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NUTRITIVE PROFILES IN DIFFERENT SIZE GROUPS AND BODY PARTS OF COMMON WHELK *Hemifuses pugilinus* (BORN, 1778) FROM PAZHAYAR, SOUTHEAST COAST OF INDIA

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ORIGINAL ARTICLE

ABSTRACT: *The aim of this study was to determine instead of levels of protein, fat, carbohydrates (proximate composition) and essential fatty acids of different body parts as well as male and female of extensive marine whelk H. pugilinus on dry weight basis. There was a significant difference in protein, lipid, carbohydrate and water contents between various size groups as well as sex (P<0.05). Total protein content was found to be varying from 30.58±0.75 (digestive diverticula) to 57.23±1.48% (Gonads) in size group II of the female body parts respectively, the carbohydrate 3.66±0.28 to 10.35±0.14 whereas the lipid 10.18±0.04 to 14.67±0.35. The water content varied from 58±1.41 minimum digestive diverticula and maximum in 85±1.41 other body tissues. There was considerably 17 fatty acid composition were identified belongs to ten in saturated fatty acids four were monounsaturated fatty acid and 3 were polyunsaturated fatty acid among these, C16:0 (22.62%) and C18:0 (14.45%) were the major components saturated fatty acids and C18: 1 (5.3%) and C20:4n6 (8.66%) were found major mono and poly unsaturated fatty acids. All groups have good source of the nutritive value particularly the size group II (80-100 mm) is effectual results for the present findings and it's symptomatic of their high nutritional quality for human consumption.*

Key words: *Common whelk, Fatty acids, Mollusc, Nutritional composition, Pazhayar*

INTRODUCTION

From the beginning of the 20th century the world population is exploding tremendously great impact on the availability of food. The seafood is a rich source of protein and many varieties of seafood are also low in sodium and cholesterol, but it's nutritious as well. It's a delightful addition to any meal and is an excellent, low-calorie source of many essential nutrients. Nutrition plays a vital role on the development, growth, maintenance of normal body functions, physical activity and length. Nutrients must be obtained through a judicious choice and combinations of variety of foods such as carbohydrate, fats, protein are macronutrients, vitamins and minerals are micronutrients which are necessary for physiological and biochemical process by which the human body acquires, assimilates and utilizes food to maintain health.

Nutritive compositions are ensuring the adequate immune competence and cognitive development of the human metabolisms (Ramakrishnan and Rao, 1995). Due to increasing the populations, new nutritional resources have to be exploited and distributed properly from the land and the sea (Chernysheld, 1977). Hence, recent researches are much focused on the nutritional sources from the marine environment. Marine organisms generally possess varying degrees of exogenous fatty acid components. For e.g. poly unsaturated fatty acid that is typical of certain primary producers (algae and microorganisms) is known to be essential FAs in marine invertebrates (Ermelinda Prato et al. 2009).Whelks are the predatory marine gastropods that are extremely favored for their high protein (Xavier Ramesh and Ayyakkannu, 1992). However, the proximate compositions are widely varied depending on species size. Even though the biochemical composition of bivalves was studied extensively, only limited studies were conducted on gastropods. However, efforts have been made to study the major biochemical composition of gastropods such as *Thais* spp. (Sundaram, 1974).

H. Pugilinus is a marine prosobranch gastropod distributed all over the southeast coast of India which is inhabited at a depth of 3 to 13 fathoms in sandy mud substratum. The species is edible in Hon Shu Islands in Japan (Kira, 1962); in India (Anandakumar et al., 1986) reported. Even they are used for ornamental purposes; lime making industries are exploited in large quantities for its shell. To overcome, the purpose of the present study was to the availability of the compositions and biochemical variations in tissues of *H. pugilinus* in different size groups.

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MATERIALS AND METHODS

Sample Collection and Processing

The study animal were sourced from trawl net operation of by - catch resources at fish landing centre of Pazhayar (Lat 11° 21’22” N; long 79° 50’55” E) the selection of this harbor is one important landing center among the three minor fishing harbor in Tamil Nadu. More then 200 samples were segregate in to three different size groups ranging from 50 to 130 cm and washed thoroughly with tap water and subsequently with distilled water to remove the surface soil and dust. The outer shells were carefully removed and dissected out and identified the male and female were separated to various parts of body such as foot, mantle, gonad and other body tissues (remain part of the animal) could be dried in hot air oven at 60°C for 24 h. The dried material was powdered, sieved and used for further analysis in triplicate to analyze total protein, carbohydrate, lipid and water content. The whole body tissues of both sexes were pooled together and analyzed for the fatty acid profile.

Estimation of total protein: The folin – Ciocalteu phenol method (Lowry et al. 1953) was adopted for the estimation of total proteins in the different body parts of the dried samples.

Estimation of carbohydrate: For the estimation of carbohydrate content, using the procedure of phenol-sulphuric acid (Dubois et al. 1956) method.

Estimation of lipid: The chloroform – methanol extraction procedure (Folch et al. 1956) methods was used for the extracting lipid from the various body parts.

The water content was estimated by subtracting the dry weight of the sample from the known wet weight of the sample dried in a hot air oven and then calculated in percentage to estimate the water content.

Estimation of fatty acid: Fatty acids in the sample were analyzed by converting them in to FAME and analyzed by Gas Chromatography (Sasser et al. 2005). The purified methyl esters were analyzed by gas chromatography (Agilent- GC 6890N) equipped with flame ionization detector. Capillary column- HP Ultra 2 with 2m long and 0.2mm inner diameter coated with 5% phenyl methyl silaxane and 0.33µm thickness was used. The rate of hydrogen carrier gas flow was maintained at 30ml/min. FAMEs were identified by MIDI calibration standard software.

RESULTS

Sea food is the important constituent of the human diet, nowadays the protein efficiency increasing in developing countries. It has stimulating exploration of non – traditional resources (Woodcock and Benkendorff, 2008). The proximate composition of the male meat of marine gastropod in various body parts and size groups were showed (Figures 1, 2 and 3) and the female body parts were shown (Figures 4, 5 and 6) the mean values of protein, carbohydrate, lipid, water content and fatty acids were showed. The percentage biochemical compositions of various body parts of male and female *H. pugilinus* were analyzed and represented, the protein, carbohydrate, lipid and water content varied significant ($P<0.05$). The level of composition was higher in gonad in case of both male and female in all the size groups.

In the present investigations SGII is more significant value compare to the SG I and SG III. The protein content varied from the SG I foot of female 44.9±1.34 - 48.4±1.88 in gonad respectively SG II 47.1±1.47 - 57.2±1.48, SG III 30.5±0.75 - 35.6±1.69.The maximum in gonads (57.2±1.48) in SG II and least amount in 30.5±0.75 in SG III. In order the protein content varied from 40.3±0.14 - 46.1±0.05, 46.4±0.05 - 56.3±0.09 and 29.1±0.14 - 35.8±0.11 the maximum (56.3±0.09) SG II and least amount in 29.58±0.75 in SG III.

Carbohydrate level ranged from the female 5.48±0.28 - 8.13±0.04 in SG I, SG II 6.9±0.14- 10.3±0.14, SG III 3.66±0.28 - 5.46±0.37.Carbohydrate higher in gonad (10.3±0.14) SG II and lower amount in foot (3.66±0.28) SG III. In order the male 8.12±0.14 - 11.2±0.12, 7.82±0.09- 9.88±0.08 and 3.90±0.07 - 5.16±0.12 the maximum (11.2±0.12) in SGI and least amount in 3.90±0.07in SG III. In female, the lipid content varied from 12.59±0.48-15.95±0.07 (SG I) 10.37±0.21 - 14.6±0.35 (SG II) 10.1±0.04 - 13.1±0.07 (SG III). Amount of lipid maximum in (15.9±0.07) gonad SG I and minimum in foot (10.8±0.04) SG I, respectively male 5.83± 0.08 - 12.5±0.14, 8.92±0.10 - 14.8±0.04 and 10.2±0.18 - 13.2±0.19 higher in gonads (15.9±0.07) SI and lower in foot (10.1±0.04) SG II. In the present study, the lipid formed only a less percentage of the total biochemical constituent and it was found to be high in gonad (15.9±0.07 SG II) followed by other body tissues (15.1±0.09 SG I), Digestive diverticula (14.6±0.35SG II) and foot (12.5±0.48 SG I) in *H. pugilinus*. Whereas in the case of *Meretrix meretrix* lipid content was higher in mantle (4.38%) (Palpandi et al. 2008), visceral mass (3.94%) and mantle (3.5%) in *Katelysia opima* (Soma Saha, 2004) and digestive diverticula (8.3%) in gonad and foot (Rajan, 1987). The differences in lipid content of tissues are partially due to the gradual transference of lipids of gonads as reported in *C. Tehuelcha* (De Moreno et al. 1976).

In the present findings, the water content in male ranged from 86±1.41 - 83±1.41 and which was high in other body tissues of SG II and minimum in digestive diverticula of SG II. In female, water content varied between 85±1.41 - 79.5±0.70 maximum in other body tissues of SG III and minimum in digestive diverticula in SG III. Totally 17 different fatty acids were identified 10 were saturated fatty acids (SFA), four were monounsaturated fatty acids and 2 polyunsaturated fatty acids (PUFA), among SFAs, and C16:0 and C18 : 0 were the major acids. In MUFA C18:1 and in PUFA C20:4ω6C were the major acids found in *H.pugilinus.*

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Table 1 - Fatty acid profile for *H. pugilinus*

Position of carbon atom	Percentage (%)		
	SG I	SGII	SGIII
Saturated Fatty acids (SFA)			
C10:0	-	0.05	-
C12:0	0.71	0.16	0.86
C13:0	0.08	0.1	-
C14:0	3.98	3.89	2.67
C15:0	1.83	1.74	0.67
C16:0	22.62	22.48	11.11
C17:0	4.9	4.65	3.26
C18:0	12.86	14.45	13.41
C19:0	0.58	0.75	0.89
C20:0	0.92	1.61	0.57
	48.48%	49.88%	33.44%
Mono Unsaturated Fatty acids (MUFA)			
C16:1n-5	0.17	0.17	-
C17:1n-8	0.67	0.65	0.47
C18:1n-9	4.15	5.3	4.61
C20:1n-7	1.94	1.81	0.71
	6.93%	7.93%	5.32%
Poly Unsaturated Fatty acids (PUFA)			
C18:3n -6	0.36	0.38	-
C20:4n-6	8.66	6.93	4.68
C20:4n-12	-	-	10.96
	9.02%	7.31%	15.64%

* Percentage composition of fatty acid profile

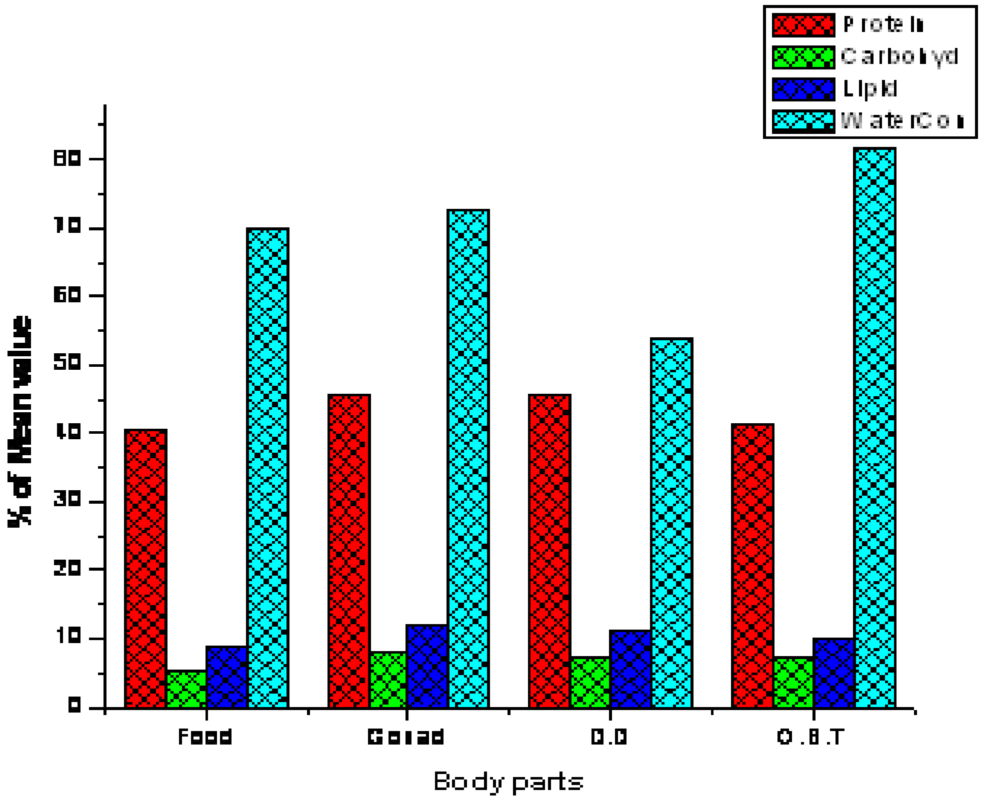

Figure 1. Proximate composition in male *H. pugilinus* body parts; * - Size group I (50 - 70 cm)

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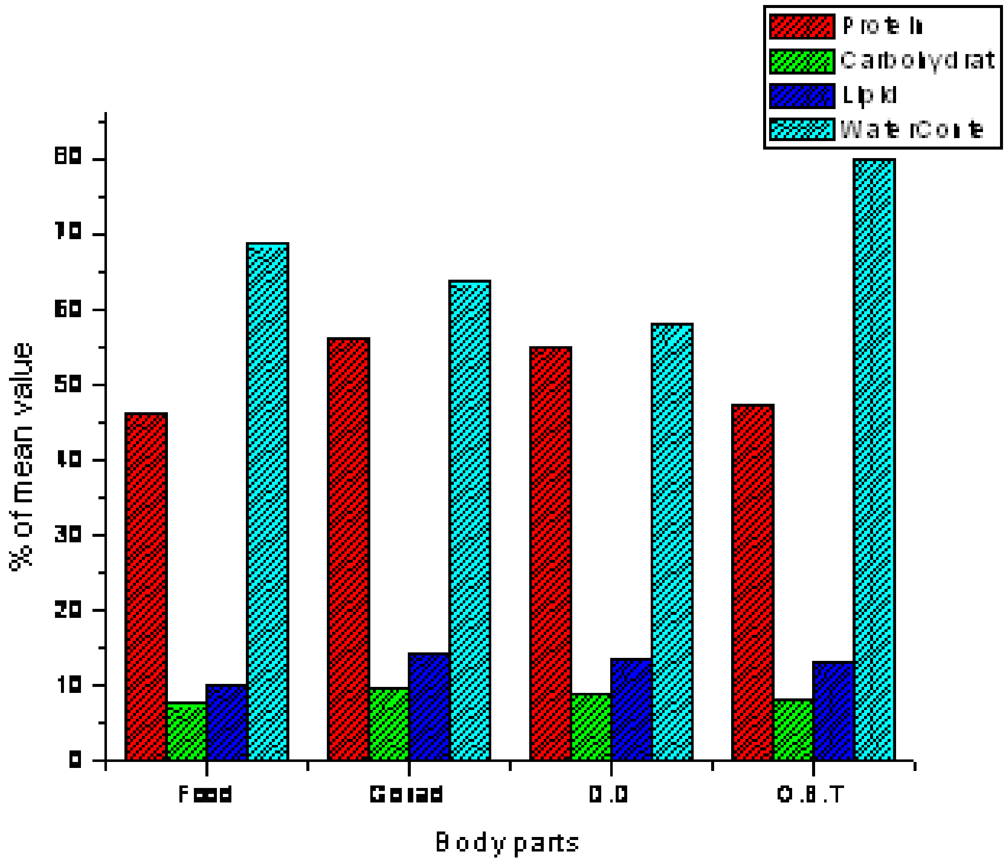

Figure.2. Proximate composition in male *H. pugilinus* body parts; * - Size group II (80 - 100 cm)

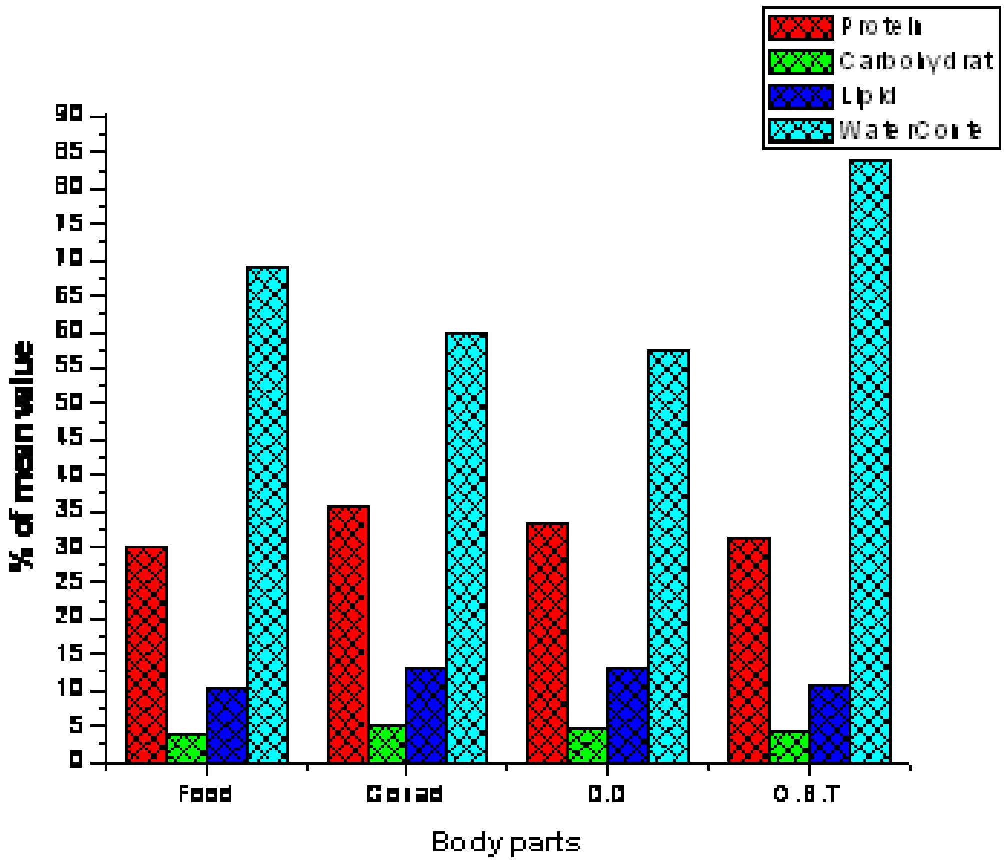

Figure 3. Proximate composition in male *H. pugilinus* body parts; * - Size group II (110 - 130 cm)

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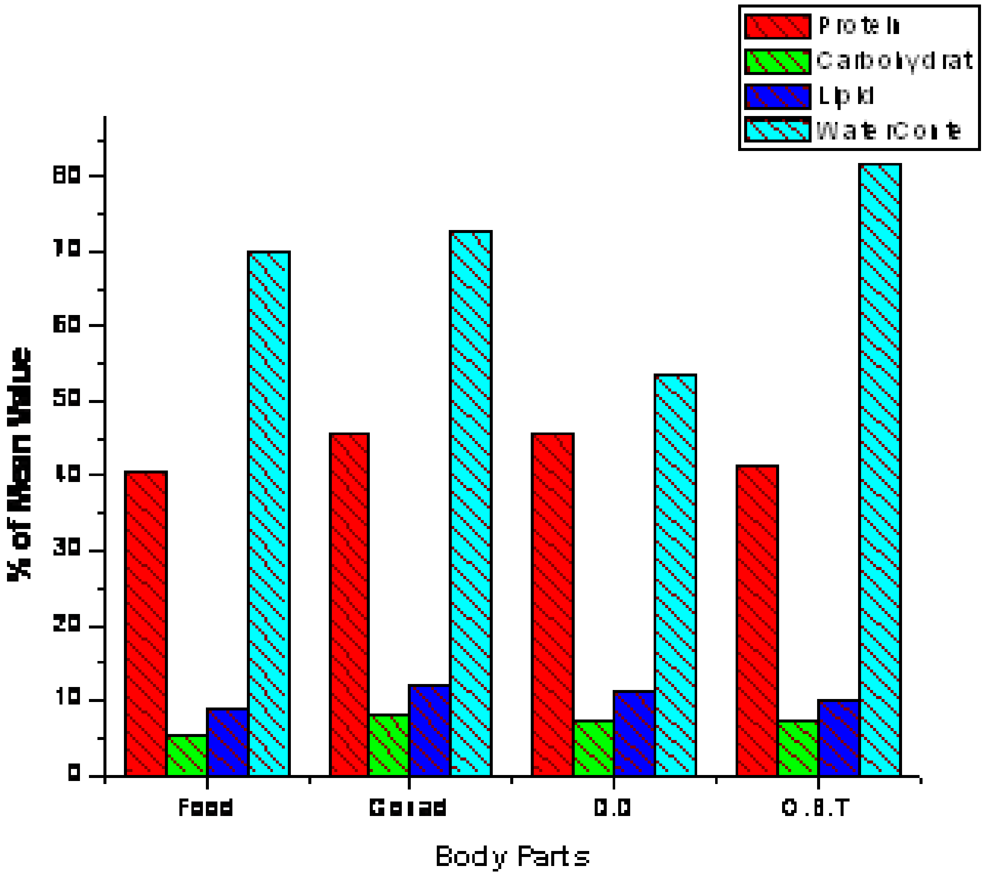

Figure 4. Proximate composition in female *H. pugilinus* body parts; * - Size group I (50 - 70 cm)

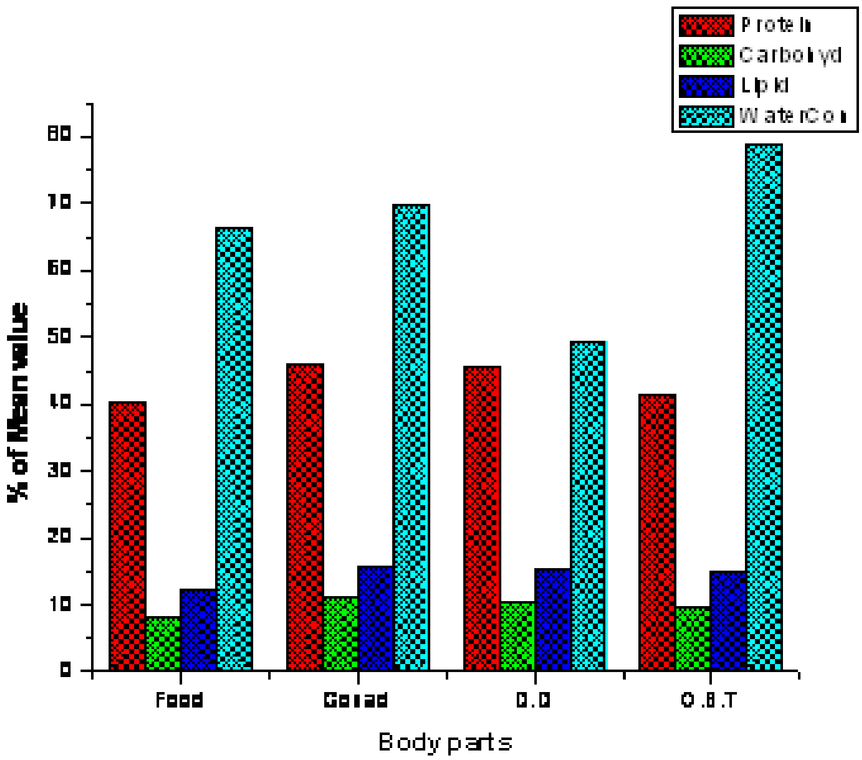

Figure 5. Proximate composition in female *H. pugilinus* body parts of Size group II (80 - 100 cm); * - Size group II (80 - 100 cm)

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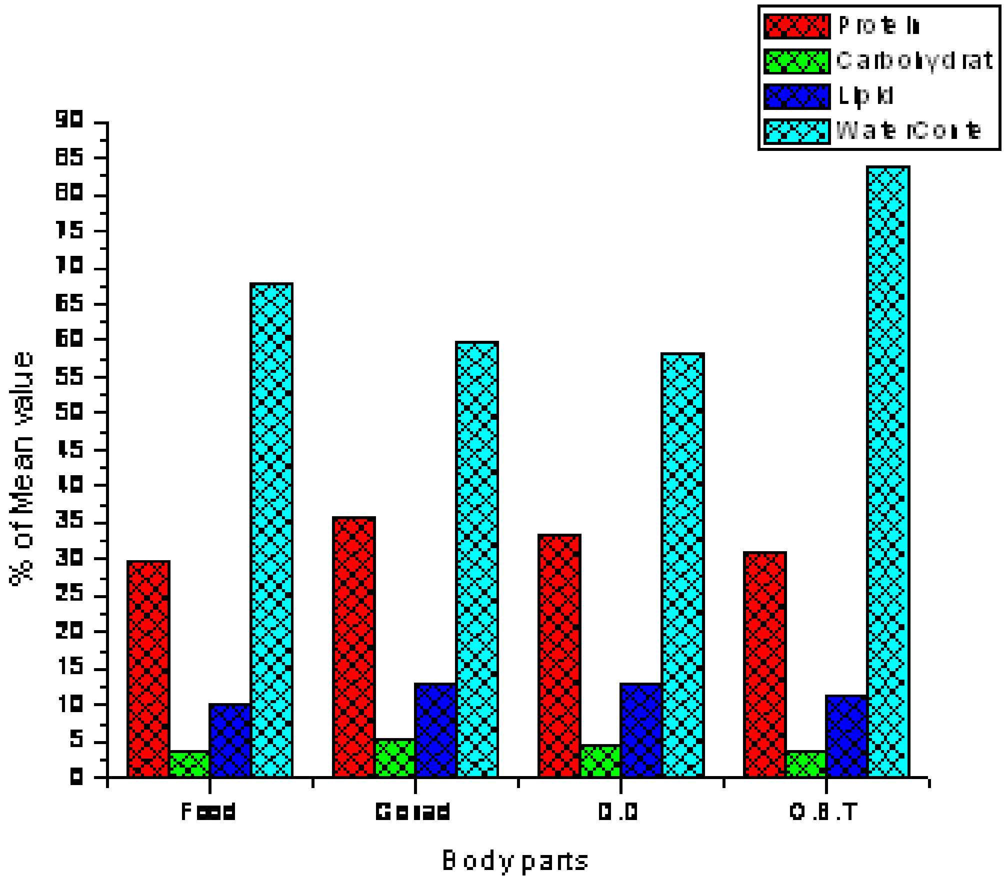

Figure 5. The Proximate composition in female *H. pugilinus* body parts of Size group III (110 - 130 cm); * - Size group III (110 - 130 cm)

DISCUSSIONS

The protein is essential for the sustenance of life and accordingly exists in large quantity of all nutrients in human body. The protein content varies from animal to animal, one body part to another and also season to season (Kunusaki, 2000). The variations in the biochemical constituents like protein, carbohydrate and lipid are mainly influenced by the reproductive cycle, feeding and age of the organisms concerned (Giese and Hart, 1967). Very well agreeing with the above facts, in the present study protein and carbohydrate were found to be higher in gonad (56.3±0.09) of SG II and SG I (48.4±1.88) respectively and it is due to the attainment of sexual maturity and consequent maturation of gonads. The reason for the maximum protein content recorded in the gonad than that of the other analyzed edible portions viz., foot, digestive diverticula and other body tissues of the *H. pugilinus* might be stated that the gonad part acts as a storage organ. In contrast to this view it was stated that the digestive gland acts as a storage site in most of the tropical molluscs (Owen, 1966; Jayabal and Kalyani, 1986; Rajkumar, 1995). The protein content values of the present study were found to be lying more with the protein values of 23.6 to 43.0% in the mantle of *Rapana rapiformis* (Rajkumar, 1995) and 15.71 to 29.8% in the whole body tissue of *Pythia plicata* (Shanmugam, 1991). But the protein was reported more or less equal to the present observation in *Babyloniya spirata* (Shanmugam et al., 2006) in which the adductor muscle, mantle and siphon mixture showed the maximum protein content of 51% and minimum of 43.87%; whereas protein in the foot muscle was 62.13% in male and 64.44% in female of *Chicorus virgineus* and 60.78% and 60.43% of the male and female samples of *R. rapiformis* respectively (Xavier Ramesh and Ayyakkannu, 1992), *Thais bufo* (46.8% in males and 49.8% in females), *T. bisserialis* (42.4% males and 43.4% in females) (Tagore, 1990). Thivakaran (1988) recorded *L. quadricentus* (35.94%) and *N. pyramidalis* (35.63%).

The carbohydrate level in the present study ranged from 10.35±0.14of SG II and to 8.13±0.04 SG I, whereas adductor muscle, mantle and siphon mixture was maximum of 6.8% and minimum of 6.5% in *B. spirata* (Shanmugam et al., 2006). More carbohydrate in the gonad and digestive gland mixture than that of viscera and foot observed in *Morula granulata* suggested that it may be used during the reproductive physiological needs or may be converted to the gonadial lipids (Umadevi et al., 1985; Rajkumar, 1995) concluded that carbohydrate was higher in foot followed by digestive diverticula, mantle and gonad in *R. rapiformis*. Ansell et al. (1973) reported that, in molluscs, generally the carbohydrate reserves may be utilized under unfavourable conditions and the great variation found in tissues indicates that the level of mobilizable carbohydrate reserves may fluctuate widely and

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rapidly in response to fluctuation in condition affecting the position of the animal. Water content in *H. pugilinus* was high in other body tissues of (85±1.41%) SG III and low in digestive diverticula of (50 %) SG I. Similar observation on the variation in water content and dry weight (Ansell et al., 1964) in *Venus mercenaria* and *Tivela stultorum* (Giese et al., 1967) which was due to the maturation and spawning.

The availability of SFAs content was 48.48 % (SG I) 49.88 % (SG II), and 33.44 % (SG III). The value of MUFA and PUFA are given in Table 1. Marine animals are the richest sources of PUFA it accounts about 31.97% of the total fatty acids, where 20:5 and 22:6 acids together accounted for about 90% of the total PUFA (Nair and Mathew, 2000). Among 17 different fatty acids were identified, 10 belong to saturated fatty acid (SFA), 4 were Mono Unsaturated fatty acids (MUFA) and three were polyunsaturated fatty acid (PUFA). The percentage availability of SFA was 48.48% (Size group - I), 49.88 % (Size group – II) and 33.44 % (Size group -III),whereas MUFA was 6.93% (Size group - I), 7.93% (Size group – II) and 5.32% (Size group -III) and PUFA was 9.02% (Size group - I), 7.31% (Size group – II) and 15.64% (Size group -III). Whereas fatty acid contents of *Perna viridis* and *Crassostera madrasensis* accounted 44.06 and 48.4%, 33.74 and 24.04%, 20.47 and 22.15% of SFA, PUFA and MUFA respectively (AjayaBhaskar, 2002).

In the present study arachidonic acid was found in all size groups which was 8.66% (Size group - I), 6.93% (Size group – II) and 4.68% (Size group -III). However, arachidonic acid has been proved effective in improving egg quality (Sargent et al. 1999) and survival at the early life stages of fish (Castell et al., 1994, Bessonart et al., 1999 and Koven et al., 2001). The variation in the SFA level in various size groups can be attributed to seasonal variations, diets and adaptation to habitat changes (AjayaBhaskar, 2002). The saturated fatty acids were the next most common fatty acids 26% in the FD and 25% in the frozen Green ripped mussels of *Perna canaliculus* (Murphy et al., 2001).

In stearic and palmitic acids were commonly high in nature in different species of limpets (Sonia Brazao et al., 2003). In this study the both acids were recorded 14.45% and 22.62% respectively. The water soluble esters of Stearic acid and of palmitic acid (Tween 20 - polyoxyethylene sorbitan monolaurate), and (Tween 40 - PSM) exhibited appreciable bacteriostatic and bactericidal activity against tubercle bacilli in concentrations of 0.01 to 0.001%, but esters of stearic and oleic acid (Tween 60 - PSM) and (Tween 80-PSM) were found inhibitory only at higher concentrations (Dubos, 1947). In the present study, *H. pugilinus* showed dominance of 16:0 and 18:0 fatty acids which constituted 22.62 and 12.86% (SGI) respectively, Therefore *H. pugilinus* would be better alternative sources since it contains both palmitic and lauric acid. Thus present study confirmed that biochemical composition was higher in the foot of various size groups and clearly indicated that they are potential source of nutrition for the currently famished world population.

CONCLUSION

In present study, variation in biochemical composition seems to be governed by different size group and different body parts. The study on proximate composition of *H. pugilinus* revealed that protein and lipid content were high. Fatty acids study depicted that, saturated fatty acids observed were ranging from 16.8 to 22.5% and Stearic acid and Palmitic acid were found to be dominant. This study clearly indicates that the mollusc *H. pugilinus* was the potential source for nutritive value and it is strongly recommended for human consumption.

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