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Comparative Analysis of Biochemical Composition of Fresh and Cooked Meat of *Portunus pelagicus* (Linnaeus 1957)

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ABSTRACT
Blue swimmer crab Portunus pelagicus is a predominantly available and economically valuable species found along the southeast coast of India. In this report, we have a detailed comparative study on the biochemical composition (total protein, carbohydrate, lipid, moisture and ash content) between fresh and cooked meat found in male, female and berried crabs in their body, claw, and leg meat separately. The meat yield was highest in fresh male body meat (12.13%) when compared to cooked male body meat (11.36%). The lowest yield was recorded in cooked female leg (1.91%) and it was (2.53%) in fresh female leg. The nutrients were generally found more in body meat followed by claw meat, and leg meat (body meat>claw meat>leg meat) both in fresh and cooked crabs. Among the macronutrients, protein was found to be maximum in fresh male body meat (47.05%) when compared to cooked male body meat (38.18%). The second highest macronutrient was found to be lipid which was higher in fresh berried body meat (10.02%) than in cooked berried body meat (9.04%). Carbohydrates was maximum in fresh female body meat (3.58% and it was slightly lower (3.07%) in cooked female body meat. Ash was found be and (13.2%) and (12.5%) in fresh and cooked female body tissue respectively. Moisture content was more in fresh male body meat (80.5%) when compared to (69.5%) in cooked male body tissues. Hence, in terms of nutritional value, male and female crabs may be considered more suitable than the berried for consumers.
Keywords: *biochemical, protein, carbohydrate, lipid, moisture, ash*

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INTRODUCTION

The world population has increased dramatically during the twenty first century. Although agricultural food production has kept pace with world population growth, the rate of population growth has outstripped the food production significantly. As a result, there is a shortage of protein in the diet of the common people. A plausible solution of the problem is aquaculture. The advent of Blue Revolution has become one of the man's the greatest hope for future food supplies to the growing human population. Aquaculture is the fast growing food producing sector providing 50% of the world fish caught as food to people [1]. India ranks second in Aquaculture and make an essential contribution to human food and nutrition security throughout the world. Even though we have been successful in increasing the food supply to meet the demand of growing population, only a few species have been focussed [2]. In general, seafood products, which include crustacean shellfish, have been praised for their health supporting characteristics. Crab is considered as a delicacy food. Crab meat is a famous and versatile kind of seafood. It is also very healthy and a good addition to a balanced diet, as it contains many nutrients coupled with a low fat content.

Blue swimming crab, *Portunus pelagicus* (Linnaeus, 1957) is an important coastal species found around the world, which have high demand and high value in the local and world markets. It forms an important large commercial species of the Indo-Pacific region. They are usually found in large numbers in shallow bays with sandy bottom. The blue swimming *P. pelagicus* is distributed from the eastern Mediterranean to east Africa in the Indian Ocean and to Japan and Tahiti in the Western and South Pacific Ocean [3]. It also occurs in estuarine waters throughout the Indo-West Pacific from Africa to India, Southeast Asia and Australia [4]. In India, the species is available all along the coast, prominently in the southeast and the

south-west regions and breeds round the year [5]. It is distributed throughout the coastal waters of the tropical regions of the western Indian Ocean and the Eastern Pacific [6]. From India, *P. pelagicus* crab was exported as whole frozen crab or as canned meat. It is collected and exported in large scale particularly in Mimisal, Tamil Nadu. The knowledge of the biochemical composition of any edible organism is extremely important since the nutritive value is reflected in its biochemical composition. Hence, the present study aims to analyze the comparative study of proximate composition of fresh and cooked meat of *P. pelagicus* of Mimisal coast.

MATERIAL AND METHODS

Specimen collection

Live (male, female and berried) crabs were collected from Mimisal landing centre (9.9202 E and long 79.1528 N) in the month of December, 2014. They were washed to remove the sand particles and weighed in the collection point. Carapace was removed carefully from each animal and meat (found in body, claw and leg) were taken separately using forceps. The separated meat and carapaces were collected in ziplock covers, labelled and brought to the college laboratory in an icebox. The meat was homogenized using mortar and pestle, centrifuged at 25,000 rpm for 20 min and taken for the analysis [7].

Analytical methods

Meat content, total protein, total carbohydrates, total lipid and moisture content were estimated following standard methods [8,7,9,10,11] respectively. Total ash was estimated by incinerating the pre-weighed samples in the muffle furnace at 560°C for a period of 5-8 hours [11].

Statistical Analysis:

The data were subjected to analysis of variance (one way ANOVA) and significant differences (if $P < 0.05$) between the means were compared with Turkey's post hoc test using PAST 3.09 version.

RESULTS

The grouping of the fresh and cooked crabs for the analysis of proximate composition was presented in Figure (1, 2 and 3). The results revealed significant variations in the biochemical constituents of body meat, claw meat, and leg meat of male, female and berried fresh (Table 1) and cooked *P. pelagicus* (Table 2). Meat content was highest in males followed by berried and female crabs. Meat yield of body, claw and leg significantly differed among male, female and berried crabs of both fresh and cooked groups (Table 1 and 2) and between the groups were significantly different ($p > 0.05$) (Table 3). The results are expressed on dry meat weight basis.

Macronutrients viz proteins, carbohydrates and lipids content of body, claw and leg were significantly different among male, female and berried crabs of fresh crabs (Table 1) and cooked crabs (Table 2) and between the groups ($p>0.05$) (Table 3). The total protein content forms the highest biochemical component followed by lipid (second) and carbohydrate (third) component in the meat of the crabs. In the present study, protein content was highest in males followed by females and berried crabs while carbohydrate content was highest in females followed by berried and males. Lipid content was highest in berried followed by females and males. Moisture and ash content was also significant among fresh, cooked groups (in male, female & berried) and also between groups (Table 1, 2 and 3). In the present study, moisture content was higher in males followed by females and berried crabs.

DISCUSSION

Biochemical studies are very important from the nutritional point of view. Accumulation of energy reserves in marine species can be utilized for consumption or to extract useful products from it. *P. pelagicus* occurs in large numbers along the coasts of Mimisal. The biochemical composition comprises of five basic components viz protein, lipid, carbohydrate, moisture and ash [12]. These energy yielding nutrients are present in high levels in the fresh meat of *P. pelagicus* when compared with cooked meat. Large variations occur in the proximate composition of any organism which is influenced by several factors like species, habitat, diet, water temperature, and seasons [13]. Even slight variations occur in the proximate composition within the same species due to several factors like sex, sexual maturity and spawning [14].

In general, consumers select species with more meat content and high nutritive value. Only very few works have been carried out on the comparative analysis of fresh and cooked crab meat. In the present study, biochemical composition of fresh meat of *P. pelagicus* (male, female and berried crabs) showed high proportion of all macronutrients, moisture and ash content than in the cooked meat. Proximate composition of southern king crab (*Lithodes santolla* Molina, 1782) showed more protein, moisture, fat and ash content (g/100 g meat) in raw meat than in cooked meat [15]. Biochemical composition of

Penaeus monodon, Portunus sanguinolentus, Perna viridis of fresh meat were higher than the cooked meat [12]. Similarly, the biochemical and microbiological evaluation of raw and processed meat of *P. pelagicus* collected from Thondi, Tamil Nadu found with total protein, free sugars, lipids, and phospholipids in raw meat when compared with processed meat [16]. Recently, proximate composition and mineral content among fishes after various cooking methods have been reported [17]. In the present study, meat yield was observed in the following order Male>Female>Berried in fresh and cooked meat. Similarly, more meat yield was seen in male crabs than in female crabs of *Callinectes sapidus* species [14], *Ucides cordatus* [18] and of *P. pelagicus* [19]. In general higher proportion of meat yield was seen in males than in females because they have bigger claws when compared with female crabs.

Proteins are recurrently used for growth and repair of tissues caused by moulting in crustaceans [20]. In the present study, protein content was observed in the following order Male>Female>Berried both in fresh and cooked meat. During cooking, heat causes the protein molecules to denature and unfold its native structure [21]. As proteins constitutes over half of the dry weight of the animal, cooking results in slight decrease in protein content due to the inhibition of protein synthesis in it. Energy giving macronutrient carbohydrates content was higher in the following order Berried>Female>Male both in fresh and cooked meat. In *P. pelagicus*, more glycogen was found in body and claw meat of males than in female crabs [22]. But elevated levels of carbohydrates in berried than males and females of *P. vigil* crabs were also recorded [23]. Reproduction and moulting are the two major physiological events in crustaceans life cycle, thus females have recorded higher carbohydrate composition followed by berried crabs when compared with male crabs.

In the present study, lipid content was observed in the following order Berried> Female>Male in both fresh and cooked meat. Lipids tend to act as main biochemical constituent concerned with storage of energy. The biochemical composition of eggs of *P. pelagicus* showed more lipid content [3]. During embryonic development in decapods, eggs utilize more fat than protein [24]. Hence, berried crabs may have more lipids to nourish the developing eggs than females and males crabs. The moisture content of the meat is an essential factor to ensure that it acceptable prior to consumption. Also it is closely related to determine the freshness and stability of meat storage for a long period of time. In the present study, moisture content was observed in the following order Male>Female>Berried in both fresh and cooked meat. The present study results are in accordance with [25,26]. The ash content was observed in the following order Female>Berried>Male in both fresh and cooked meat. Fresh food ash content rarely exceeds 5%. The higher value recorded in the present study could be due the presence of rich minerals.

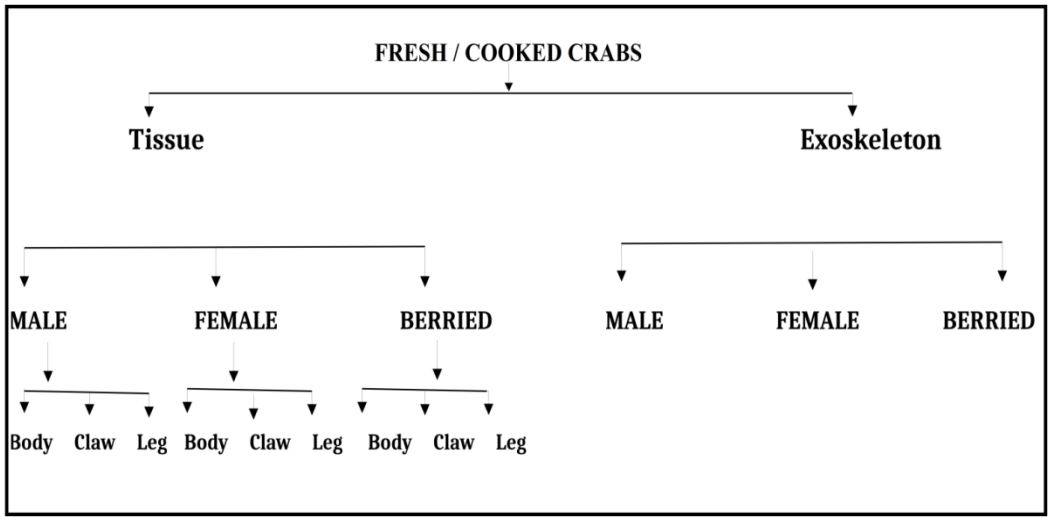

Figure 1 Grouping of the crabs

Figure 2 Fresh crabs

Figure 3 Cooked crabs

Table 1 Proximate analysis of fresh tissues of *Portunus pelagicus* from male, female and berried crabs.

Proximate analysis		Body	F Value Significant Level *P<0.05*	Claw	F Value Significant Level *P<0.05*	Leg	F Value Significant Level *P<0.05*
Meat content (%)	FM	12.13	F = 56.06	8.10	F = 82.89	4.18	F = 62.82
	FF	10.45		5.81		2.53	
	FB	10.56		6.41		3.26	
Protein (mg%)	FM	47.05	F = 3357	26.71	F = 21.52	11.88	F = 549.8
	FF	40.65		23.00		9.65	
	FB	38.12		20.47		7.71	
Carbohydrates (mg%)	FM	2.92	F = 758.5	2.34	F = 488.7	2.13	F = 117.2
	FF	3.58		3.03		2.44	
	FB	3.21		2.73		2.29	
Lipid (mg%)	FM	7.76	F = 1717	5.0	F = 5607	3.92	F = 4510
	FF	8.87		6.86		5.49	
	FB	10.02		9.69		7.51	
Moisture (%)	FM	80.5	F = 159.7	75.8	F = 95.68	71.6	F = 82.24
	FF	78.8		73.9		70.2	
	FB	76.3		72.5		68.5	
Ash (%)	FM	10.6	F = 58.24	7.5	F = 41.43	3.5	F = 30.8
	FF	13.2		9.8		5.2	
	FB	11.4		8.4		4.8	

Table 2 Proximate analysis of cooked tissues of *Portunus pelagicus* from male, female and berried crabs.

Proximate analysis		Body	F Value Significant Level *P<0.05*	Claw	F Value Significant Level *P<0.05*	Leg	F Value Significant Level *P<0.05*
Meat content (%)	FM	11.36	F = 62.51	7.11	F = 58.96	3.22	F = 25.42
	FF	9.33		4.90		1.91	
	FB	10.21		5.48		2.41	
Protein (mg %)	FM	38.18	F = 543	24.76	F = 1525	10.24	F = 396.1
	FF	36.41		21.35		8.59	
	FB	34.18		18.82		6.65	
Carbohydrates (mg %)	FM	2.45	F = 130.4	2.12	F = 128	1.81	F = 152.5
	FF	3.07		2.55		2.21	
	FB	2.91		2.40		2.02	
Lipid (mg %)	FM	5.96	F = 4620	3.61	F = 5281	2.59	F = 1134
	FF	6.39		4.16		3.31	
	FB	9.04		8.18		4.61	
Moisture (%)	FM	69.5	F = 619.1	65.9	F = 891.8	60.6	F = 1041
	FF	66.2		62.0		56.0	
	FB	62.4		58.1		51.4	
Ash (%)	FM	9.3	F = 81.6	5.5	F = 21.67	1.7	F = 10.17
	FF	12.5		7.2		3.1	
	FB	10.1		6.3		2.7	

CM – Cooked Male; CF – Cooked Female; CB – Cooked Berried crabs
Df Value: Between Groups – 2; Within Groups – 21 (Meat content)
Between Groups – 2; Within Groups – 15

Table 3 Comparison of proximate composition between fresh and cooked tissues of *Portunus pelagicus* from male, female and berried crabs

Proximate analysis	Groups	F value Significant Level *P<0.05*		
		Body	Claw	Leg
Meat content (%)	M	8.2	28.62	22.61
	F	19.8	11.74	9.54
	B	17.52	18.15	32.66
Protein (mg %)	M	5225	327.8	172.4
	F	1080	455.5	106.8
	B	1757	146.8	49.61
Carbohydrates (mg %)	M	110.5	75.02	402.6
	F	775.6	608.6	105.1
	B	212.8	159.9	40.47
Lipids (mg %)	M	3183	868	1416
	F	4737	5569	3402
	B	549.9	777.5	3572
Moisture (%)	M	2335	3346	3285
	F	4956	3273	3674
	B	4437	3633	5827
Ash (%)	M	24.64	55.54	34.85
	F	5.63	73.04	109.4
	B	34.09	119.1	41.97

M – Male F- Female B – Berried crabs

CONCLUSION

The present study revealed that the meat of male and female crabs contain higher macronutrients and ash content than the berried crabs. Hence, it is better to catch crabs before breeding season. The high nutritive value and great palatability of this species encourage its suitability for being appropriate seafood. Being a highly nutritional species, nearly major portion of the caught crabs were sold to seafood companies for export. It can be used by the local people to meet the malnutrition and as a high protein

alternate food. The exoskeleton of this species also showed high proximate components and thus can be powdered and used as animal feeds besides extracting chitin, chitosan and carotenoids.

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CONFLICTS OF INTEREST
The authors declare that they have no conflicts of interest.

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