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Meat yield studies in *Harpiosquilla harpax* (de Haan, 1844) and *Oratosquilla anomala* (Tweedie, 1935) (Crustacea: Stomatopoda) represented in the shrimp trawl net by-catches off Visakhapatnam, east coast of India

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ABSTRACT

The meat yield of Harpiosquilla harpax and Oratosquilla anomala was studied, because these two species form an important component of the shrimp trawl net by-catches off Visakhapatnam during January - December, 2009. The mean value of meat yield noticed was 34.53% ± 3.04 and 36.59% ± 2.58 in males and female of H. harpax respectively. The meat yield in females was little higher than males. The mean value of meat yield in O. anomala reported was 39.56% ± 2.55 and 39.49% ± 2.55 for ma les and females respectively. The average mean value of meat yield was almost equal in both sexes. The mean value of meat yield in two species indicated that, O. anomala has higher meat yield than H. harpax. The highest meat yield was observed during monsoon and lowest during pre-monsoon in both the species. Analysis of variance showed that the meat yield was statistically not significant (p>0.05) between the sexes in both species in the present study.

Key words: Meat yield, *Harpiosquilla harpax, Oratosquilla anomala,* Visakhapatnam fishing harbor

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INTRODUCTION

Stomatopods are commonly called as 'Squilla' or 'mantis shrimps'. There are 412 species known to inhabit the world oceans and seas [1]. Of which, 97 species inhabiting in Indo-Pacific region and about 54 species of stomatopods represented in the seas around India [2, 3]. In the fishery point of view stomatopods are macrobenthic communities of demersal invertebrates in marine soft sediments have long been recognized as important resources as global fishery especially in Asia [4,5,6]. Many species of stomatopods are commercially valuable species, such as *Oratosquilla oratoria* [7], *Squilla* sps. [8] and *Harpisquilla raphidea* [9]. However in some countries they are eaten as the meat is also reported to possess medicinal properties [10].The stomatopods *H. harpax and O. anomala* are nutritionally equal to any other food fish and could be used as human food [11].

Stomatopods landed in considerable quantities in almost all maritime states of India. The stomatopods *Harpiosquilla harpax* and *Oratosquilla anomala* form an important component of by-catch of the shrimp trawl at Visakhapatnam fishing harbor [11]. Though stomatopods are landed in large quantities, no concrete work has been made to utilization of these resources. According to literature survey, very little work on the meat yield of stomatopods was undertaken [12,13]. Due to the paucity of information on meat yield of *H. harpax* and *O. anomala* from Visakhapatnam, the present study aims to describe the meat yield in relation to sex, season, length and body weight.

MATERIALS AND METHODS

Stomatopods were collected from the shrimp trawl net by-catches at Visakhapatnam fishing harbor (Lat.17◦41'N.Long.83◦18'E) twice in a month during January to December, 2009. A total of 585 specimens of *H. harpax* (224 males and 361 females) ranging from 74 to 211 mm length and 4 to 76g, weight; 703 specimens of *O. anomala* (370 males and 333 females) ranging from 54 to 119 mm length and 2 to 13g, weight. The specimens were not available in May due to fishing holidays from 15th April to 31st May as a policy, implementing for conservation of marine fishery resources. The freshly collected stomatopod samples were stored in crushed ice and immediately brought to the laboratory, where washed with tap water and sorted into species and sex-wise. The sorted *H. harpax* and *O. anomala* were measured to obtain the kubo's body length. Length measurement was made to the nearest 1 mm and weight was measured nearest 1 g for each specimen.

For easy peeling, the fresh mantis shrimp has to be freezed at -10° c for one hour (Slight modification of Rajeswary method) [14]. After the process of thawing, the shell was removed by cutting with a scissor from the abdominal region up to the 5th thoracic somite. The muscle tissue was separated and weight was noted for each specimen. The percentage of meat yield was calculated adopting the formula [15] as Meat yield (%) = Meat weight (g) /Body weight of mantis shrimp (g)x100 according to sex, season, length and body weight of *H. harpax* and *O. anomala* .

For calculate the meat yield in relation to length, specimens were divided in to three length groups (sex pooled) i.e. 74-119 mm, 120-159 mm and 160-211 mm in *H. harpax*, where as in *O. anomala* specimens were grouped into two length groups i.e. 54-79 mm and 80-119 mm. For calculate the meat yield in relation to weight, specimens were divided into 10g class intervals for *H. harpax* and 2g class intervals for O. *anomala* in order to observe more accurately the difference in the meat yield in relation to change of body weight.

ANOVA was conducted to test the significance of the meat yield between males and females of *H. harpax* and *O. anomala*.

RESULTS

Meat yield in *H. harpax*

Relation to sex:

The percentage of meat yield varied from 8.30 to 45.92% in males and from 32.06 to 45.73% in females. The distinct peak values were observed in Sep and Dec in both sexes. Lowest values were observed in Feb and Mar in males, where as in females lowest values were observed in Mar, Apr and Oct. The mean value of meat yield noticed was 34.53% ± 3.04 in males and 36.59% ± 2.85 in females during the study period (Figure 1). The highest percentage of meat yield was observed during monsoon and the lowest percentage of meat yield was observed during pre-monsoon in both sexes (Table 3).

Relation to length:

The highest percentage of meat yield (41.41%) was observed in length group of 75-119 mm, followed by 120-159 mm (34.62%) and 160-211 mm (33.85%) (Table 1).

Relation to body weight:

The highest percentage of meat yield (40.26%) was observed in weight group of 4-13 g and lowest percentage yield (26.00%) was observed in weight group of 74-83 g (Figure 2).

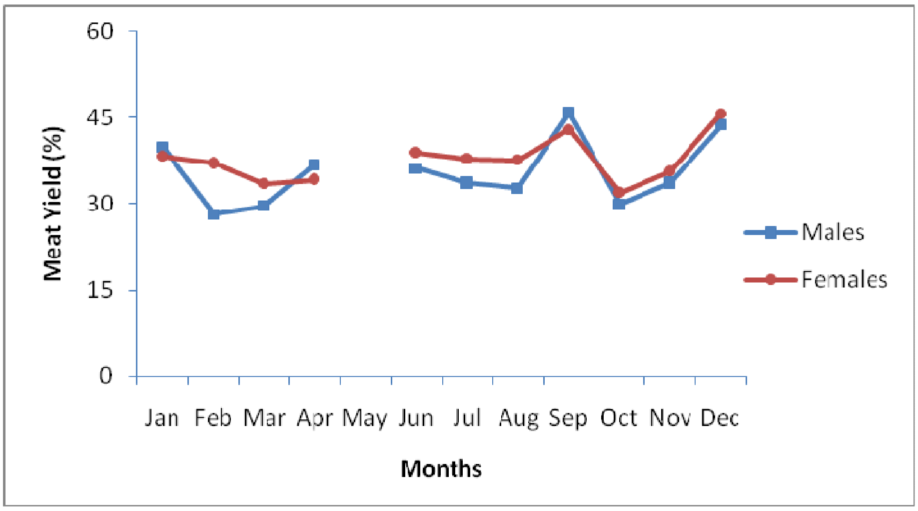

Figure 1: Meat yield in males and females of *H. harpax*

Table 1: Meat yield of *H. harpax* in relation to length

Item Name	Length groups		
	75-119mm	120-159mm	160-211mm
Length (mm)	111.21 ± 2.61	140.30 ± 2.51	173.11 ± 4.28
Body Weight (g)	17.55 ± 3.41	27.52 ± 2.70	42.00 ± 4.62
Meat Weight (g)	6.74 ± 1.04	9.32 ± 1.05	13.51 ± 1.41
Meat Yield (%)	41.41 ± 4.33	34.62 ± 2.94	33.85 ± 2.18

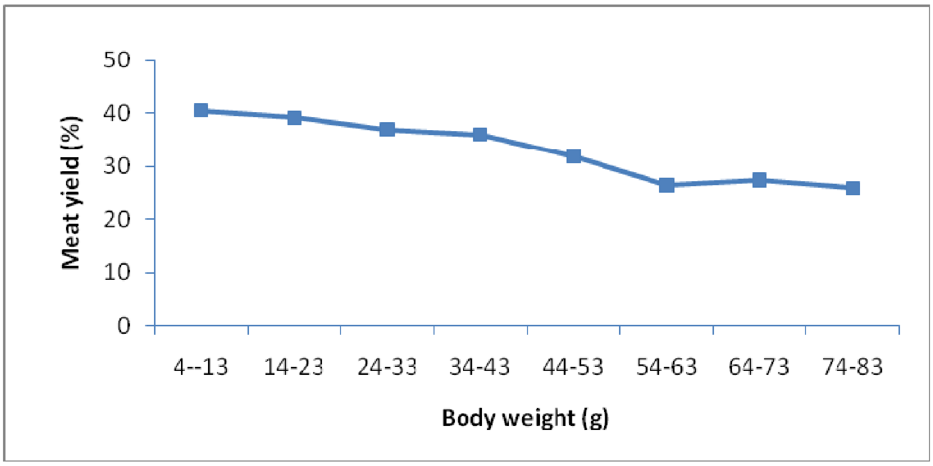

Figure 2: Meat yield of *H. harpax* in relation to body weight

Meat yield in *O. anomala*
Relation to sex:
The percentage of meat yield varied from 35.20 to 48.41% in males, where as in females it was varied between 33.83 and 47.81%. The peak values were observed in Jan and Sep, Dec in males, but in females peak value was noticed in Jun in addition to Jan, Sep and Dec. Lowest values were observed in Apr, Jun and Oct in males where as in females lowest values were observed in Feb and Aug. The mean value of meat yield noticed was 39.56% ±2.55 in males; 39.49% ± 2.55 in females during the study period (Figure 3). Seasonally highest meat value was observed during monsoon, lowest meat yield was observed during pre-monsoon in both sexes (Table 3)

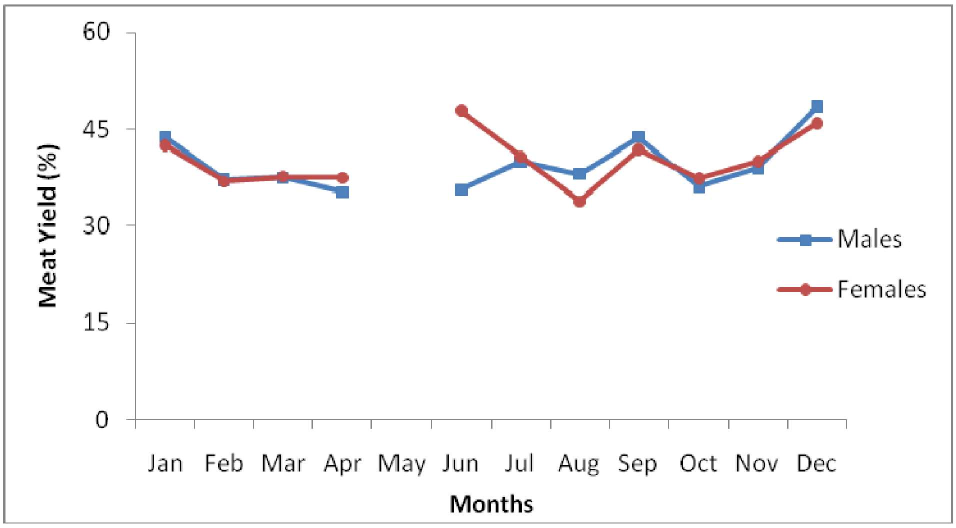

Figure 3: Meat yield in males and females of *O. anomala*

Relation to length:
The highest percentage of meat yield (40.74%) was observed in 54-79 mm length group and lowest percentage of meat yield (36.80%) was observed in 80-119 mm length group (Table 2).

Table 2: Meat yield of *O. anomala* in relation to length

Item Name	54-79mm	80-119mm
Length (mm)	72.15 ±1.43	85.19 ± 1.50
Body weight (g)	5.58 ± 0.30	7.89 ± 0.40
Meat weight (g)	2.23 ± 0.13	2.88 ± 0.14
Meat yield %)	40.74 ± 2.57	36.80 ± 1.75

Relation to body weight:
The highest percentage of meat yield (54.92%) was observed in weight group of 2-3g and low percentage of meat yield (25.64%) was observed in weight group of 12-13g (Figure 4).

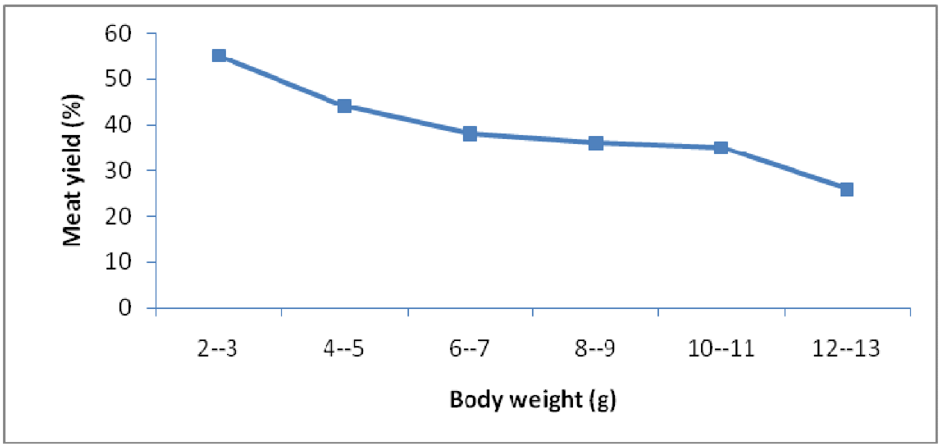

Figure 4: Meat yield of *O. anomala* in relation to body weight

Table 3: Seasonal variations of meat yield in *H. harpax* and *O. anomala*

Season	*H. harpax*		*O. anomala*	
	Male	Female	Male	Female
Pre-monsoon	31.90 ± 1.70	34.57 ± 1.94	36.96 ± 1.33	37.29 ± 1.52
Monsoon	34.87 ± 3.63	39.33 ± 2.94	41.33 ± 2.81	41.93 ± 2.90
Post-monsoon	32.37 ± 4.58	36.18 ± 3.99	38.21 ± 2.32	40.42 ± 2.63

DISCUSSION

The mean value of meat yield noticed was 34.53% ± 3.04 and 36.59% ± 2.58 in males and female of *H. harpax* respectively. The meat yield in females was little higher than males. Where as in *O. anomala* the mean value of meat yield reported was 39.56% ± 2.55 and 39.49% ± 2.55 for males and females respectively. The mean value of meat yield was almost equal in both sexes. The mean value of meat yield in two species indicated that, *O. anomala* has higher meat yield than *H. harpax*. It was further noticed that the highest meat yield was observed during monsoon and lowest during pre-monsoon in both the species. Analysis of variance showed that the meat yield was statistically not significant ($p>0.05$) between the sexes in both species in the present study. Similar findings were also noticed in crayfish *Cherax quadricarnatus* [16] and squilla *O. oratoria* [13].

The meat yield was related to length and body weight indicated that the highest percentage was noticed in lower length and weight groups in both the species. The lowest percentage in higher length and weight groups, may be attributed to the spawning activity, moulting, formation of excessive chitinous exoskeleton, age etc. Kenneth et al., [16] and Kodama et al., [13] also mentioned that the lowest processed meat yield may be related to moulting, maturity and condition of individual in crustaceans. Relating meat yield to body weight has been reported to be misleading since large individuals may have a greater weight attributed to the exoskeleton [17]. Furthermore, the degree of mineralization can vary among individuals, population and species [18]. However, calculating muscle weight as a percentage of total body weight does allow relative comparison [16].

Tanuja and Hameed [12] reported that the meat yield in similar species *O. nepa* was 20% only. Dabrowski et al., [19] noticed that the meat yield for females was 14.41% of the body weight, and for males it was 16.53% in American crayfish *Orconectes limosus.* According to Harlioglu and Holdich [17], the meat yield of narrow clawed crayfish noticed was 9.45% and during summer increases up to 19.55%. Berber and Balik [20] established average values of 16.45% for the population of cray fish. The study of Hubenova et al., [21] showed that the total meat yield for females of narrow clawed crayfish *Astacus leptodactylus* ranged between 10.07% and 12.24%, and for males between 10.15% and 14.13%. Gustao-Yomar et al., [22] reported that the greater meat yield was in the carapace than other body parts of crab *Callinectes bocourti* , the total yield from the males (28.57%) was significantly higher than the females (22.10%). Chiou and Haung [15] reported muscle yield in mud crab *Scylla serrata* with a range of 10.60-17.60% (15.10% ± 2.00%) and 11.00-19.10% (14.60 ±2.10) in the males and females respectively and they stated that the females had a large variation in muscle yield throughout the year, but no significant changes in muscle yield were observed in males. Hubenova et al., [23] reported that the relative meat yield for males taken on an average 22.90% ± 2.36% of the body weight, while for females the average value was significantly lower 14.97% ± 2.78% in stone crayfish *Austropotambius torrentium.*

CONCLUSION

The present study indicates that the meat yield of stomatopods, *H. harpax* and *O. anomala* is significantly higher than meat yield of other crustaceans discussed in this study, further the highest percentage of meat yield is noticed in juveniles than adults in both the species.

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