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Biochemical Composition of the Eggs of Commercially Important Crab *Portunus pelagicus* (Linnaeus)*

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Abstract: In the present investigation an attempt has been made to know the biochemical composition of matured eggs of *P. pelagicus*. The protein content was found to be 57.00% followed by lipid (14%) and carbohydrate (6.40%). The total values of saturated fatty acids in crab eggs were calculated as 12.78%. Among various saturated fatty acids recorded, the amount of myristic acid (06.36%) was predominant and minimum was capric acid (00.14%). The total amount of monounsaturated fatty acids in the present study was found to be 02.97%. Higher amount of monounsaturated fatty acid was nervonic acid (02.44%) and less amount of fatty acid was palmitoleic acid (00.10%). The total amount of polyunsaturated fatty acids in the present observation was calculated as 12.66%. Maximum amount of fatty acid was reported to be arachidonic acid (07.77%) followed by linoleum acid (01.83%) and minimum was linlelaidic acid (00.02%). From the present study, it is confirmed that the percentage of protein is highest among the biochemical constituents. The percentages of saturated and polyunsaturated fatty acids are high when compared to monounsaturated fatty acids studied in the matured eggs of *P. pelagicus*. Further study is needed to know which biochemical constituents and fatty acids are fairly utilized during embryogenesis and larval development. For this investigation one should study the biochemical changes of different stages of embryogenesis and larval development.

Key words: *Portuns pelagicus*, biochemical composition, PUFA, embryogenesis, MUFA, yolk

INTRODUCTION

In India the consumers mostly prefer bigger crabs viz., *Scylla serrata* and *S. tranquebarica*. But as far as Parangipettai coast is concerned the availability of these bigger crabs are restricted only in summer season. Recently, Samuel *et al*. (2004) documented 12 commercial Portunid crab species along Parangipettai coast. Among 12 commercial species the blue swimming crabs, *Portunus pelagicus* and *P. sanguinolentus* available throughout the year. In recent times the blue swimming crabs are processed and finally sold as a processed food. So demand for these crabs is increasing day-by-day. Although some information is available on the biochemical changes during larval development of crabs (Kannupandi, 1980; Anger *et al*., 1983; Anger and Harms, 1990; Balagurunathan and Kannupandi, 1995). Studies on the biochemical composition of crab eggs are scanty. So study on the biochemical composition of matured eggs are need of the hour. The principle components of most lipids are fatty acids (Castal, 1981). Though the energy requirements is met from the oxidation of fat during embryonic development of crabs the relative proportions of fatty acids accompanying embryogenesis is still unknown. Hence in the present study, biochemical changes and fatty acid profile was investigated in matured eggs of *P. pelagicus*.

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MATERIALS AND METHODS

Berried females of *P. pelagicus* were collected from the Annan Kovil landing center at Parangipettai (Lat.11°26'N; Long.79°48'E). The matured eggs were scrapped off from the brood with the help of scalpel. The eggs were then sun dried for 3 days, properly ground using mortar and pestle and subsequently used for biochemical analysis. The protein, carbohydrate and lipid contents were estimated by adopting the standard methods of Raymont *et al*. (1964), Dubois *et al*. (1956) and Folch *et al*. (1956), respectively.

The fatty and methyl esters of the sample was injected into the gas chromatography (AP5890) capillary column coated with 5% phenyl silicane at a temperature from 170 to 310°C for 23.33 min. Flame ionization detector was used for analysis. Based on the retention time, the different fatty acid samples were identified. Triplicate was maintained for each experiment.

RESULTS

The proximate composition of the matured eggs of *P. pelagicus* is presented in Table 1. The protein, lipid and carbohydrate contents of the *P. pelagicus* eggs were found to be 57.00, 14 and 6.46%, respectively.

The total values of saturated fatty acids in crab eggs were calculated as 12.78%. Among various saturated fatty acids recorded, the amount of myristic acid (06.36%) was maximum followed by and heptadeeanoic acid (02.69%), pentadecanoic acid (01.83%) and minimum was capric acid (00.14%) However total absence was reported for palmitic acid (Table 2).

The total amount of monounsaturated fatty acids was found to be 02.97%. Higher amount of monounsaturated fatty acid was nervonic acid (02.44%) followed by myristoleic acid (00.25%) and eicosenoic acid (00.18%). Less amount of fatty acid was palmitoleic acid (00.10%) (Table 3).

The total amount of polyunsaturated fatty acids was calculated as 12.66%. Maximum amount of fatty acid was reported to be Arachidonic acid (07.77%) followed by linoleum acid (01.83%), esadic acid (1.82%) and linolenic acid (01.11%). Minimum was linlelaidic acid (00.02%) (Table 4).

Table 1: Proximate composition in the matured eggs of *P. pelagicus*

Nutrients	(%)
Protein	57.00±0.02
Lipid	14.00±0.22
Carbohydrate	06.46±0.01

Table 2: Saturated fatty acids in the matured eggs of *P. pelagicus*

Fatty acids	Position of the carbon atom	Crab eggs (%)
Capric acid	C10:0	00.14
Lauric acid	C12:0	00.63
Tridecanoic acid	C13:0	00.18
Myristic acid	C14:0	06.36
Pentadecanoic acid	C15:0	01.83
Palmitic acid	C16:0	-
Heptadeeanoic acid	C17:0	02.95
Heneicosanoic acid	C21:0	00.18
Behenic acid	C22:0	00.51
Total		12.78

Table 3: Monounsaturated fatty acids in the matured eggs of *P. pelagicus*

Fatty acids	Position of the carbon atom	Crab eggs (%)
Myristoleic acid	C14:1	00.25
Palmitoleic acid	C16:1	00.10
Eicosenoic acid	C20:1	00.18
Nervonic acid	C20:1	02.44
Total		02.97

Table 4: Polyunsaturated fatty acids in the matured eggs of *P. pelagicus*

Fatty acids	Position of the carbon atom	Crab eggs (%)
Esadic acid	C18:2	01.82
Linlelaidic acid	C18:2	00.02
Linoleum acid	C18:2:9,12	01.83
Linolenic acid	C18:3:9,12,15	01.11
Arachidonic acid	C20:4:5,8,11,14	07.77
Ecosapentaenoic acid	C24:1	00.11
Total		12.66

DISCUSSION

The proximate composition changes during embryogenesis of crustacea vary according to the yolk materials, ecological conditions in which the animals live and initial egg size. During embryogenesis the crustacean eggs utilize preferentially either protein or fat to meet their energy requirements. Carbohydrate content of the egg is negligible as compared to that of either fat or protein (Shakuntala and Pandian, 1972). Carbohydrate is typically a minor contributor to embryonic metabolism (Holland, 1979). Some of the scientist reported that which biochemical constituents are used during embryogenesis (Kannupandi *et al*., 1999; Kannupandi *et al*., 2003). But in the present study was focused only on eggs not on the different stages of eggs. So it is highly impossible to say which biochemical constituent is utilized for embryogenesis of *P. pelagicus.* So further study is very much needed in this aspect.

In the present study, the protein content of the *P. pelagicus* eggs was found to be 57.00%. The protein content of the yolk is important for the tissue differentiation and organization particularly for the cuticle layers, muscle, the digestive and nervous systems (Babu, 1987). Barnes (1965) and Pandian (1972) reported that the protein in developing eggs is progressively depleted and they also suggested the possible utilization of protein during embryogenesis to meet the metabolic demand. The protein content of the present study is comparable to other studies elsewhere (Vijayaraghavan *et al*., 1976; Amsler and George, 1984; Kannupandi *et al*., 1999).

Lipids are highly efficient source of energy in a way that they contain more than twice the energy of carbohydrates and proteins. In the present study, the lipid content of the matured eggs of *P. pelagicus* was found to be 14.00%. Needham (1950) classified the crustacean eggs as cleidoic and non-cleidoic types of eggs. The cleidoic eggs are not dependent on the environment for water and salt (ash); oxidation of protein is suppressed to considerable extend and fat oxidation is greatly enhanced, serving as main source for the embryonic metabolism. But in non-cleidoic eggs protein is the main energy source for the metabolism. Pandian (1970) reclassified the crustacean eggs into terrestrial, marine and freshwater depending upon the habit. In terrestrial eggs, the protein metabolism is greatly suppressed and the oxidation of fat is high; while in the marine and freshwater eggs, the protein metabolism is prominent. In the crab *Callinectes sapidus*, the utilization of fat was higher than the protein. In rocky intertidal zone beach crabs *Xantho bidentatus* eggs; the utilization of fat was greater than that of protein. During egg development in dermasal marine crustacean eggs, lipid was found to be the main energy source (Pandian and Schmann, 1967; Pandian, 1967; Pandian, 1970, 1972). A similar pattern has been reported for *C. sapidus* (Amsler and George, 1984) and *X. bidentatus* (Babu, 1987). Kannupandi *et al.* (2003) also reported that the utilization of lipid was greater than protein in *S. brockii.*

Carbohydrates constitute only a minor percentage of total biochemical composition. In the present study, the carbohydrate content of the matured eggs of *P. pelagicus* was 6.46%. The amount of carbohydrate in the present study is comparable with other crabs (Kaunupandi *et al*., 1999).

To fuel the major anatomical changes during embryogenesis of crustaceans, the stored energy reserves play a crucial role. These endogenous reserves from the eggs not only provide energy but also important for the biosynthetic precursors to meet the embryonic demands for growth and development (Whyte *et al*., 1993). Two long chain Polyunsaturated Fatty Acids (PUFA), eicosapentaenoic acid and docosahexaenoic acids are nutritionally essential for the eggs and embryos (Kanazawa *et al*., 1979: Langdon and Waldock, 1981; Watanabe, 1982; Levine and Sulkin, 1984) and also for early larval stages (Watnabe *et al*., 1982; De Pauw and Pruder, 1986; Mortensen *et al*., 1988) of fish and shell fish.

In the present study, the total values of saturated fatty acids in *P. pelagicus* eggs were calculated as 12.78%. Among various saturated fatty acids recorded, the amount of myristic acid (06.36%) was predominant and minimum was capric acid (00.14%). Usually palmitic acid was recorded most of the marine animal source. But in the present study this acid was conspicuous absence.

The total amount of monounsaturated fatty acids in the present study was found to be 02.97%. Higher amount of monounsaturated fatty acid was nervonic acid (02.44%) and less amount of fatty acid was palmitoleic acid (00.10%). The monounsaturated fatty acids like eicosenoic acid play an active role in water transport and osmoregulation (Freas and Grollman, 1980).

The total amount of polyunsaturated fatty acids in the present observation was calculated as 12.66%. Maximum amount of fatty acid was reported to be Arachidonic acid (07.77%) followed by linoleum acid (01.83%) and minimum was linlelaidic acid (00.02%). In the present study, PUFA is higher side (16.97%) than MUFA (02.96%) probably is attributed to the fact that the developing eggs require enormous energy for cleavage, gastrulation and cellular differentiation in early stages and organogenesis in the later developmental stages. This finding agrees with Mathavan *et al*. (1986) and John Samuvel *et al*. (1998). According to Subramoniam (1991) the cellular differentiation in mole crab starts soon after gastrulation and requires enormous energy expenditure, which is supposed to be supplied with PUFA.

PUFA of both n-3 and n-6 types are important in biomembranes, particularly in the vascular and nervous systems (Crawford *et al*., 1989; Vergroesen, 1989). Lands (1986) has shown that n-3 fatty acids act as a suppressant to the biosynthetic pathway of prostaglandins, while n-6 fatty acids enhance the path way. The high levels of linolelaidic acid, arachidonic acid in the present study may also be due to the biosynthesis of prostoglandins since, arachiodonic acid is the precursor for the biosynthesis of prostoglandins (Mddleditch *et al*., 1979) and they have structural roles in phospholipids and permeability (Ahigren *et al*., 1992).

From the present study, it is confirmed that the percentage of protein is highest among the biochemical constituents. The percentages of saturated and polyunsaturated fatty acids are high when compared to monounsturated fatty acids studied in the matured eggs of *P. pelagicus*. Further study is needed to know which biochemical constituents and fatty acids are fairly utilized during embryogenesis and larval development. For this investigation one should study the biochemical changes of different stages of embryogenesis and larval development.

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