IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 8, Issue 5 Ver. II (May. 2014), PP 50-57
www.iosrjournals.org

Proximate composition, Amino acid, Fatty acid and mineral analysis of box crab, *Calappa lophus* (Herbst, 1782) from Parangipettai, Southeast Coast of India

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Abstract: *The proximate composition of protein, lipids, carbohydrate, minerals and other minor components of Calappa lophus was analyses. The crab was separated into two parts, which is body (Shell and Muscles) and appendages (Walking legs Claws). The digestive system was removed edible portions were taken separately and the tissues samples were kept in an electric oven at 75°C (30 Min.) for proper drying. The Calappa lophus appendage and body region has average quantity of Protein, Carbohydrate, Fat, Ash and Moisture in the level of (22.19 gm, 21.45gm), (8.34gm, 5.45gm), (55.18gm, 61.91gm), (2.56gm, 2.98gm), (73.11gm, 82.98gm) respectively. Totally twenty-one amino acids were found in the box crab. Therefore, eleven essential amino acids (EAA) and ten non essential amino acids (NEAA) were detected. In maximum 0.925 mg Lysine was detected in an appendage. Minimum concentration of EAA Tryptophan 0.193 mg was observed in body portion of box crab. Important EAA Taurine 0.251 mg detected in the crab. In NEAA Glutamic acid 1.012 mg was the maximum level of NEAA in body part. Aspargine 0.119 mg was observed as a minimum quantity of NEAA in body part. Totally six fatty acids were found in appendage and body of box-crab. In appendage 8.39 mg of Stearic acid 18:0 was observed as the high quantity of fatty acid and in minimum 0.35 mg of Moroctic acid 18:4 was detected in the body part of C. lophus. Totally seven major minerals are observed in this C. lophus both sample. Calcium (Ca), Magnesium (Mg), Zinc (Zn), Iron (Fe), Copper (Cu), Sodium (Na) and Potassium (K) were present in both sample of C. lophus. The calcium 245.2 mg was observed as a major element in appendages. The objective of present study is to conclude the proximate composition and nutrition value of the box crab to encourage an increase in the utilization of these species in larger amount.*

Keywords: *Amino acid, Box crab, Calappa lophus, Fatty acids, Minerals.*

I. Introduction

The marine food consumption of human resources has increased rapidly in world-wide. As a whole, seafood products, including crustacean, shellfish have been acclaimed for their health promoting characteristics. The Shellfish are nutritionally precious sources of various minerals and high quality of protein concentrations to human [1,2,3,4,5]. Though the nutritional composition of many commercially harvested species of crab has been partially described, in general, shellfish vary in their nutrient content [6]. The chemical composition and nutritive value of crab meat have been extensively investigated in various parts of the world [7,8,9]. Albeit determining of the proximate composition and mineral elements of crab species has a great importance due to the good effect on human health. Box crabs are having a good source of essential amino acids, fatty acids and minerals. Therefore, it is so compulsory for human health, from these minerals like Calcium (Ca) and Irons (Fe) are basic components to maintain an optimal bone development, more of both minerals being required during childhood and growing stages to prevent Rickets and Osteomalacia disorder [10]. Ca has a very important role in blood clotting functions, muscle contraction and nerve transmission on human. Fe is an essential for many proteins and enzymes that sustain good health and oxygen transformation in the blood to all parts of the body as well as proper functioning of the liver [11]. Zinc (Zn) is a constituent of many enzymes and is essential for the proper function of these various enzymes. Zn is essential for the metabolism and structural stability of nucleic acid. Zn has been associated with variety of bodily functions such as the wounds healing, production, growth and maintenance of glucose acceptance in the body [12].

Box crab were distinctly massive carapace and the name of shame-faced is came from incarnate the way the crab's claws fold up and cover up its face, as if it were hiding its face in shame. In general, the box crabs were generally edible and larger verities are in good demand.

The objective of present study is to conclude the proximate composition and nutrition value of the box crab to encourage an increase in the utilization of these species in larger amount.

II. Material And Method:

The crab was collected lively at Mudasal odai landing center, Parangipettai (Lat.11°29'N; Long.79°46'E) and transported immediately to the laboratory for the analysis. The crab was separated into two parts, which is body (Shell and Muscles) and appendages (Walking legs Claws). The digestive system was removed edible portions were taken separately and the tissues samples were kept in an electric oven at 75°C (30 Min.) for proper drying. The dried samples were powdered and stored for below mentioned estimations.

2.1. ESTIMATION OF PROTEIN:

The Folin-Ciocalteu Phenol method of Lowry et al., (1951) was used for the estimation of total protein in the crab [13].

2.2. ESTIMATION OF LIPID:

The total lipid content was estimated gravimetrically by following Folch et al., [14].

2.3. ESTIMATION OF CARBOHYDRATE:

The total carbohydrate was estimated by phenol- sulphuric acid method of Dubois et al., [15].

2.4. ESTIMATION OF AMINO ACIDS:

The experimental samples were finely ground for estimating the amino acids in the HPLC (Merck Hitachi L-7400) following the method of Baker et al., [16].

2.5. FATTY ACID ANALYSIS:

For fatty acid analysis, the samples were homogenized with chloroform: methanol (2:1 v/v) mixture and they were extracted using the method of Bligh et al. [17]. After the fat was extracted, they were esterifies with 1% H2So4 and fatty acid methyl esters were prepared by following the procedure of AOAC. The identification and quantification of fatty acids were done using Gas Chromatography (Hewlett Packard 5890 model). [18].

2.6. ESTIMATION OF VITAMINS:

The fat soluble vitamins A, D, E and K and the water soluble vitamins B1, B6, B12 and C were analyzed in the HPLC (Merk Hitachi L-74000) following the method described by Sadasivam and Manickam. [19]The folic acid was estimated by following the calorimetric procedure of Sethi [20].The pyridoxine, panthothenic acid and vitamin B12 were estimated by following methods are suggested in USP NF 2000 Asian edition.

2.7. ESTIMATION OF MINERALS

The minerals were estimated by following the method of Guzman and Jimenez (1992) [21].

III. Result:

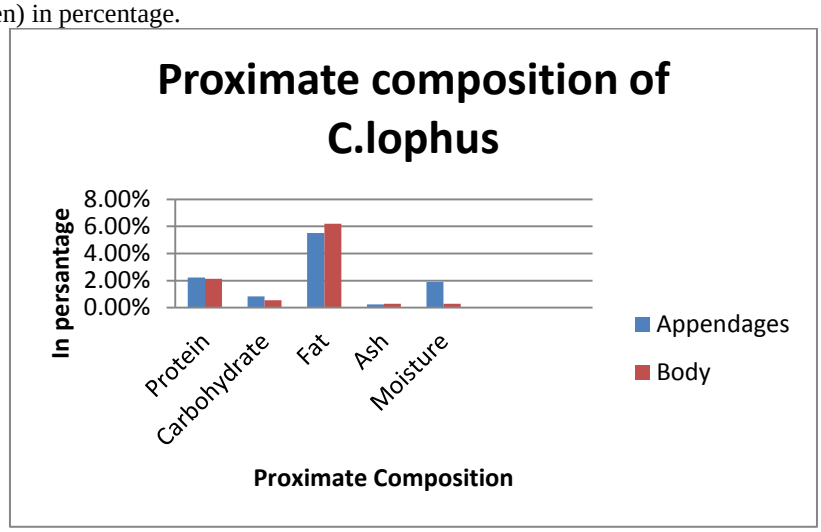
3.1. PROXIMATE COMPOSITION:

In this present study the protein, carbohydrate, fat, ash and moisture contents of *C. lophus* were estimated on appendages (Claws and legs) and body (shell and flush). The appendage and body region of *C. lophus* showed narrow to broad variety of variations among the parameters. The maximum value 61.91 gm fat was noticed in the body part and the minimum value 5.45gm of Carbohydrate was measured in body portion in *C. lophus* species. Appendage contains a high content of protein, carbohydrate, fat, ash and moisture than body portion. Table 1 and Fig.1 shows the proximate composition of box-crab.

Table 1 Proximate composition of *C. lophus* crab appendages (Claws & legs) meat and body meat (Including Shell and abdomen) for mg/100 gm.

S.No		Appendages	Body	Total
1	Protein	22.19	21.45	43.64
2	Carbohydrate	8.34	5.45	13.79
3	Fat	55.18	61.912	117.09
4	Ash	2.56	2.98	5.54
5	Moisture	73.11	82.98	156.09

Figure 1 Proximate composition of *C. lophus* crab appendages (Claws & legs) meat and body meat (Including Shell and abdomen) in percentage.



3.2. ESTIMATION AND NON ESSENTIAL AMINO ACID:

In this present investigation totally twenty-one amino acids were found in the box crab. Therefore, eleven essential amino acids (EAA) and ten non essential amino acids (NEAA) were detected. In maximum 0.925 mg Lysine was detected in an appendage. Minimum concentration of EAA Tryptophan 0.193 mg was observed in body portion of box crab. Important EAA Taurine 0.251 mg detected in the crab. In NEAA Glutamic acid 1.012 mg was the maximum level of NEAA in body part. Aspargine 0.119 mg was observed as a minimum quantity of NEAA in body part. The total amino acid content was measured by standard graph. EAA content list shows in Table number 2 and Fig. 2. In this present study, result revealed that, the box crab *C. lophus* meat has an average potential source for food value, due to presence of balanced essential amino acids in box crab.

Table 2: Essential amino acid composition of *C. lophus* crabs appendages meat and body meat. Mg/100gm

S.N	Essential Amino acids	Appendages	Body	Total
1	Threonine	0.415	0.394	0.809
2	Arginine	0.426	0.394	0.82
3	Histidine	0.782	0.713	1.495
4	Valine	0.371	0.213	0.584
5	Methionine	0.431	0.353	0.784
6	Iso Leucine	0.414	0.345	0.759
7	Phenylanine	0.226	0.193	0.419
8	Leucine	0.384	0.325	0.709
9	Lysine	0.925	0.834	1.759
10	Tryptophan	0.286	0.193	0.479
11	Taurine	0.251	0.243	0.494

Figure 2: Essential amino acid of *C. lophus* crab appendages meat and body meat for percentage

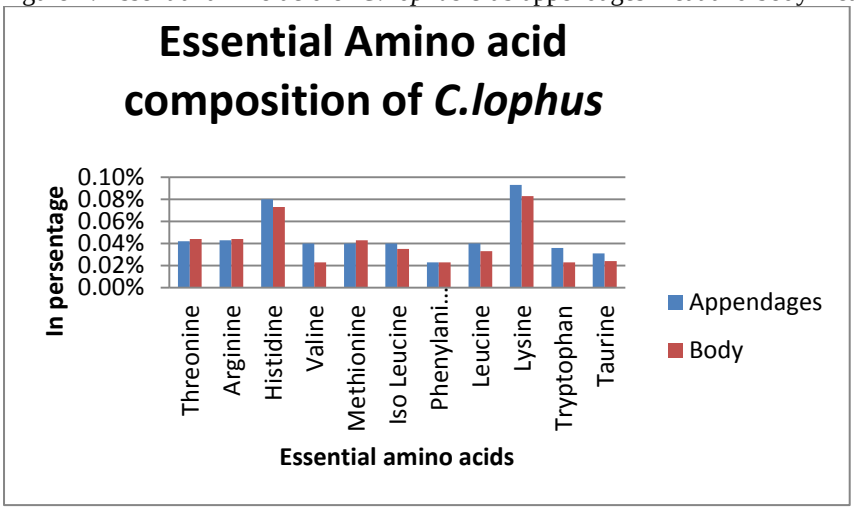
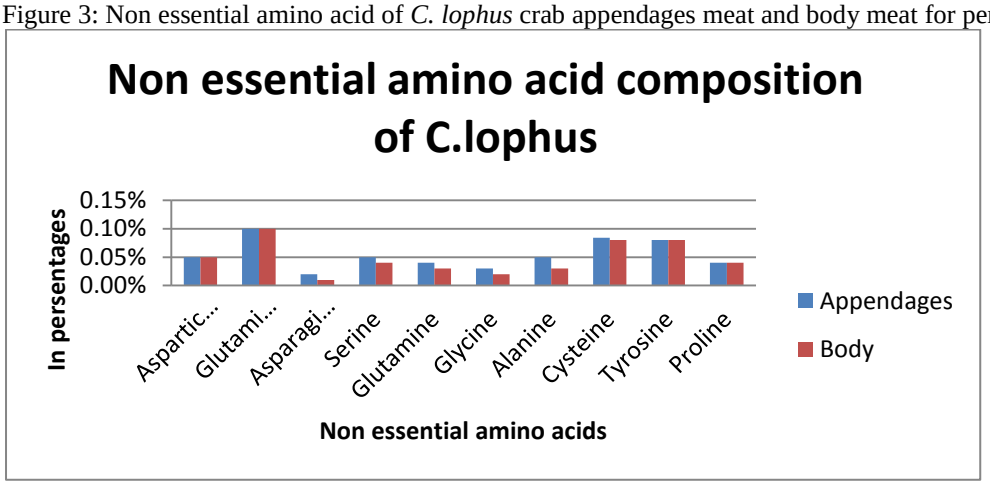
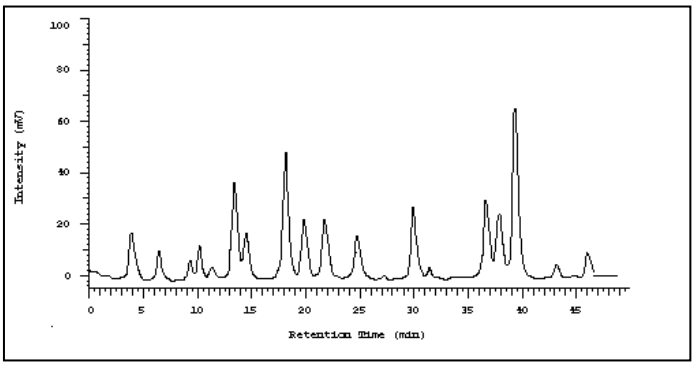


Table3: Non essential amino acid composition of *C. lophus* crab on appendages and body meat mg/100gm

S.N	Non essential Amino Acids	Appendages	Body	Total
1	Aspartic Acid	0.513	0.456	0.969
2	Glutamic Acid	1.012	0.993	2.005
3	Asparagine	0.199	0.114	0.313
4	Serine	0.525	0.445	0.97
5	Glutamine	0.396	0.334	0.73
6	Glycine	0.316	0.214	0.53
7	Alanine	0.497	0.343	0.84
8	Cysteine	0.835	0.783	1.618
9	Tyrosine	0.896	0.834	1.73
10	Proline	0.413	0.366	0.779

Figure 3: Non essential amino acid of *C. lophus* crab appendages meat and body meat for percentage.





Standard graph for Amino acid

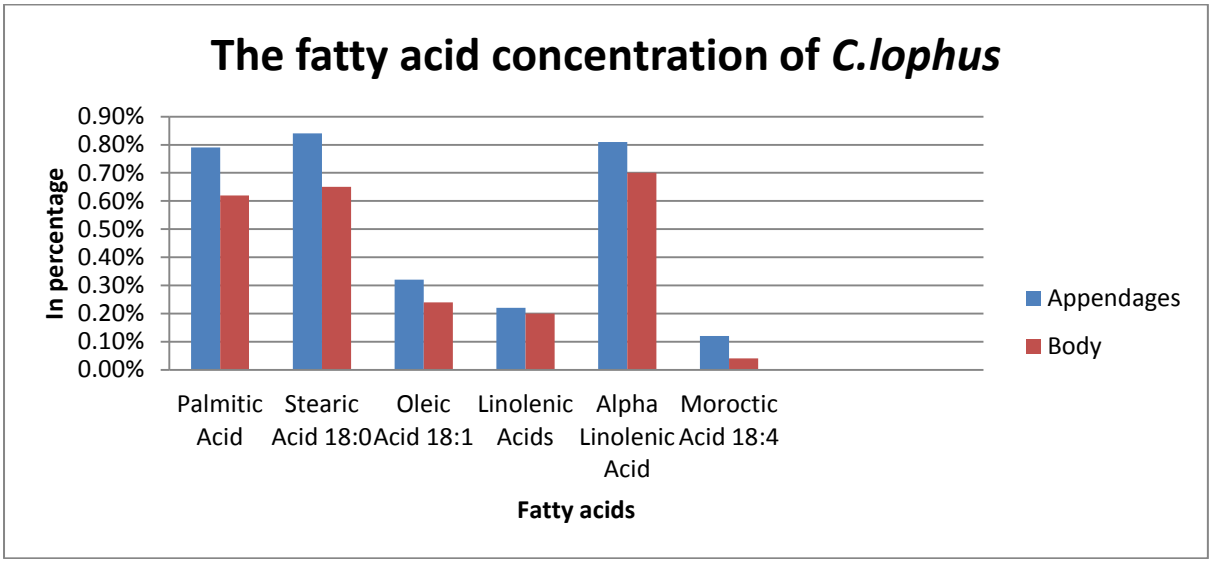
3.3. ESTIMATION OF FATTY ACIDS:

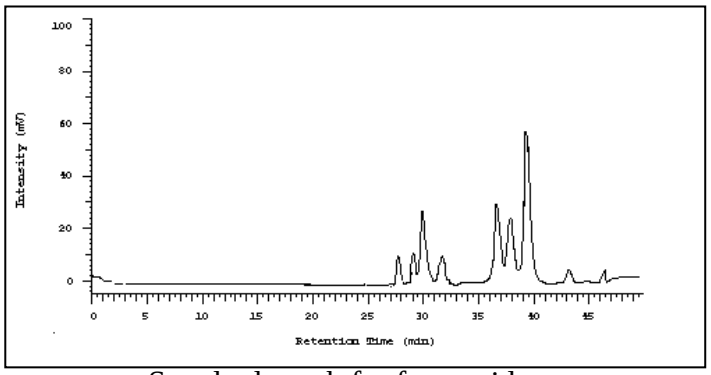
In this present study totally six fatty acids ware found in appendage and body of box-crab. In appendage 8.39 mg of Stearic acid 18:0 was observed as the high quantity of fatty acid and in minimum 0.35 mg of Moroctic acid 18:4 was detected in the body part of *C. lophus.* The fatty acid contents of the *C. lophus* are listed in Table 4 and Fig. 4. The fatty acid concentrations were measured by standard graph.

Table 4: The fatty acid composition of *Calappa lophus* crabs appendages meat and Body meat. Mg/100gm.

S.N	Fatty Acids	Appendages	Body	Total
1	Palmitic Acid	7.93	6.24	14.17
2	Stearic Acid 18:0	8.39	6.45	14.84
3	Oleic Acid 18:1	3.24	2.36	5.6
4	Linolenic Acids	2.16	1.98	4.14
5	Alpha Linolenic Acid	8.06	7.04	15.1
6	Moroctic Acid 18:4	1.21	0.35	1.56

Figure 4: Fatty acid concentration of *C. lophus* crab appendages meat and body meat for percentage.





Standard graph for fatty acid

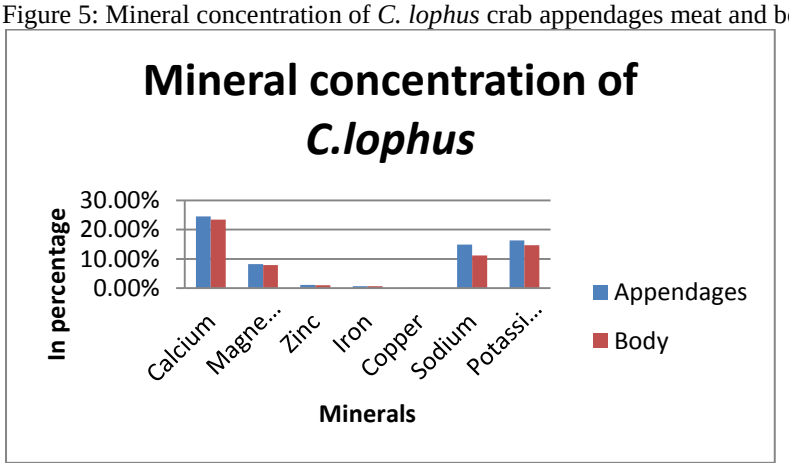
3.4. ESTIMATION OF MINERALS:

Totally seven major minerals are observed in this *C. lophus* both sample. Calcium (Ca), Magnesium (Mg), Zinc (Zn), Iron (Fe), Copper (Cu), Sodium (Na) and Potassium (K) were present in both sample of *C. lophus*. The calcium 245.2 mg was observed as a major element in appendages. In minimum level was 0.46 mg of Copper detected in the body portion. Results were showed in Table No: 5 and Fig. 5.

Table No: 5: The mineral composition of *C. lophus* in appendages meat and body meat mg/100gm

S.N	**Minerals**	**Appendages**	**Body**	**Total**
1	Calcium	245.2	234.6	479.8
2	Magnesium	82.3	78.6	160.9
3	Zinc	10.9	10.2	21.1
4	Iron	6.86	6.45	13.31
5	Copper	0.94	0.46	1.4
6	Sodium	148.8	111.4	260.2
7	Potassium	163.2	146.7	309.9

Figure 5: Mineral concentration of *C. lophus* crab appendages meat and body meat for percentage.



IV. Discussion:

4.1. PROXIMATE COMPOSITION:

In the present study, the protein concentration varied between 21.45 gm and 22.19 gm in appendages and body of investigated crab species (Table 1). Several studies on crab were revealed on some crab species. Emmanuel et al. were recorded the protein concentration on common West African crab *Sudananautes africanus.* Total protein content was 22.1mg and 18.6mg were detected in male and female crab [22]. Udo and Vivian were observed on whole body of *U. tangeri*, Shell and flesh of *C. amnicola* crab species has 23.16 % 5.23% 20.12% respectively. The protein concentration values between the present investigated species and the above revealed an average of 16.17% higher [23].These differences might be due to the geographical location of the water bodies and population of species as mention by Udo and Vivian (2012). Moronkola et al., were determined the protein substance on crab *C. amnicola* having 19.820%, 19.233% and 28% on crunchy chest, walking legs and tissue samples in an order [24]. Ke chen were investigated on Chinese mitten crab has 7.02 % and 5.80% of protein content in an edible viscera of female and male Chinese mitten crab. In these results showing the protein content was increased than other species [25].

In this current investigation the carbohydrate concentration of *C. lophus* has 8.34 gm and 5.45 gm in an appendages and body. (Showed in Table No: 1). Moronkola et al, were previously recorded the carbohydrate concentration on *Callinects amnicola* crab. In this *C. amnicola* the carbohydrate concentration were recorded 2.443 % and 1.021 % in walking legs and tissues [24]. The George et al. were mentioned the carbohydrate level on body and claw meat of *Scylla serrata* has 0.17% and 0.24% respectively (George et al. 1990). Radhakrishnan was observed the carbohydrate level on *P. pelagicus* and *P. sanguinolentus*. This species has 0.16% To 0.55% and 0.44 to 0.73% respectively [26].In *S. tranquebarica* the carbohydrate values on body, claw, and leg meat were studied these has 0.59 to 2.23%, 0.68 to 2.87 and 0.76 to 2.76% in that order [27]. The carbohydrate contents of *P. sanguinolentus.* Sudhakar, et al. and *C. lucifer* Murugesan, et al. has checked in the range of 1.42% and 2.89% respectively. [28,29]These all has happened because of food and feeding pattern of crabs in different region. In this present study exposed the *C. lophus* having the optimum level of carbohydrate.

In the present study, lipid content of *C. lophus* is 55.18gm (5.51%) in appendages and 61.92gm (6.19%) in body (Showed Table No: 1). Numerous studies on crab revealed similar values of lipid contents, Udo Paul and Vivian are recorded 0.22%, 0.01% and 0.45% of lipid level in whole body of *U. tangeri*, shell and flesh of *Uca tangeri* and *C. amnicola* [23]. In *Potamon potamios* crab species were recorded 1.08% lipid in female crab and 1.05% in male *P. potamios* crab. Moronkola et al. was mentioned the fat content in *C. amnicola* having 0.060%, in crunchy chest, 0.002% in walking legs and 1.021% in tissue sample [24]. Reproduction season of the crabs are in hunt of the food and get abundance of prey. However, the lipid concentration may be increased.

The ash content of species is an indication of the mineral concentration in the organisms [30,31]. In the box crab ash content in appendages 0.26 % and in body it has 0.31% (Table 1). The ash content of *C. lophus* showed the highest level of ash in body than appendages. Udo Paul and Vivian are mentioned 1.40 % in the whole body of *U. tangeri* and 1.84% in the flesh meat of *C. amnicola* crab [23]. In *C. amnicola* the ash content is lower than box crab, Moronkola et al. were recorded 1.04%, 1.30%, and 1.041 % in crunchy chest, walking legs and tissues sample [24]. This variation might be most probably linked to the size of the species investigated for the separate studies or seasonal conditions at the time of study conducted.

The moisture content in an appendage of box crab was higher than that in the body (Table 1). Similar observations were recorded in the breast; claws and hepato-pancreas meat of *Callinectes sapidus* are having 78.020gm, 79.050gm, and 73.605gm correspondingly [8]. King et al. were recorded 77.6 gm of moisture in

Cancer magister species [3]. Moronkola was specified 70.31%, 65.951% 67.377% in crunchy chest, walking legs and tissue sample of *C. amnicola* [24]. In whole green crab (*Carcinus maenas*), the moisture level is 67.96% respectively [32]. Fagbnaro omotayo et al. was investigated in *Sudanonautes africanus***,** this crab species having 6.39 gm, 5.06 gm and 6.42 gm in an exoskeleton, flesh and whole body [33]. This elevated moisture contents in an organism are consider as a benefit because of its involvement in the stabilization of the organisms during movements.

The biological value of protein is obviously reflected upon its essential amino acid concentration. In this present study *C. lophus* showed 21 amino acids in this, essential amino acids were recorded 0.49 % and 0.42 % and non-essential amino acids were recorded 0.59% and 0.49% of the body and appendages respectively. Parallel studies are conducted in various crab species. Totally 19 amino acids are investigated in whole green crab of *Carcinus maenas*, 1.26% of glutamic acid were recorded in high-level in the green crab. This difference may be most probably linked to the size of the crab studied for the separate studies or seasonal conditions at the time of study conducted [32]. Manivannan et al. were observed nine essential amino acids and 10 non essential amino acids totally nineteen amino acids in crab *Scylla tranquebarica.* Arginin (11.473%) and Liucin (9.266) are the highest proportion of amino acids found in *S. tranquebarica* [34].

4.2. FATTY ACID COMPOSITION:

In this present investigation totally seven fatty acids found in *C. lophus*. Fatty acid profiles showed that *C. lophus* have four saturated fatty acids (SFA), one Monounsaturated fatty acid (MUFA) and two polyunsaturated fatty acids (PUFA). Stearic acid (C18:0) is the predominant saturated fatty acid, which is having 0.84%, 0.65% in the *C. lophus* appendages and body. Alpha Linolenic acids also obtained predominant element, which is having 0.8%, 0.70% in the appendages and bodyparts. Celic et al. were reported that the values of stearic acid in blue crabs having 5.56% to 6.29%, this was 5% higher than our species [35]. Ayas and Ozogul were checked the fatty acid level in blue crab *Callinectes sapidus***.** They were mentioned the major MUFA of Oliec acid is varied between 14.66%-14.75% in all male and female crab carapace meat [36]. Kuley et al. reported the amount of oleic acid and palmitoleic acid concentration in blue crab *Callinectes sapidus* having 3.4%-17.1% and 3.0%-3.3% male and female crab [37]. This variation might be almost certainly connected to the size of the species investigated for the separate studies or seasonal conditions at the time of study conducted.

4.3. MINERALS COMPOSITION:

In this present study totally seven essential mineral detected in the *C. lophus*. An elevated level of minerals found in an appendages then the body of *C. lophus*. (Showed in Table 6) Calcium 245.2 mg is the maximum quantity of mineral in appendage of box crab suggested that, this crab sample can provide a significant proportion of calcium and other essential minerals if we take appropriately. Copper 0.46 mg observed in body tissue as lower quantity. Similar studies were conducted in some other crab species. Udo Paul and Vivian were studied mineral concentration on *Callinectes amnicola* has 718 mg/100gm of Ca is the highest concentration on *U. tangeri* species and Cu 7mg was observed as lower concentration in *C. amnicola* [23]. Soundarapandian et al. were observed mineral quantity on *Podophthalmus vigil* was shows 14.58 mg of Ca on female crab [39]. Fe has quite a lot of vital functions in the human body. Iron deficiency occurs when the demand for iron is high, in this present study the iron level is near to similar in appendages and body. The Mg content was found to be higher level in our sample. This value was higher than that by reported [38].

V. Conclusion:

In general, the box crabs are not consuming by the all group of community and this box crabs are also considered as a low cost crab. This study revealed that this box crab C. lophus species are able to compete with more commercially consumed species in terms of nutritional values, and they can definitely also compete when it comes to taste**.**

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