International Journal of Advanced Science and Research
ISSN: 2455-4227
Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 3; Issue 1; January 2018; Page No. 11-15

Biochemical composition of the of mud crab *Scylla serrata* (Forskal) of Coringa mangroves, Andhra Pradesh, India

[1] Vijaya Bharathi T, [*2] Myla S Chakravarty, [3] PRC Ganesh
[1] State Institute of Fisheries Technology, Jagannaickpur, Kakinda, Andhra Pradesh, India
[2, 3] Andhra University, Dept. of Marine Living Resources, College of Science and Technology, Visakhapatnam, Andhra Pradesh, India

Abstract
The biochemical constituents of muscle and hepatopancreas – carbohydrates, proteins and lipids of the mud crab in *Scylla serrata* of Coringa mangroves in relation to sex, size and season have been studied. Muscle carbohydrates were almost similar between male and female but in hepatopancreas it has shown minor variation in females and high carbohydrate content was observed in the 4th quarter of the study period. The protein content of muscle in males and females were 31.98 % and 31.97 %, and in hepatopancreas it was 15.23 % and 12.75 %. Proteins of muscle and hepatopancreas showed an increasing trend with the increase in size of the crab and high protein content was noticed in all the size classes of male crabs, in the last quarter of the year (October, November & December) and low levels during the second quarter of the year (April, May & June). The average lipid content in muscle was similar in both males and females. A gradual increase in lipid content was observed with the increasing size of the crab and hepatopancreatic lipids are more than those of the muscle.

Keywords: mud crab, *Scylla serrata*, muscle, hepatopancreas, biochemical composition

1. Introduction
The nutritional value of different species of fish and shellfish depend on their biochemical composition such as carbohydrates, protein, lipids vitamins, minerals etc. Water, protein, fat, carbohydrates, vitamins and minerals are the main constituents of fish and shellfish [1]. Crabs are the good source of protein [2, 3]. The meat of crab is high nutritional quality when compared to that of mutton, chicken, duck and fish [4, 5, 6] Crabs may be treated as important sea food, since they contain proteins of superior nutritional properties [7]. Biochemical composition of a species varies with sex, season, and stage of maturity etc reflecting on its nutritional quality [7]. The biochemical composition specially the components *viz.*, proteins, carbohydrates and lipids imparts nutritional value of the organism. Biochemical composition of crustaceans has been studied by several workers [8-25].
As the demand of mud crab has been increasing as a nutritional delicacy with high domestic as well as in export market an attempt is made to estimate the main constituents like carbohydrates, proteins and lipids in Coringa mangroves on the East Coast of India for a period of two years 2007 and 2008.

2. Material and Methods
The crabs were collected from the Pedavalasala village (16^0 46' 45.93"N; 82^0 15' 47.05" E), the main landing centre of the mud crab fishery of Coringa mangroves. Live crabs in inter moult condition selected and procured for the study were brought to the laboratory. Male and female crabs were grouped into three different size classes *viz.*, 0-4 cm, 5-8 cm and 9- 13cm based on the carapace length of the animal *i.e.*, length from the extreme tips of the carapace anteriolateral spines. All crabs were thoroughly washed. The muscle of the body and chelated legs of each size class and hepatopancreas were collected. The wet weight of muscle and hepatopancreas was taken and the tissue was dried at 50ºC and dry weight was taken. Then it was homogenized and dried again for 1-2 hours before storing in airtight vials. The samples of muscle and hepatopancreas were estimated for carbohydrates, proteins and lipids. For protein, 20mg of dried and powdered component of muscle, hepatopancreas and gonads were weighed separately and whole protein was estimated following Lowry *et al.* [26] method. Total carbohydrates were estimated by Anthrone method of Caroll *et al.* [27] Sulphophosphovanillin method of Barnes and Blackstock [28] was followed to estimate the total lipids. The values were represented as % dry weight of tissue powder.

3. Results
Monthly and quarterly variations in the biochemical constituents- carbohydrates, protein and lipids of muscles and hepatopancreas in different size groups and sexes were estimated and expressed as the percentage of dry weight of the tissue.

Monthly variation of Carbohydrates, proteins and lipids in different months
The average carbohydrate content of the muscle was more or less the same. In males high value was observed in December (0.46) followed by November and October with 0.44 and 0.42. Low muscle carbohydrate content was noticed in May (0.28). In females high value was noticed in December (0.44) followed by November (0.43) and February (0.40). Minimum value was noticed in July with 0.29 and in the remaining

months it was more than 0.30. The average carbohydrate content of the hepatopancreas in (2007 & 2008) was 0.47 in females and 0.43 in males. In males high value was noticed in the month of December (0.55) followed by November (0.52) and October (0.49) and low in March (0.36). In females high value was noticed in December (0.55) and followed by November (0.53) and January (0.52) and low value (0.37) in May.

The muscle protein content of male (31.98) and female (31.97) was almost similar. Higher value was observed in December (37.97) followed by November (36.45) and January (36.03). Low value in May (25.84) followed by July (28.33) and June (28.33).In females high values were observed in December with 38.02, followed by November (35.85) and October 34.52 and low value in May (25.94). The males exhibited high hepatopancreatic protein content (15.26) over female (12.75). In males high hepatopancreas protein level was observed in December with 17.79 followed by October (17.55) and January (16.94) and low value was observed in May with 12.46. In female high value was noticed in January (14.10) and low value (10.95) in May as observed in male and in other months the value was more than 12.0.

The males and females showed more or less similar values of muscle lipids. In male it was 5.24 and in female it was 5.23. In males high muscle lipid level was observed in December with 6.26 followed by November (6.05) and October (5.98) and low value in April (4.35). The muscle lipid levels in the remaining months were January (5.26), February (4.63), March (4.60), May (4.57), June (5.26), July (5.37), August (5.25) and September (5.28). In females high muscle lipid content was observed in January (5.40) followed by November (5.39) and June (5.36). Low value was noticed in October (4.91). Males had shown high lipid content in the hepatopancreas over female. In males high lipid content in hepatopancreas was noticed in December with 32.27 and low in September with 23.40. The lipid content in remaining months were 27.84 in January, 28.23 in February, 25.63 in March, 25.25 in April, 24.51 in May, 25.23 in June, 25.06 in July, 23.64 in August, 29.35 in October and 31.70 in November. In females high lipid content was observed in October with 29.65 followed by December with 29.61 and low content was observed in July (21.77) (Fig.1)

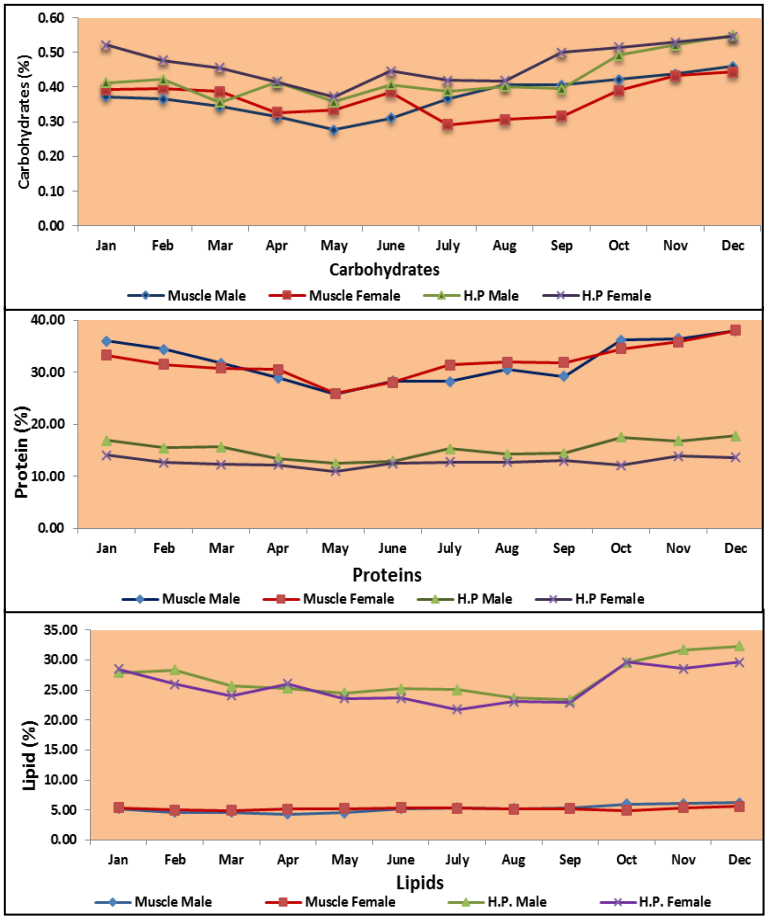

Fig 1: Carbohydrates, proteins and lipids (%) in muscle and hepatopancreas of males and females of *S. serrata*

Variation of Carbohydrates, proteins and lipids in different quarters

The muscle carbohydrate content was observed high in the 4th quarter in both male and female with 0.44 and 0.42 respectively when two year data was pooled. Low value (0.31) was observed in 2nd quarter in males and in 3rd quarter (0.30) in females. In hepatopancreas high level of carbohydrates was observed in the 4th quarter in both male and females with 0.52 and 0.53 respectively. Low carbohydrate content was observed in 2nd quarter in male with 0.39 and females with 0.41.

High muscle protein content was observed in the 4th quarter in

both male and female with 36.86 and 36.13 respectively in both the years were put together. Low protein values were found in males (27.69) and females (28.20) in the 2nd quarter. High hepatopancreatic protein was observed in the 4th quarter in both male and females with 17.38 and 13.24 respectively. Low content was observed in 2nd quarter in both male (12.94) and females (11.90).

The muscle lipid content was high in both male (6.09) and female (5.30) in the 4th quarter was observed. Low level was observed in males (4.73) in 2nd quarter and females (5.24) in 3rd quarter. In hepatopancreas high lipid levels were observed in the 4th quarter in both male and females with 31.17 and 29.28 respectively, and low content was observed in 3rd quarter in both male (24.03) and females (22.56) (Fig. 2).

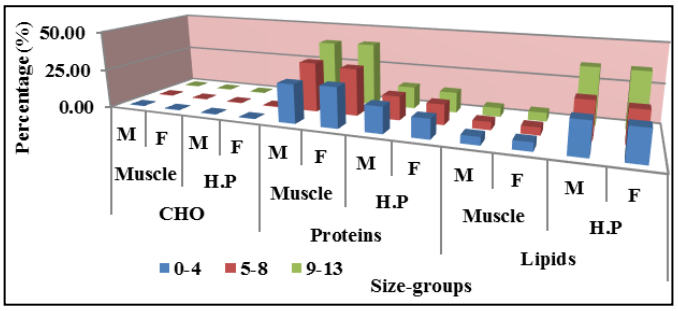

Fig 2: Carbohydrates, proteins and lipids (%) of muscle and hepatopancreas of males and females of *S. serrata* in different size groups

Carbohydrates, proteins and lipids in different size groups

0-4 cm size group

The carbohydrate content in muscle and hepatopancreas in males of size class 0-4cm were 0.40 and 0.43 respectively and in females they were 0.373 and 0.40 respectively. The protein content of muscle was 26.67 and of hepatopancreas was 16.56 in males whereas in females it was 25.49 in muscle and 12.33 in hepatopancreas and the lipid content noticed in muscle and hepatopancreas of males was 5.01 and 20.61 respectively whereas in females it was 5.40 and 19.77.

5-8 cm size group

The carbohydrate content of muscle and hepatopancreas of males were 0.35 and 0.43 respectively whereas in muscle of females they were 0.37 and 0.53 in hepatopancreas. The protein content in muscle and hepatopancreas of males of the size class 5-8 cm were 31.64 and 15.20 respectively. In females, muscle protein was 30.07 and in hepatopancreas it was 12.90 and the lipid content noticed in muscle and hepatopancreas of males at 5-8cm size class were 5.01 and 23.76 respectively, and in females they were 4.83 and 21.08.

9-13 cm size group

The carbohydrate content observed in muscle and hepatopancreas of males were 0.37 and 0.42 whereas in females they were 0.36 and 0.46 respectively. The protein content noticed in muscle and hepatopancreas of males were 39.60 and 14.03 respectively, and in females they were 30.06 in muscle and 12.90 in hepatopancreas and the lipid content of muscle and hepatopancreas of males of size class 9-13cm were 5.69 and 36.24 respectively. In females they were 5.46 and 36.00 (Fig.3).

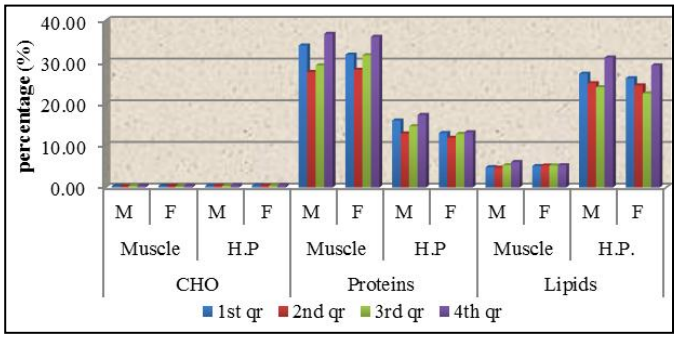

Fig 3: Carbohydrates, proteins and lipids (%) of muscle and hepatopancreas of males and females of *S. serrata* indifferent quarters

4. Discussion

Crabs serve as a good source of nutritionally important biochemical constituents like carbohydrates, proteins and lipids. Variations in biochemical composition with respect to sex, size, seasonal maturity, season, food availability, temperature etc., help in the assessment of nutritional quality [7, 29, 30]. The present study on the mud crab *S. serrata* in Coringa mangroves has brought to light that the protein is the major biomolecule in male and female with an increasing trend with the increasing size of the animal and also in the 4th quarter of the year *i.e.*, winter indicating probably the breeding season. Though hepatopancreas is the main source of lipids and high lipid levels have also been found in muscles in all seasons and in all size groups. Carbohydrates are very low, though they serve as an immediate source of energy.

The biochemical constituents in *S. serrata* have shown variations with season, size class and sex during the present study collaborating with the earlier observations by researchers on different portunid crabs. According to Lockwood [32]. crustaceans store less glycogen in the body tissue. Generally carbohydrates are the immediate source of energy and are found in the form of glycogen in crustaceans. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides [33]. It has been reported by Love [34] that the carbohydrates are primarily stored in the gonads, hepatopancreas and muscle of crustaceans. The presence of low carbohydrates in muscle than hepatopancreas in correlation with the findings of Bhaskara Reddy [35] in *S. serrata*. This may be due to the storage of glycogen in the hepatopancreas. The carbohydrate is 0.17% in body meat and 0.24% in claw meat of *S. serrate* [36]. Chiou and Huang [17] have observed more glycogen content in the muscle of females of farm reared mud crabs. According to them variation in the levels of muscle carbohydrate may be due to the habitat difference and also due to the supplementary feed given to the cultured crabs whereas the present study has been carried out on the wild-caught crabs.

Muscular and hepatopancraetic protein has been found to be almost similar in males and females in the present study and is not significant. Crustacean tissues contain free amino acids of about ten times more than the mammalian tissue [31]. George and Gopakumar [11] have reported 16.8% protein in the meat of *S. serrata*. Akbar *et al.* [7] have observed a high protein

level in body meat and claw meat in *P. pelagicus*. George *et al.* [37] have reported 11.60% protein in males and 19.92% in females in the meat of *S. serrata*. It has been reported by Mathai & Devi [14] that the abdominal muscle of juvenile female is rich in all the tissue components. Generally in crustaceans, growth is an increase in the dry weight of the body between moults when the absorbed water is gradually replaced by protein [38] Anon [39] has reported that the protein value in *Portunus pelagicus* is 17.17%. High mean protein content in females over males of *S. serrata* has been observed by Zafar *et al.* [18] in Chakaria Sundarban, Bangladesh. Thirunavukkarasu [40] has recorded 65.48% to 72.24% of protein in meat and 69.5% to 80.29% in hepatopancreas of *S. tranquebarica.* Ramesh Kumar *et al.* [19] have found highest protein content in the haemolymph of *S. serrata* among the brachyuran crabs.

High values of the biochemical constituents have been observed in the fourth quarter in all size groups of crabs. This is in agreement with the findings of Akbar *et al.* [7] in *P. pelagicus* where high values have been recorded in the winter months. In the observations made in *S. serrata* of Chakaria Sundarban of Bangladesh *by* Zafar *et al.* [18] highest protein content (20.10%) has been found in the month of December in males and lowest is found in the month of May. High protein content in females has been observed in the post monsoon (4th quarter) and pre monsoon periods (1st quarter) in the study area and low during the dry period and monsoon period coinciding with the findings of Zafar *et al.* [18] in *S. serrata* in Chakaria Sundarbans who have observed high protein content during pre–monsoon (Jan-April) and lower in monsoon (June to October).

Lipids as a general rule act as major food reserve along with protein and are subjected to periodic fluctuations influenced by environmental variables like temperature [9]. In crustaceans, the hepatopancreas is generally regarded as a major lipid storage organ [41]. Lipids are efficient as sources of energy and they contain more than twice the energy of carbohydrates and proteins [33]. George and Gopakumar [11] have observed 1.07% of lipid in body meat of *S. serrata*. Prasad and Neelakantan [36] have recorded 1.65% in body meat of *S. serrata*. The average lipid content in muscle and hepatopancreas in both males and females *S. serrata* is low and the difference is not significant. But increase lipid content has been observed with the increasing size of the crab. The observation in the present study is in agreement with that of Hill *et al.* [42] Correia *et al.* [43] have found that the total lipid is higher in adults than in juveniles of many crustaceans. Lipid content of 0.9% to 1.6% in body meat has been reported by Thirunavukkarasu [40] in *S. tranquebarica*.

Total lipid content is maximum in sub adult stage than juveniles in all three tissues such as hepatopancreas, gills and muscles which may be due to the type of food intake, climate, age, sex and habitat etc [44]. The lipid content has been found to show seasonal variation. In males and females it was highest in the 4th quarter in both years. Similar observations were found in which fat content has increased from 3rd to 4th quarter *i.e*., from pre monsoon to post monsoon in Chakaria Sundarbans of Bangladesh [18]. Shivraj and Roy [22] have found a significant reduction (P<0.001) in the concentration of total protein (10-35%), free sugars, total carbohydrates and free fatty acids (15-70%) in experimental group tissue of *S. serrata* as compared to control group. Bijoya *et al.* [24] have found nearly about 11% protein was measured in both male and female mud crab and 2.4% of lipids in male and 2.3% in female mud crab *S. serrata* from body meat. Sreelakshmi *et al.* [25] have found significant differences ($p<0.05$) in biochemical composition of *Scylla serrata* with females showing higher protein content than the males.

5. Acknowledgements

The authors are grateful to the Head, Department of Marine Living Resources, Andhra University, Visakhapatnam for providing facilities to carry out research work.

6. References

1. Zafar M. Study on sergestid shrimp *Acetes* in the vicinity of Mathamuhuri river confluence, Bangladesh. Ph.D. thesis, university of Chittagong, Bangladesh, 2000.
2. Siddiqui MZH, Zafar M. Crabs in the Chakaria Sundarban area of Bangladesh. J NOAMI. 2002; 19:61-77.
3. Derosier NW. The technology of food preservation. The Avi Publishing Company, Inc. 1963; 20.
4. Newcombe CL. The nutritional value of sea foods Virginia Fisheries Laboratory of the College of William and Mary and Commission of Fisheries as the Series. 1944, 2.
5. Zaitse V, Kizevette I, Lagunoy L, Makarov T. Fishing, Curing and Processing. Mir publishers, Moscow. 1969; 280.
6. Rameshkumar G, Ravichandran S, Kaliyavarathan G, Ajitkumar T. Comparison of protein content in Haemolymph of Brachyuran crabs *Portunus pelagicus.* Global Journal of Environmental Research. 2009; 3(1):42-45.
7. Akbar Z, Qasim R, Siddiqui PJA. Seasonal variations in biochemical composition of edible crab (*Portunus pelagicus* Linnaeus), Jour. of Islamic Acad. of Sci. 1988; 1(2):127-133.
8. Senthil Kumar NS, Desai KM. Seasonal changes in glycogen total lipids and cholesterol content of crabs, *Neptunus pelagicus* (Linneaus) and*Scylla serrata* (Forskal) of Sikka coast (Decapoda, Brachyura) Ind. J Zool. 1978; 6(1):24-27.
9. Nagabhushanam R, Farooqii VM. Mobilization of protein, glycogen and lipid during ovarian maturation in marine crab *Scylla serrata* (Forskal). Indian J Mar. Sci. 1982; 11:184-189.
10. Zhukova. Lipid content and composition of the pink shrimp, *Scylla serrata* and *Portunus pelagicus.* J Experimental. Marine Biol. Ecol. 1987; 162:253-263.
11. George C, Gopakumar K. Biochemical studies on crab, *Scylla Serrata.* Fish. Technol. 1987; 9(1):15.
12. Sundararao K, Tinkerame J, Kaluwin C, Singh K, Matsuoka T. Lipid content, fatty acid and mineral comparison of mud crabs (*Scylla serrata*) from Papua New Guinea. Jour. of Food and Comp. Analysis. 1991; 4(3):276-280.
13. Jeyalectumie C, Subramoniam T. Biochemistry of seminal secretions of the crab *Scylla serrata* with

reference to sperm metabolism and storage in the female. Molecular Reproduction and Development. 1991; 30(1):44-55.
14. Mathai M, Devi S. Studies on the biochemical compositon of the muscel of the edible marine crab, *Scylla serrata*. Indian J Comp. Anim. Physiol. 1993; 11:155-162.
15. Wang Gui Zhong, Tang Hong, Li Shaogang, Wang Dazhai and Lin Qiongwuu. Biochemical composition for mud crab *Scylla serrata* during embryonic development. Journal of Oceanography In Taiwan Strait. 1995; 08.
16. Sheen SS. Dietary cholesterol requirements of juvenile mud crab *Scylla serrata*. Aquaculture. 2000; 189:227-285.
17. Chiou Huang. Chemical constituents in the abdominal muscle of cultured mud crab *Scylla serrata* in relation to seasonal variation and maturation. Fisheries science. 2003; 69:597-604.
18. Zafar Mohammad, Mohammad Ziaul Huda Siddiqui, Mohammed Abdul Hoque. Biochemical composition in *Scylla serrata* (Forskal) of Chakaria Sundarban Area, Bangladesh. Pakistan Jour of Biol. Sci. 2004; 7(12):2182-2186.
19. Ramesh Kumar G, Ravichandran S, Kaliyavarathan G, Ajithkumar T. Comaprison of protein content in hemolymph of brachyuran crabs Portunus pelagicus. Global Jour. of Envi. Res. 2009; 3(1):42-45.
20. Fang WH, Hu LL, Yang XL, Hu K. Effect of temperature on pharmacokinetics of enrofloxacin in mud crab, *S. serrata* (Forskal) following oral administration. Journal of Fish Diseases. 2008; 31(3):171-176.
21. Yedery RD, Reddy KVR. Purification and characterization of antibacterial proteins from granular haemocytes of Indian mud crab, *Scylla serrata.* Acta. Biochemica. Polonica. 2009; 56(1).
22. Shivraj Bhoite, Roy R. Adaptation to hypo-saline environment of mud crab, *Scylla serrata*: Metabolic changes. Inter. Jour. of Res. in Fish. and Aqua. 2012; 2(1):4-11.
23. Jeyalakshmi Kala KL, Chandran M. Chemical composition of brachyuran crabs from various environments. International Journal of Pharma Bio Sciences. 2014; 5(4B):612-620.
24. Bijoya Paul, Hasan Faruque Md., Roland Nathan Mandal, Dewan Ali Ahsan. Nutritional susceptibility to morphological, chemical and microbial variability: An investigation on mud crab, *Scylla serrata* in Bangladesh. Inter. J of Fish. and Aqua. Studies. 2015; 2(6):313-319.
25. Sreelakshmi KR, Manjusha L, Vartak VR, Venkateshwarlu G. Variation in proximate composition and fatty acid profiles of mud crab meat with regard to sex and body parts. Indian J of Fish. 2016; 63(2):147-150.
26. Lowry OH, Rosenberg NJ, Para A, Randall RJ. Protein measurement with Folin phenol reagent. J Biol. Chem. 1973; 193:265-275.
27. Caroll WV, Longley RW, Roe JHThe, determination of glycogen in the liver and muscle by the use of anthrone reagent. J Biol. Chem. 1956; 220:583-593.
28. Barnes H, Blackstock J. Estimation of lipids in marine animals and tissue detail investigation of the sulphophosphovanilin method for total lipids. J Exp. Mar. Ecol. 1973; 12:103-118.
29. Viswanathan Nair PG, Suseela Mathew. Biochemical composition of fish and shellfish, CIFT technology advisory series, CIFT, Cochin, 2000.
30. Soundarapandian P, Ananthan G. Effect of unilateral eyestalk ablation on the biochemical composition of commercially important juveniles of *Macrobrachium malcolmsonii*. Int. J Zool. Res. 2008; 4(2):106-112.
31. Huggins AK, Munday KA. Crustacean metabolism. In: Advances in Comparative Physiology Biochemistry, Loensteind, O. (Ed.), Academic Press, New York. 1968; 271-378.
32. Lock Wood APM. Aspects of the physiology of crustacean. Oliver Boyn. Edinburg. London. 1968; 9-15.
33. Okuzumi M, Fujii T. Nutritional and functional properties of squid and cuttle fish. 35th Anniversary of commemorative publication. 2000; 223.
34. Love RM. The Chemical Biology of Fishes. Academic Press, New York. 1980; 2:943.
35. Bhaskara Reddy K. Studies on the biology and histophysiology of the portunid edible crab genus *Scylla* de haan from Bhimunipatnam backwaters. Ph.D thesis, submitted to Andhra University, 1982.
36. Prasad PN, Neelakantan B. Maturity and breeding of the mud crab, *Scylla serrata* (Forskal) (Decapoda: Brachyura: Portunidae). Proceedings of the Indian Academy of Science (Animal Sciences). 1989; 98(5):341-349.
37. George C, Gopakumar K, Perigreen PA. Frozen storage characteristics of raw and cooked crab (*Scylla serrata*) segments, body meat and shell on claws. J Mar. Biol. Ass. India. 1990; 32(1-2):193-197.
38. Thomas G. Relationship between growth rate and RNA/DNA protein ratio in *Penaeus indicus.* CMFRI special Publ. 1993; 58-60.
39. Anon. Fishery Statistics. Food and Agriculture Organisation, United Nations, Rome. 1999; 84:703.
40. Thirunavukkarasu N. Biology, nutritional evaluation and utilization of mud crab *Scylla tranquebarica* (Fabricius, 1798). Ph. D. Thesis, Annamalai University, India. 2005, 126.
41. Muriana Francisco JG, Valentina Ruiz-gutierrez, Lourdes Gallardo-guerrero M, Isabel M. A study of the Lipids and Cartenoprotein in the Prawn, *Penaeus japonicus.* Japanese Biochemical Society. 1993; 114(2):223-229.
42. Hill C, Quningley MA, Cavalleto JF, Gordon W. Seasonal changes in lipid content and composition in benthic amphipods *Monoporeia affini*s and *Ponotoporeia femorata*. Limnol. Oceanogr. 1992; 37:1280- 1287.
43. Correia A, Helena-Costa M, Luis J, Living ston R. Age related changes in antioxidant enzyme activities, fatty acid composition and lipid peroxidation in whole body *Gammarus locusta.* J Expl. Biol. Ecol. 2003; 411:1-9.
44. Malingam L, Kolandhasamy Prabhu, Chandran Yuvaraj, Saravanbhavan P. Lipid estimation from Freshwater Prawn *Macrobrachium malcomsonii*. Advances in Biological Research. 2009; (5-6):153-158.