Biochemical Studies on Crab *Scylla Serrata**

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Studies on the biochemical composition of crab meat from body and claw revealed marked differences in relation to flavour. Protein content is on the higher side in crabs (19.1 to 20.9%) with high percentage of free amino acids and phosphorus and less carbohydrate and fat. The variation in composition due to the presence of eggs in female crabs and the importance of claw liquor and its composition are reported.

The works of Heath (1970) on the biochemical composition of crab *Carcinus maenas* during moult cycle, Badawi (1971), on the chemical composition of *Portunus pelagicus* and Addisson *et al.* (1972), on the lipid content of the queen crab *Chinocetes opilio* are worth mentioning. Radhakrishnan & Natarajan (1979), had reported the proximate composition in different size groups of crab *Podophthalmus vigil.* Velankar & Iyer (1961), studied the amino acid pattern of crab *Neptunus pelagicus,* and Chatbar & Velankar (1979), studied the vitamin B_{12} content in crab *Scylla serrata.* Allen (1971) gave an account of the amino acid and fatty acid composition of the tissues of dungeness crab. The studies on the variations in the protein content in different tissues of fresh water crab as a function of salinity adaptation by Venkatachari & Vasantha (1973) are worth mentioning. The information on the biochemical composition of *Scylla serrata* both body and claw meat and claw juice is scanty and the present paper is dealing with such studies.

Materials and Methods

Female crabs of 12 ± 1 cm length were selected for the studies. They were washed in chlorinated water and the carapace length and breadth were measured and whole weight of the animal was recorded. After removing the carapace the orange red coloured eggs in the intestinal cavity was picked up and its weight determined. Crab body was cleaned free of gills, intestines and by cutting off the intermittant shells the meat was picked up and weighed. The claw shell was cut open with scissors, the liquor retained inside the cavity was collected, its volume and weights determined and the weight of the claw meat was also determined. The muscle was cooled to 0°C and minced. This minced muscle was taken for the different analysis. Three series of experiments were conducted and the average values are reported. Moisture, protein, ash and lipids were estimated according to AOAC (1975).

Fractionation of protein: Protein fractions were accomplished by the preferential solubility technique of King (1966) and Paul *et al.* (1966). Potassium phosphate (KH_2PO_4), sodium phosphate (Na_2HPO_4) buffer of μ 0.05 and pH 7.45 were used for the extraction of sarcoplasmic proteins at 0–3°C. The myofibrillar proteins were extracted using KCl–KH_2PO_4 – Na_2HPO_4 buffer (μ 0.5, pH 7.5) at 0–3°C. For extraction of nucleo proteins 80% ethyl alcohol was used at 0–3°C and for inextractable denatured proteins 0.1 N sodium hydroxide at room temperature (25–27°C) was used. Residue after these extractions was directly digested to estimate the stroma or connective tissue.

All samples were similarly extracted with Dyer's (1950) buffer (5% sodium chloride and 0.02 m sodium bicarbonate μ 0.87, pH 7.2) at 0–3°C and centrifuged.

An aliquot sample from each extract was digested and its nitrogen content determined. Total nitrogen in the muscle was determined on each sample by digesting one gram of

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the minced muscle with sulphuric acid and determining its nitrogen content.

Total non-protein nitrogen was determined by precipitating all protein from an aqueous extract of the muscle (10g) by blending with 20 ml trichlor acetic acid and filtering off the precipitate. The filtrate was made upto 250 ml and its nitrogen content was determined. Content of the different protein nitrogen fractions was then calculated and expressed as percentage of total protein nitrogen and non-protein nitrogen fraction as percentage of total nitrogen.

Water extractable nitrogen: 10 g of the minced muscle was blended with 200 ml distilled water in a waring blender for one min, filtered, an aliquot of the filterate was digested and its nitrogen content was determined.

Free alpha amino nitrogen was estimated by the method of Pope & Stevens (1939) and the extraction of free amino acids has been made according to Jones (1959), and the determination of amino acids by the microbiological assay method of Schockman(1963).

Glycogen was estimated by the method of Van de Kleiy (1951) and phosphorus (total and inorganic) by the procedure of Fiske & Subbarow (1925) and ribose by the method of Mejbaum (1939). The extraction of pigments in body meat and claw meat of crab was effected using acetone and measuring the optical density at 470 nm (Rousseau Jr 1960; Lusk *et al.*, 1964; Stewart James, 1970). Sodium, potassium and calcium were estimated by flame photometry (Vogel, 1961).

Results and Discussion

Water, protein, fat and carbohydrates are the main constituents of fish and shell fish with non-protein nitrogenous constituents and salts in small measures. Table 1 gives an account of the proximate composition of the body meat of crab picked from female crabs of same size group, one having egg (1) and the other without egg (2). Meat content in sample 1 is only 21.9% while in the other 26.4%, the difference is due to the presence of egg in the first sample. Protein content is on the higher side in crabs

Table 1. *Proximate composition of crab (Scylla serrata)* meat

Chemical constituents	With egg (1)	Without egg (2)
Moisture %	78.02	77.20
Size ratio	1.386	1.316
Meat weight %	21.94	26.46
Egg %	12.3	Nil
Protein (TN x 6.25) %	19.16	20.92
Water extractable nitrogen mg%	1387	1666
Non protein nitrogen mg%	896	812
Free alpha amino nitrogen mg%	378	291.3
Glycogen mg%	870	1345
Phosphorus (inorganic) mg%	180	160
Fat g%	0.43	0.70

TN = Total nitrogen

Note: 1. All samples belonged to same size group and were females.
2. Results obtained relate to average values of 10 samples of crab.
3. Values are the average of 3 estimations.

(19.1–20.9%) and high percentage of free alpha amino nitrogen and phosphorus are observed and glycogen and fat contents are extremely low. In all the indices studied distinct difference is noticed between samples with egg and without egg, lesser values in crabs carrying egg.

Body meat and claw meat of crab differ in proximate composition, protein fractions, minerals and free amino acids (Table 2). Yield is more in claw (42–47.3%) compared to crab body (23.6–36.0%). Water content is more in claw meat and much variation is not observed in protein, lipid or ash contents in both. Body meat gives higher values for glycogen and phosphorus but the pentose sugar ribose content is slightly higher in claw meat than the body meat. The minerals, potassium and calcium are slightly higher in body meat but sodium is extremely higher in claw meat.

Table 3 gives the analytical data of claw liquor. About 21% of the whole weight of claw is liquid. 3.9 g protein, 111 mg

Table 2. *Composition of body meat and claw meat of crab (Scylla serrata)*

	Body meat	Claw meat
Meat content g%	23.6–36.0	42.0–47.3
Moisture g%	80.19	82.94
Protein (TN x 6.25) g%	16.80	16.28
Fat g%	1.07	1.00
Ash DWB g%	5.09	5.11
Acid insoluble ash DWB g%	0.176	0.057
Glycogen mg%	665	496
Phosphorus total mg%	411	384
Phosphorus (in) mg%	184	131
Ribose mg%	168	176
Potassium mg%	207.6	180.2
Sodium mg%	390.4	515.3
Calcium mg%	165.7	161.1
Pigments O.D. of acetone extract at 470 nm	0.10	0.59

TN = Total nitrogen

Note: 1. Results obtained relate to average values of a composite sample from 10 crabs.
2. Values are average of 3 estimations.

Table 3. *Composition of claw juice*

Juice volumes, ml/100 g claw	20.8
Protein, g/100 ml	3.9
Alpha amino N, mg/100 ml	111
Phosphorus (inorganic), mg/100ml	21
Ribose, mg/100 ml	26
Glycogen, mg/100 ml	9

Note: 1. Results obtained relate to average values of a composite sample from 10 crabs.
2. Values are averzge of 3 estimations.

alpha amino nitrogen, 9 mg glycogen, 21 mg phosphorus (inorganic) and 26 mg ribose on the basis of 100 ml are present in claw liquor.

Table 4 presents the protein fractions of body meat and claw meat of crab. The extractability of nitrogenous constituents in Dyer's buffer are 97.70 and 90.60% and non protein nitrogen 27.34 and 26.71% respectively in body meat and claw meat. Sarcoplasmic protein content is more in body meat (33.33%) but the myofibrillar protein in claw meat (58.98%). Nucleoprotein and connective tissue are slightly higher in body meat. The denatured protein content is more in claw meat (10.6%). This gives an indication of the denaturation of the native sarcoplasmic or myofibrillar proteins occurred during the extraction process.

Table 4. *Protein fractions in body meat and claw meat of crab*

Protein fractions	Body meat	Claw meat
Total nitrogen g%	2.688	2.680
Soluble protein in Dyer's buffer as percent of T.N.	92.70	90.60
Non protein nitrogen as percent of T.N.	27.34	26.71
Sarcoplasmic protein as percent of protein	33.33	28.22
Myofibrillar protein as percent of protein	56.63	58.98
Nucleoprotein as percent of protein	2.55	1.87
Denatured protein as percent of protein	7.00	10.60
Stroma or connective tissue as percent of protein	0.39	0.21

T.N. = Total nitrogen

Note: 1. Results obtained relate to average values of a composite sample from 10 crabs.
2. Values are average of 3 estimations.

Table 5 gives the free amino acid pattern of body meat and claw meat of crab. In both body meat and claw meat, glycine-alanine constitute the major amino acid pool (82.4 and 52.5% respectively). Other major amino acids in body meat are lysine (4.1%), aspartic acid (3.1%), and histidine (2.28%). In claw meat lysine concentration is 19.1%, valine 5.0%, histidine 4.3%, leucine and phenylalanine 3.5% each. Both body meat and claw meat contain all the essential amino acids recommended by FAO/WHO (1973).

Flavour is a complex concept involving primarily aroma and taste, but also appearance, behaviour on manipulation, feel in the mouth and even the sounds emitted on chewing (Nursten, 1975). While much information has accumulated concerning the

Table 5. *Amino acids* (% of total free amino acids) *in crab (Scylla serrata)*

	Body meat	Claw meat
Free alpha amino nitrogen mg%	283.5	275.8
Aspartic acid	3.090	0.07742
Threonine	0.849	0.8197
Serine	0.427	0.409
Glutamic acid	0.724	0.469
Proline	0.452	
Glycine+Alanine	82.416	40.98+ 11.64
Cystine	0.679	0.348
Valine	1.086	5.06
Methionine	0.335	1.82
Isoleucine	0.4596	1.36
Leucine	1.03	3.59
Phenylalanine	0.554	3.415
Tyrosine	0.253	1.475
Histidine	2.282	4.335
Lysine	4.12	19.12
Arginine	1.20	0.32
Tryptophan	0.17	0.198

Note: 1. Results obtained relate to average values of composite sample from 10 crabs.

2. Values are average of 3 estimations.

chemistry of fish much of it has not been correlated directly to flavour (Jones, 1961). The peculiar flavour characteristics in body meat and claw meat of crab can be attributed to the differences in the amino acid pattern, sugar content and mineral salts. Body meat is more juicy and sweet probably due to the presence of more glycine, glycogen and sarcoplasmic protein. The granular texture in claw meat is due to the presence of more myofibrillar proteins in it. The higher concentration of sodium in claw meat also support the peculiar salty taste in that.

The abnormal concentration of pigments in claw meat is due to the thick membrane covering the muscle inside the claw shell, on the other hand the body meat is not fully covered with membranes but packed in between thin shells. The lesser quantity of connective tissue in both muscles shows the easy digestibility of the muscle.

The present findings support the previous observations of Velankar & Govindan (1958) that the concentrations of the amino acids in prawns and crustaceans are about ten times as high as that in fishes. Robert & Mary (1966) observed variations in body constituents according to season in body meat and claw meat. Nelson & Claude (1965) observed high protein and low oil contents and higher quantities of sodium and potassium in dungeness crab *(Cancer magister)*. Chinnamma George & Arul James (1971) observed marked changes in composition due to season of the year in crab *Scylla serrata.*

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