brockii was found to be lipid (80.94%), protein and carbohydrate contributed only 29.71% and 19.62% respectively of the total. S. brockii inhabits the intertidal and supertidal areas of Pichavaram mangroves and thus semiterrestrial, accounting for the enhanced lipid utilization rather than that of protein during development. A similar pattern of lipid utilization has been reported for crabs such as C. sapidus (Amsler and George, 1984), and Xantho bidentatus (Babu, 1987).

Gross efficiency and energy loss

The calorific content of the egg steadily decreased from stage I to V. The gross efficiency was 76.88% and the energy loss 23.12% which indicated that the net yolk utilization efficiency as much as 23%. The values obtained in S. brockii are close to those given by Rao et al. (1984) and Pillai and Subramoniam (1985). High yolk utilization efficiency and greater provisions of reserve yolk energy may be regarded as adaptive features to cover the extended period of larval development in the species studied.

Cumulative yolk utilization efficiency

The cumulative yolk utilization efficiencies of the egg during development were 65.99, 19.22, 23.11, 18.64, 18.03 and 77.95% for the dry matter, or-
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References


