

Biochemical Status of Edible Palaemonid Prawn *Macrobrachium idella idella* (Hilgendorf, 1898)

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Abstract: The freshwater prawn, *Macrobrachium idella idella* is dominant in the Vellar estuary during October-December. The local communities are eating *M. idella idella* during the above period without knowing its nutritional value. But practically no information is available on the biochemical composition during different phase of growth in palaemonid prawns in general and *M. idella idella* in particular. So in the present study, proximate composition (protein, carbohydrate, lipid, ash and moisture) and fatty acids were studied in different size groups and sexes of *M. idella idella*. In general, the protein content was higher in younger ones than in adults. The total values of saturated fatty acids were maximum in females (34.81%) than in males (28.49%). Among various saturated fatty acids recorded, the amount of oleic acid (C18:1n9c) in both sexes was more. As in saturated fatty acids the total amount of monounsaturated fatty acid also shows maximum in females rather than males. The total amount of polyunsaturated fatty acids of *M. idella idella* is minimum than monounsaturated fatty acids and saturated fatty acids. The present study clearly indicated that the nutritive value of *M. idella idella* is very well comparable to the edible species of decapod crustaceans already studied (shrimp, prawns, and lobsters). Considering the above results from the nutritional point of view, *M. idella idella* can be very well used as food and perhaps as a candidate species in future for culture.

Key words: *Macrobrachium idella idella*, protein, carbohydrate, lipid, moisture and fatty acid

INTRODUCTION

The role of nutrition and diet in human health has been well established, but it has only recently become popular for a large segment of the Indian population to actively select foods for health maintenance and disease prevention. The current wave of scientific and popular literature which correlates traditional, cultural diets with the incidence of disease has brought seafood to the attention of the health-conscious to the public. Epidemiological studies have shown that those cultures which predominantly consume sea food have low incidence of heart attacks (Lands 1986; Nettleton, 1985). Prawn/shrimps have become the major source of animal protein to the low income earners due to its low price and availability (Adeyeye, 1996). However, the chemical composition and functional properties of prawns have not been reported. These studies and their implications have generated considerable interest to do biochemical composition in *M. idella idella* which commonly consumed by the local communities in Parangipatti area. So the present study is carried out to evaluate and update the nutritional value of *M. idella idella* at different sexes and size groups which are helpful for the selection and utilization of a particular species and also to know which size group will be adequate and advantageous for consumption from the nutritional point of view.

MATERIALS AND METHODS

Collection: The prawn, *M. idella idella* was collected from Ponanthittu (Lat.11°28'50.50°N; Long. 79°45'28.23°E) waters which is located 2 km south to Parangipettai and connected with Vellar estuary during October 2008. The prawns were caught by the fisherman with the help of trap, line and hand-net and scoop net. The specimens were collected from fisherman as the sizes of the collected specimens were ranged from 30 to 125mm in length. Totally 210 specimens were collected and transported to the laboratory in live condition by keeping them in bucket containing freshwater and aeration. After reaching the laboratory they were washed carefully with distilled water to remove dust and algal particles and ice killed. Then they were separated in to three groups viz., male, female and berried. Further grades were made according to the size and each group were graded in to nine size groups at 10 mm intervals. After grading, the exoskeleton were peeled out and homogenized with pestle and mortar. The grounded samples were then freeze dried and powdered and stored in refrigerator for further analysis. In the present study the maximum size caught in both males and females (70-80 mm) were subjected to fatty acid analysis.

Analysis of Proximate composition: 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 difference in weight between wet and dried tissue represented the weight of water in the body tissue, which is expressed as percentage. Ash was estimated by incinerating the pre- weighed test material (1 g dry weight in a mettle turn ace at 560°C for a period of 5 h). The residue was weighed and the percentage was calculated. The fatty and methyl esters of the sample was injected into the gas chromatography (GC-6890) capillary column coated with 5% phenyl silicone at a temperature from 170 to 300°C for 23.33 min. Flame ionization time, the different fatty acid samples were identified. Triplicate was maintained for each experiment.

Statistical Analysis: The data were subjected to One-way analysis of variance (ANOVA) and difference between means were determined by Duncan's multiple range tests ($P < 0.05$) using SPSS version 17.0.

RESULTS

The proximate composition of different sexes and size groups of *M. idella idella* are presented in Table 1. Data on the size groups of 96-125 mm females and berried females were not reported in the table, because lacking of specimen in that size groups.

Protein: The protein content was maximum in males (64.28%) in the size groups of 46-55 mm. While minimum was (58.60%) recorded in the size group of 86-95 mm. The females showed highest protein content (61.86%) in the size groups of 35-45 mm and lowest protein content (58.36%) was in the size groups of 86-95 mm. The protein content in berried females was ranged from 57.16% to 60.54% in the size groups of 76-85 and 35-45 mm respectively (Fig. 1, 3 and 5). The protein content was statistically significant between different size groups and sexes (Table 1).

Carbohydrate: In males, the carbohydrate values varied between 1.93% in 66-75 mm size groups and 3.32% in 106-115 mm size groups. Likewise in females, it fluctuated between 1.87% in 46-55 mm size groups and 2.47% in 76-85 mm size groups. In berried females it ranged from 1.80% in 56-65 mm to 2.33% in 66-75 mm size groups (Fig. 2, 4 and 6). In general, carbohydrate content was significantly more in males and that was followed by females and berried females. The differences were statistically significant (Table 1).

Lipid: The lipid content was maximum in males (5.60%) in the size groups of 96-105 mm. While minimum lipid was recorded (3.53%) in 46-55 mm size groups. In females showed highest lipid content of 5.88% in 76.85 mm size groups and lowest lipid values (3.98%) was in 66-75 mm size groups. The lipid content in berried

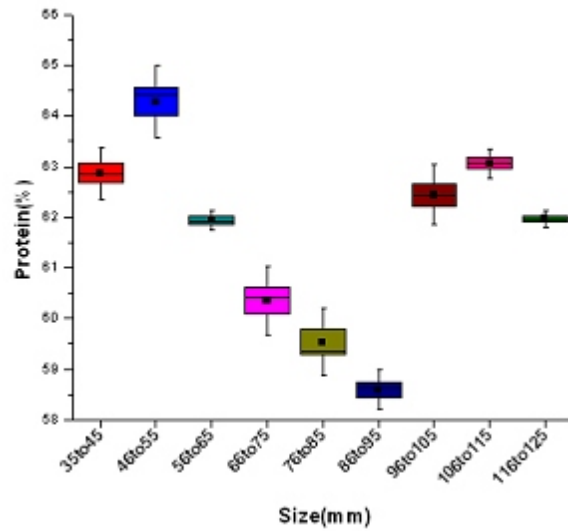


Fig. 1: Protein content in different size groups of males (Box represents SE, Whiskers SD and mean)

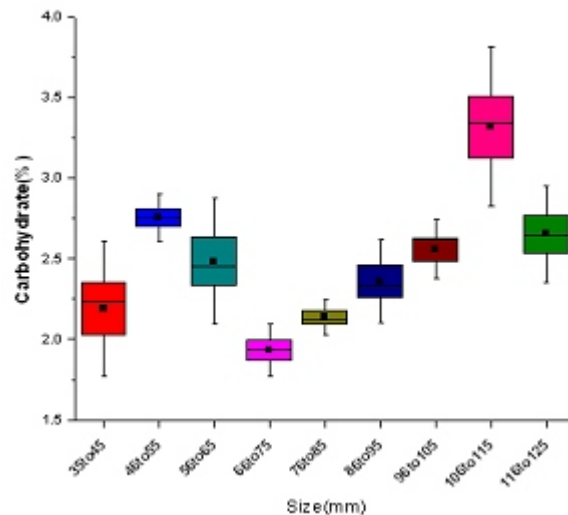


Fig. 2: Carbohydrate content in different size groups of males (Box represents SE, Whiskers SD, mean)

females was ranged from 3.18 to 4.73 % in 46-55 and 86-95 mm size groups respectively (Fig. 7, 8 and 9). The lipid content was maximum in males and minimum in berried females and that difference were statistically significant (Table 1).

Ash: Ash content showed an increasing trend from young ones to adult for both males and females. The maximum ash content was recorded in males (6.83%) in the size groups of 116-125 mm, while the minimum ash content was (5.17%) recorded in 35-45 mm size groups. In females, showed highest level of ash content (6.58%) in the size groups of 86-95 mm and lowest ash values

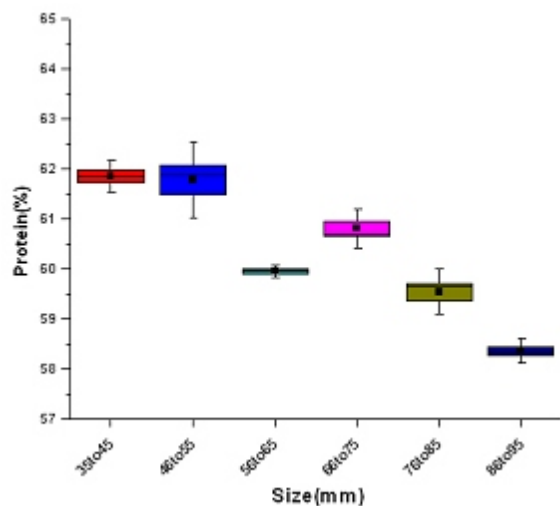


Fig. 3: Protein content in different size groups of females (Box represents SE, Whiskers SD, mean)

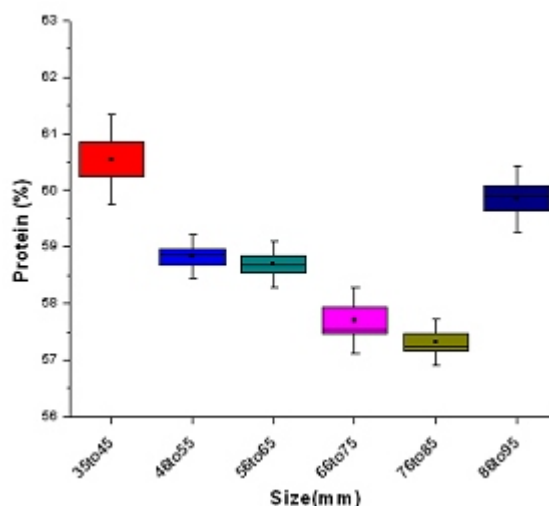


Fig.5: Protein content in different size groups of berried females (Box represents SE, Whiskers SD, mean)

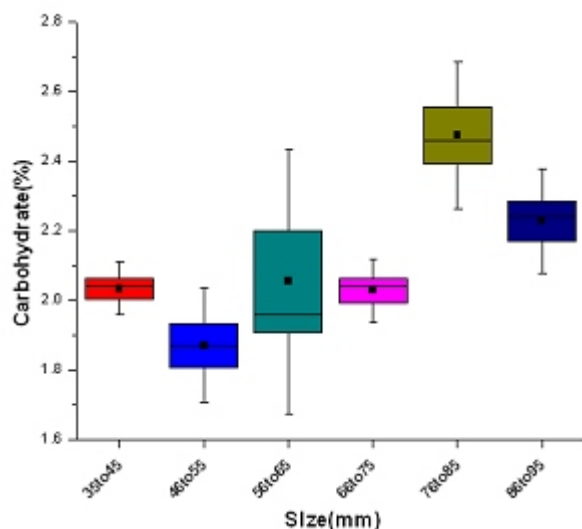


Fig. 4: Carbohydrate content in different size groups of females (Box represents SE, Whiskers SD, mean)

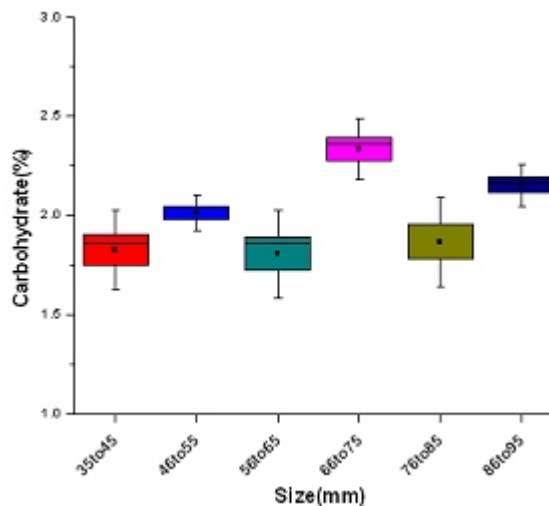


Fig. 6: Carbohydrate content in different size groups of berried females (Box represents SE, Whiskers SD, mean)

Table 1: Proximate composition values are mean of three values \pm SE in the muscle tissues of male, female and berried females of *M. idella idella*

Constituents	Male	Female	Berried
Protein	61.67 ^a \pm 0.34	60.39 ^b \pm 0.31	58.82 ^c \pm 0.28
Carbohydrate	2.49 ^a \pm 0.08	2.11 ^b \pm 0.05	2.00 ^c \pm 0.05
Lipid	4.59 ^b \pm 0.13	4.73 ^a \pm 0.15	3.88 ^c \pm 0.13
Ash	6.31 ^b \pm 0.11	5.95 ^c \pm 0.15	6.49 ^a \pm 0.13
Moisture	80.97 ^a \pm 0.21	78.57 ^c \pm 0.21	80.58 ^b \pm 0.29

Different superscripts in a rows are significantly different (P<0.05)

(5.02%) was in 35-45 mm size groups. The ash content in berried females was ranged from 5.48 to 6.86% in 35-45 and 76-85 mm size groups respectively (Fig.10, 11 and 12). The ash content in different size groups and sexes were shown significant variation (Table 1).

Table 2. Saturated fatty acids (%) of *M. idella idella*

Fatty acids	Female 70-80(mm)	Male 70-90(mm)
C12:0	0.64	ND
C14:0	3.53	2.33
C15:0	1.53	1.14
C16:0	26.87	20.23
C17:0	2.24	1.13
C18:0	7.80	3.66
Total	34.81	28.49

ND: Not Detected

Moisture: The moisture content in males was ranged from 79.52 to 82.64% in 46-55 and 96-105 mm size groups respectively. The females showed higher water content of 80.14% in 46-55mm size groups and lower water content of 77.58% in the size groups of 76-85 mm.

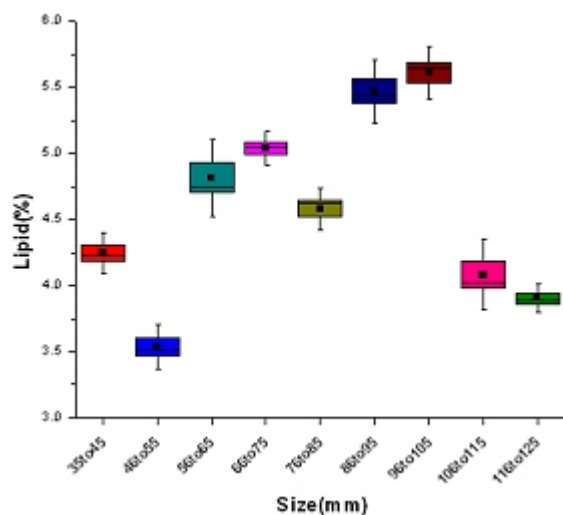


Fig. 7: Lipid content in different size groups of males (Box represents SE, Whiskers SD, mean)

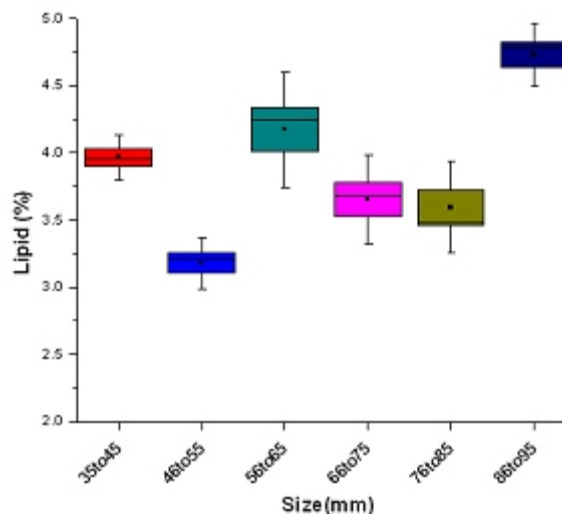


Fig. 9: Lipid content in different size groups of berried females (Box represents SE, Whiskers SD, mean)

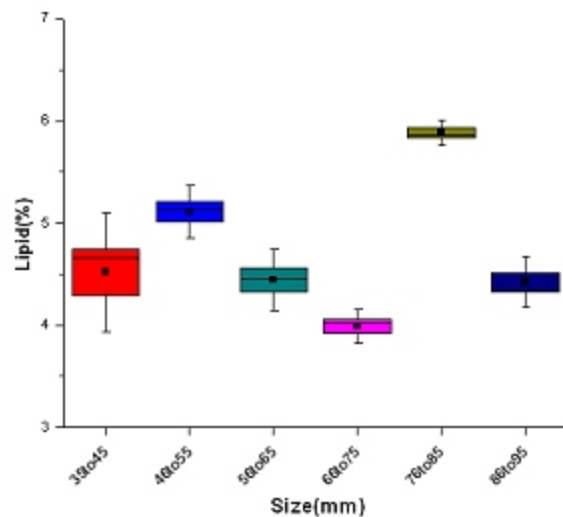


Fig. 8: Lipid content in different size groups of females (Box represents SE, Whiskers SD, mean)

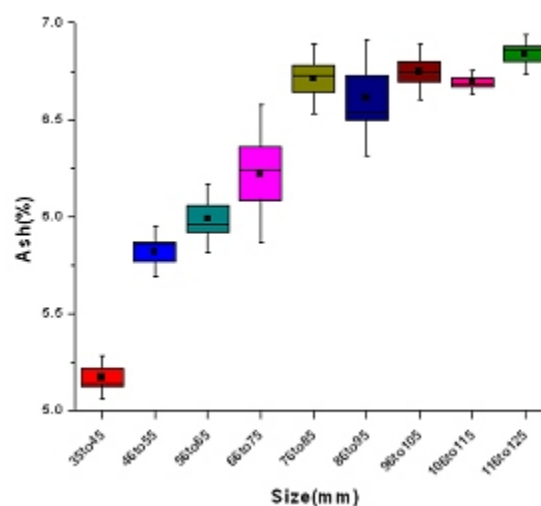


Fig. 10: Ash content in different size groups of males (Box represents SE, Whiskers SD, mean)

Table 3. Monounsaturated fatty acids (%) of *M. idella idella*

Fatty acids	Female 70-80(mm)	Male 70-90(mm)
C15:1n5c	ND	0.86
C17:1n8c	0.72	0.64
C18:1n9c	17.81	12.51
C18:1n7c	3.78	2.98
Total	22.31	16.99

Table 4: Polyunsaturated fatty acids (%) of *M. idella idella*

Fatty acids	Female 70-80(mm)	Male 70-90(mm)
C18:2n6c	9.32	7.45
C18:3n6c	0.68	0.52
C20:2n6c	0.46	0.53
C20:4nc	7.56	3.89
Total	18.02	12.39

Berried females exhibit a minimum water content of 78.61% in 35-45 mm and maximum values of 82.35% in

the size groups of 76-85 mm (Fig. 13, 14 and 15). The water content in different size groups and sexes were statistically significant (Table 1).

Fatty acids: Fatty acid analysis was carried out only in maximum sized males (70-90 mm) and females (70-80 mm). The total amount of saturated fatty acids present in the males was 28.49% and females it was 34.81%. Among total 6 individual saturated fatty acids reported, the C16:0 acid was maximum in both females (26.87%) and males (20.23%). However C12:0 acid was reported minimum and present only in females (Table 2). The total amount of monounsaturated fatty acids was minimum in males (16.99%). Whereas in females it was about 23.31% (Table 3). C18:1n9c fatty acid was found to be maximum

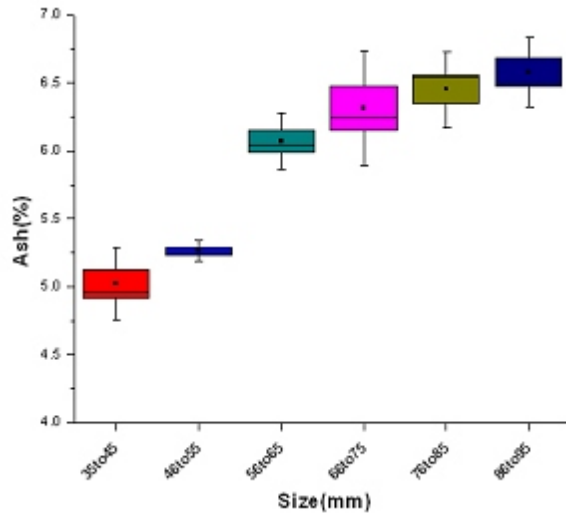


Fig. 11: Ash content in different size groups of females (Box represents SE, Whiskers SD, mean)

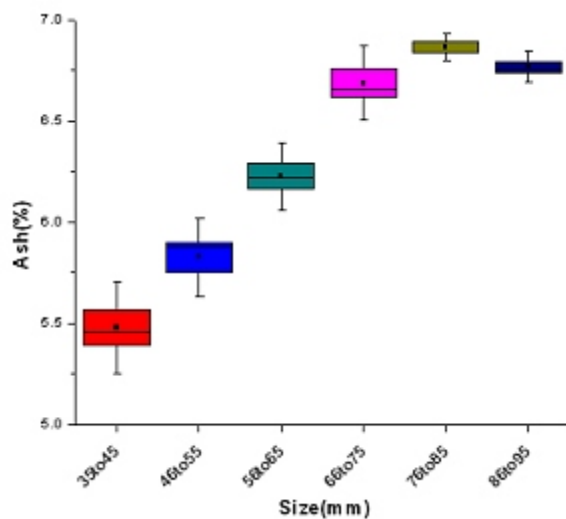


Fig. 12: Ash content in different size groups of berried females (Box represents SE, Whiskers SD, mean)

than any other monounsaturated fatty acids in both males and females. But it was dominated in females (17.81%) rather than in males (12.51%) (Table 4). The total amount of polyunsaturated fatty acid was recorded maximum in females (18.02%) than in males (12.39%).

DISCUSSION

Biochemical composition of any organisms are known to vary with season, size of animal, stages of maturity and availability of food, temperature etc (Soundarapandian and Ananthan, 2008). Protein is the most prominent biochemical components of crustaceans from eggs to adult and is strikingly dominant in younger phases. The quantity of protein in shrimps is largely

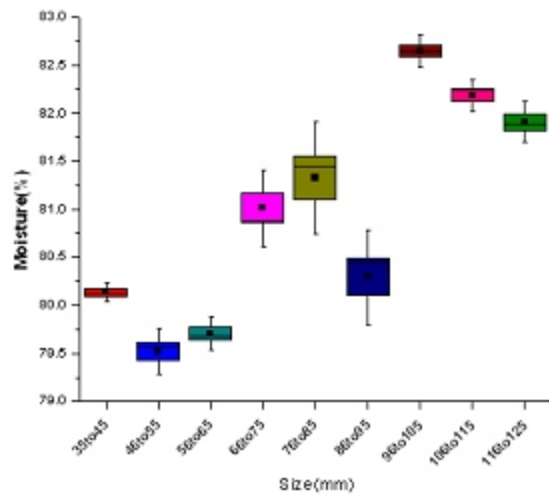


Fig. 13: Moisture content in different size groups of males (Box represents SE, Whiskers SD, mean)

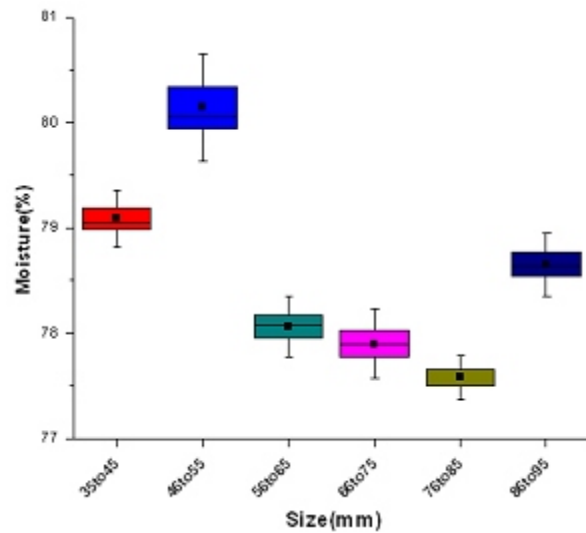


Fig.14: Moisture content in different size groups of females (Box represents SE, Whiskers SD, mean)

influenced by the extent of fat and water content. In the present study, males were found to have significantly more protein than females. The fall in protein content, which is very well pronounced in females suggested that the protein in the muscle may be mobilized for the gonadal development. The same trend was observed by Sriraman (1978) in shrimp, *Penaeus merguensis* and in fresh water prawn, *M. idae*. In contrary, females of *P. indicus* and *Metapenaeus monoceros* were increasingly proteinacious than males. Garg *et al.* (1977) reported that the protein content in *Squilla* was varied from 70.09 to 75.46% and in Jawla prawn from 61.93 to 72.64%. Nair and Prabhu (1990) showed that protein content in *M.dobsoni* was 65.25% and in *Acetes* sp. was 66.98%. According to Sambhu and Jayaprakash (1994) the protein level in *P. indicus* was varied from 44.62 to 80.87%. The

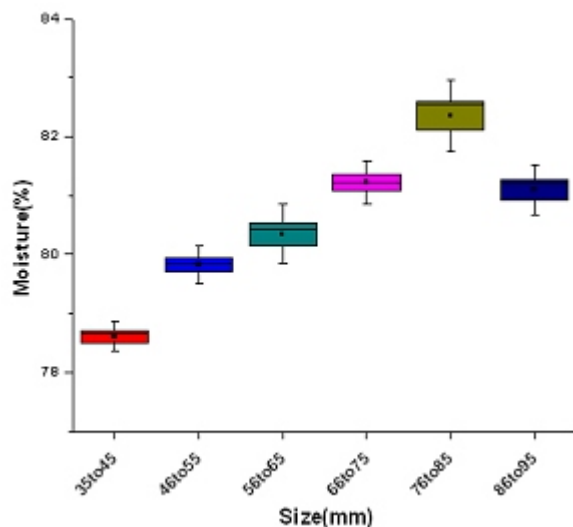


Fig. 15: Moisture content in different size groups of berried females (Box represents SE, Whiskers SD, mean)

protein content was ranged between 58.17 to 64.15% in *M. malcolmsonii* (Soundarapandian and Ananthan, 2008). *M. idae* showed greater variation in protein (Sriraman, 1978) with regard to size group, protein content was higher in younger organisms than in adults. The high protein content in the lowest size groups may be attributed to increased protein synthesis during the active growth phase as it has been observed elsewhere in shrimps and mantis shrimps (Achuthan Kutty and Parulekar, 1984; Ajit kumar, 1990; Tanuja, 1996). The protein content was maximum in small sized males of *M. scabriculum* 59.15% (Amrendra Kumar Tiwary, 2009) and *M. idae* 61.44% (Saunak Kumar Chandra, 2009). The present study also showed higher protein content in younger ones than in adults. Among females, non-berried females showed higher values than berried females. This is mainly due to the intake of protein for the development of eggs in berried females. Protein was significantly varied between sexes and size groups.

Carbohydrates constitute a meager percentage of the total biochemical make up in *M. idella idella* muscle when compared to protein and ash contents. Carbohydrate content exhibited an inverse relationship with protein content. Similar findings were recorded by Sriraman (1978), Nair and Prabhu (1990), Reddy and Shanbhogue (1994), Sambhu and Jayaprakash (1994), Soundarapandian and Ananthan (2008). The rise in carbohydrate content was gradual among the small size groups and the peak value was observed in the bigger size group, which may be due to more synthesis and accumulation of carbohydrates in the higher size groups than in the younger ones. Various factor like gonad development in addition to starvation, feeding, rest, exercise and other physiological states changes the carbohydrate level. Presently the higher values

encountered in larger organisms might be due to storage and senility in them. No distinguished trend in carbohydrate fluctuation was noticed among the size groups of many shrimps studied by Achuthan Kutty and Parulekar (1984) and Ajit kumar (1990). In the present study the males shown significantly higher carbohydrate values than in females and among females, non-berried females showed significantly higher carbohydrates, which is agreement with the studies of Ajith kumar (1990), Amrendra Kumar Tiwary (2009) and Saunak Kumar Chandra (2009).

In general, lipid act as major food reserves along with protein and subjected to periodic fluctuations influenced by environmental variables like temperature (Johnstene, 1917). The wide fluctuations in lipid composition have been reported to occur both in hepatopancreas and gonads of prawns during gonadal development (George and Patel, 1956; Gopakumar and Nair, 1975). But this does not affect the lipid composition of muscle tissue to any great extend. Shaikhmahmud and Magar (1957) obtained higher lipid content in mature females of *Parapanaeopsis stylifera* when compared to immature ones. Gopakumar and Nair (1975) did not find any variation in the lipid content of muscle tissue of five species of penaeid shrimps. Kutty and Parulekar (1984) also did not find any consistency to suggest that maturity condition influences the lipid composition of muscle tissue. A similar result was reported in *M. scabriculum* by Tiwary (2009) and in *M. idae* by Chandra (2009).

Many publications are available regarding fat and protein values having inverse relationship between lipids and protein was earlier reported by George and Patel (1956), Pillay and Nair (1973), Sriraman (1978), Radhakrishnan (1979) and Pillai and Nair (1973) marked an inverse relationship between lipids and moisture content. The amount of proteins was influenced by extent of fat and water content .

Ash is one of the least studied biochemical constituents in crustaceans. Sriraman and Reddy (1977) observed slight increase in ash content with increase in size of juveniles in *P. monodon*. In the present study also signals a marginal and gradual rise in the ash composition of muscle regardless of sex. Similar marginal increases in ash during growth were also reported by Kutty and Parulekar (1984) in *P. stylifera* and *M.affinis* and Ajithkumar (1990) in *M. idella*. Nair and Prabhu (1990) reported that ash composition in *M. dobsoni* was 15.79% and in Jawla prawn (*Acetes* sp.) was 17.11%. Almost similar values were obtained by Tiwary (2009) and Chandra (2009) in *M. scabriculum* and *M. idae* respectively. The present study reflected that increased ash content was noticed in increased size groups, regardless of sex. The significant difference of ash content among males, berried and non-berried females is also noticed.

In the present study the moisture content in males was ranged from 79.52% to 82.64%. In berried females it was ranging between 78.61 to 82.35%. In females the water content was varied from 77.58 to 80.14%. Almost similar values of water content were reported in *M. malcolmsonii* (Soundarapandian and Ananthan, 2008). But in *M. scabriculum* (Tiwary, 2009) and *M. idae* (Chandra, 2009) berried females had little bite more moisture content than to male and females.

In the present study the values of saturated fatty acids are maximum in females (34.81%) than in males (25.49%). Among various saturated fatty acids recorded, the amount of palmitic acid in both sexes was more. But when compared with males (18.23%) the females had more (26.87%). Murugesan (2007) also reported maximum amount of palmitic acid (20.09%) in *C. lucifera*. Similar results were also observed in *M. scabriculum* and *M. idae* by Tiwary (2009) and Chandra (2009).

As in saturated fatty acids the total amount of monounsaturated fatty acids are maximum in females. Among mono-unsaturated fatty acids studied, Oleic acids are higher in females (17.81%) than in males (11.51%). In general the total amount of polyunsaturated fatty acids of *M. idella idella* was minimum than monounsaturated fatty acids and saturated fatty acids. The total amount of fatty acids were more in females when compared to males, it may be due to the storage of lipids for the development of ovaries. Similar results were reported in *M. scabriculum* (Tiwary, 2009) and *M. idae* (Chandra, 2009).

In the present study the fatty acids having carbon atoms above 20 could not be identified by the instrument. So the rest of the fatty acids in the *M. idella idella* were not detected. Further detailed study on fatty acid profile using advanced and versatile instrument is suggested. From the present observation, it could be conformed that *M. idella idella* is not inferior in terms of nutritive value of already studied decapod crustaceans. So *M. idella idella* is suggested to introduce in aquaculture practices as an alternative to bigger sized prawns like *M. rosenbergii* and *M. malcolmsonii* if necessity arises.

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