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RESEARCH ARTICLE

STUDIES ON WATER AND LIPID DISTRIBUTION PATTERN IN *PARATELPHUSA MASONIANA* (HENDERSON) (FEMALE), AN EDIBLE FRESHWATER CRAB FROM JAMMU REGION OF J&K (INDIA).

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Abstract

Studies on the seasonal variation in the lipid and moisture content of body tissues of *Paratelphusa masoniana*, a locally available freshwater crab, of Jammu were conducted for a period of one year (i.e., July 2010 to June 2011). Remarkable variation in the lipid and moisture content of different tissues of *P. masoniana* has been analyzed during the study period. Changes in the lipid content in all the three tissues were observed to be statistically significant ($P<0.05$). The results revealed that moisture content was high when lipid was low during the peak spawning indicating inverse relationship between the two components ($r = -0.4971$; $p>0.05$).

Introduction

The freshwater crabs constitute a great food potential for human. A large part of these shell fish species are cultivated forms. So there is growing need for information about the biochemical composition of these shell fishes. For the cultivation of these shellfishes some important characteristics, such as nutrition properties, biochemical structure and growth conditions need to be known.

Lipids play important roles in the biochemistry, metabolism and reproduction of decapod crustaceans. Neutral lipids, particularly triacylglycerols, are a major energy source, and the predominant form of energy storage in the adult, egg and pre feeding larvae (Middleditch *et al*., 1979; Teshmina and Kanazawa, 1983 and Clarke *et al*., 1985). Phospholipids and sterols have important function as cytoplasm and membrane constituent of cells, affecting structural and physiological properties. Polyunsaturated Fatty Acids (PUFA) are important component of lipids and are essential for marine fish and crustaceans (Sargent *et al*., 2002).

Apart from being a major role of metabolic energy and main form of energy storage, lipids also supply essential fatty acids needed for the maintenance and integrity of cellular membranes and serve as precursor of steroid and molting hormones (Middleditch *et al*., 1980; Harrison, 1990).

Crustaceans use lipid for numerous biological structures and processes (Allen, 1976). Radhakrishnan and Natrajan (1979) while investigating the lipid content in *Podopthalmus vigil* (Fabricus) assessed the values to vary between 5.13 to 9.73%. The most studied decapod crustaceans in term of lipid concentrations and ovarian maturation are penaeid shrimp (Kulkarni and Nagabhushanam, 1979; Middleditch *et al*., 1980; Read and Caulton, 1980; Castille and Lawrence, 1989; Mourente and Rodgiguez, 1991; Lubzene *et al*., 1995). Lipids play important role during the development of decapods crustaceans, not only as energy source, but also as essential nutrients (Kanazawa *et al*., 1985). In crustaceans, the hepatopancreas is generally regarded as a major lipid storage organ. In the case of female crustaceans, ovaries also contain higher levels of lipid than other organs and this suggests that lipids are important for maturation of crustacean ovaries. (Ando *et al*., 1977 and Teshima and Kanazawa, 1983). Lipids play significant role during gonadial growth, maturation and development of decapods crustaceans. They are very important food reserves in the oocytes (Gallager *et al*., 1986; Le Pennee *et al*., 1988).

The present investigation has therefore been carried out to study the variation in the quantity of lipids in muscle of *P. masoniana*. The data may lead to the better understanding of the relative importance of the lipids during reproductive

cycle and during different seasons of a year. It is of great importance to know the seasonal variations of the lipids and moisture content of *Paratelphusa masoniana*, a local freshwater crab of our state.

Study area

Crabs were collected from their natural habitat (Gho-Manhasan stream), at a distance of about 12 kms from University of Jammu, (32˚67/ Lat N; 74˚ 79/ Long E) and were immediately dissected for body meat, claw meat and trash.

Material and Methods

During the present course of study, only adult female crabs (of carapace width 5-6cm) were selected and the juveniles were again released into their natural habitat. The analysis was performed for a period of one year (July 2010 - June 2011). The organic constituents of each component were determined by standard methods such as lipid (Folch *et al*., 1957); moisture (Standard method of AOAC, 1999). The results were expressed on dry weight basis.

Statistical Analysis: The data was analyzed on personnel computer to calculate correlation by Pearson's correlation method, ANOVA to test the level of significance with the help of Microsoft Excel 2003 and SPSS (12.0 Version, Chicago, USA) and mean compared by using Duncan's multiple range test taking $p<0.05$ as level of significance (Duncan, 1955).

Results

The seasonal variation in the moisture and protein content in both male and female crabs has been shown in Table 1.

Lipid (female)

The annual average lipid content in the body meat of *P. masoniana* throughout the year was 4.83±0.61% with minimum (3.99±0.32%) and maximum (5.85±0.46%) values being recorded in the months of July and September respectively.

In claw meat as well, minimum (2.82±0.31%) and maximum (4.01±0.53%) values were recorded in the months of December and April respectively with annual average being 3.38±0.36%.

In trash, minimum (2.51±0.53%) and maximum (4.07±0.28%) values were however recorded in the months of February and May respectively with annual average being 3.69±0.47%.

Moisture (female)

In the body meat, minimum (78.13±1.45%) and maximum (84.23±1.60%) values were recorded in the months of March and July respectively with annual average being 80.98±1.79 %.

In the claw meat, minimum (77.73±1.44%) and maximum (83.58±1.55%) values were also recorded in the months of March and July respectively with annual average being 79.66±1.58%.

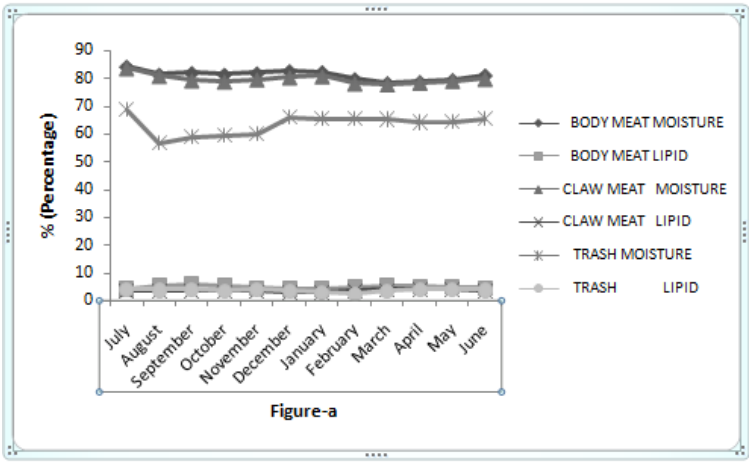
In trash however, minimum (56.75±1.12%) and maximum (68.53 ±1.22%) values were however recorded in the months of August and July respectively with annual average being 63.28±3.57%.

Table 1: Showing monthly variation in the lipid and moisture content of *P. masoniana* (female)

Month	Body meat		Claw meat		Trash	
	Moisture	Lipid	Moisture	Lipid	Moisture	Lipid
July	84.23±1.60^{a}	3.99±0.32^{d}	83.58±1.55^{a}	3.17±0.36^{abc}	68.53±1.22^{a}	3.95±0.28^{a}
August	81.30±1.53^{bcd}	5.45±0.43^{ab}	80.80±1.54^{b}	3.46±0.54^{abc}	56.75±1.12^{d}	3.81±0.27^{a}
September	81.90±1.61^{abc}	5.85±0.46^{a}	79.20±1.19^{bcd}	3.32±0.54^{ab}	58.70±1.27^{cd}	3.92±0.81^{a}
October	81.29±1.57^{bcd}	5.33±0.19^{ab}	78.78±1.39^{bcd}	3.15±0.59^{abc}	59.43±1.10^{c}	3.79±0.46^{a}
November	81.76±1.48^{abcd}	4.41±0.53^{cd}	79.56±1.46^{bcd}	3.12±0.25^{abc}	60.00±1.15^{c}	3.98±0.52^{a}

December	82.56±1.40^{ab}	4.08±0.40^{d}	80.30±1.52^{bcd}	2.82±0.31^{c}	66.00±1.28^{b}	3.70±0.53^{a}
January	82.20±1.65^{abc}	4.22±0.54^{cd}	80.69±1.45^{bc}	3.02±0.32^{bc}	65.19±1.30^{b}	2.91±0.34^{b}
February	79.61±1.55^{cdef}	4.76±0.54^{bcd}	78.08±1.36^{cd}	3.54±0.56^{abc}	65.23±1.19^{b}	2.51±0.53^{b}
March	78.13±1.45^{f}	5.49±0.38^{a}	77.73±1.44^{d}	3.72±0.60^{ab}	65.15±1.23^{b}	3.78±0.53^{a}
April	78.53±1.40^{ef}	5.03±0.28^{abc}	78.35±1.50^{bcd}	4.01±0.53^{a}	64.03±1.29^{b}	3.91±0.63^{a}
May	79.28±1.61^{def}	4.84±0.63^{bcd}	79.04±1.37^{bcd}	3.86±0.34^{ab}	64.17±1.21^{b}	4.07±0.28^{a}
June	80.98±1.57^{bcde}	4.44±0.51^{cd}	79.76±1.54^{bcd}	3.38±0.35^{abc}	65.23±1.19^{b}	3.89±0.66^{a}
Annual Average	**80.98±1.79**	**4.83±0.61**	**79.66±1.58**	**3.38±0.36**	**63.28±3.57**	**3.69±0.47**

- Data presented above is the mean of three readings i.e, Mean±S.D
- Values having the same superscript do not differ significantly (P> 0.05)



Graph showing seasonal variation in the lipid and moisture content of *P. masoniana* (female)

Discussion

In the present study, two peaks in the muscle lipid content are observed in the month of March (5.49±0.38%) and September (5.85±0.46%) for body meat and in the months of August (3.46±0.54%) and April (4.01±0.53%) for claw meat in female crab. There is however, no such significant variation in the trash of female crab. In general, the high values for lipid were observed during non-spawning season. The cycles of storing lipid are directly connected with food abundance. If there is scarcity of food in their environment the variation is low, but if it is abundant, the variation is higher during the year. (Ackman and Eaton, 1976; Kluytmas and Zandee, 1973; Kinsella *et al*., 1977; Mute *et al.*, 1989. Much more energy is needed during the development of gonads; so plenty of food must be available in that period (Wang *et al*., 1990).

The high lipid content observed in spring and post-monsoon could be attributed to active feeding and optimum availability of food, as algal blooms and plankton are reported to acquire maxima during this period (Sharma, 2005). The lipid content however showed a declining trend towards May to July and November to January and an increase during August to October and February to April. The decline in lipid content during spawning period was possibly due to mobilization of lipid as energy source to meet the high energy demands, during the act of ovulation and spawning on one hand (Ackmon, 1976; Gill and Weatherley, 1984; Akpman, 1987a; Stansby *et al*., 1990; Aggelousis and Lazos, 1991) and due to low feeding intensity and low availability of food items on the other.

The studies showed that the amount of total lipid in *P.masoniana* reached maximum level during non-spawning but that amount diminished during spawning / reproductive season of the species. Based on present observation, *P.masoniana* appears to be a biannual breeder i.e., it breeds twice.

Similar reports on energy mobilization in fishes during spawning seasons have previously been made by Jafri and Khawaja (1968), Love (1970), Diana (1983), John and Hameed (1995), Vanden Thillart *et al.* (2002), Kilne and Willet (2002), Jonsson and Jonsson (2005), Nargis (2006) and Zaboukas *et al* (2006). In the present study, it has been observed that male crabs have average higher lipid content than female crabs. Our results are in contradiction with the findings of Clarke (1980) wherein lipids were found to be the most variable fraction and males of marine invertebrates were found to have a lesser lipid content. Lipid and water percentages in male and female crabs are shown in fig 1.

There is significant variation in the moisture content throughout the period of investigation. Comparatively high values of water content were recorded during July (monsoon) and December (winters) which may be due to the breeding period of the animal. High water content has also been recorded during breeding season (Pillay and Nair, 1970 and Farragut and Thompson, 1965). It can be presumed that *Paratelphusa masoniana* developed gonads at this time of the year.

High moisture content has been reported during spawning after which it followed a decline. Similar trend has been shown in *Mugil cephalus* where the authors opined that high values of moisture content could be due to decline in food intake during the monsoon months (Das, 1978). It has been observed that the fluctuation of the water content is mainly affected by the reproductive cycle and after the spawning-period, high amount of water content was noticed during monsoon months which was probably due to the low salinity prevailing in the habitat (Tagore, 1990). Similar trend has been reported in somatic tissues of Atlantic bonito wherein water content increased with gonadal maturation (Stage III, IV and V i.e. 72.77%, 76.63%, 77.40%) and decreased after spawning (Stage VI 73.90%) being about lowest in immature bonitos(Zaboukas *et al*., 2006).

The values for moisture content so obtained in *P. masoniana* are well within the range reported for other species of finfishes and shellfishes viz., *Tor putitora*–77.98% and *Labeo rohita*–78.37%, *Mystus seenghala* - 75.52%, *Channa punctatus*–76.43% (Jafri and Khawaja, 1964) , *Carcinus maenus*–79.0 07 % to 82.3+0.5% (Naczk *et al*., 2004), *S. tranquebarica*–73.5 to 81.8% in body meat, 73.5 to 80.16% in claw meat, 73.23 to 79.6% in leg meat(Thirunavakkarasu, 2005), *M.dayanum*–79.14% and *M.kistensis*–80.84%(Langer *et al*., 2007).

The lipid content in the present species is comparatively low as against higher values recorded by finfishes. Higher values of lipid content have been reported in *I. crenata* (5.4 -15.6%) by Mercy Thomas (1985) and *P. vigil* (16.8–31.9%) by Radhakrishnan (1979). Thus, the candidate species has been placed in a better quality food list for human beings. Present observations revealed tha*t P.masoniana* has higher lipid content than those reported for other species of shell fishes viz., *M. rosenbergii*: 3.37, *Scylla tranquebarica: 1.8-2.7%*, *Scylla serrata*: 0.21% (Gopakumar, 1993 Ed.). The significance of such high lipid level, however, can be specially established only if their complete lipid profiles are determined.

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