ISSN 1996-3351

Asian Journal of Biological Sciences

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Asian Journal of Biological Sciences 4 (2): 166-174, 2011
ISSN 1996-3351 / DOI: 10.3923/ajbs.2011.166.174

Compositional Characteristics and Nutritional Quality of *Podopthalmus vigil* (*Fabricius*)

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ABSTRACT

The proximate composition (Protein, Carbohydrate and lipid), fatty acids, amino acids and minerals contents were investigated in *P. vigil*. The aim of this study was to demonstrate the nutritive value of *P. vigil* crab. The protein, carbohydrate and lipid contents were found (19.5, 1.57 and 1.38%), respectively. Totally 18 amino acids was found, among 10 essential amino acids 9 were recorded and non essential amino acids 9 was reported. The essential and non essential amino acid were totally contributed (8.93 and 10.393 g/100 g), respectively. Fatty acids were analyzed, saturated fatty acids (palmitic acid 0.8141% and stearic acid 0.297%), monounsaturated fatty acid (oleic acid 0.9912%) and polyunsaturated fatty acid (Linoleic acid 1.112% and alpha-linoleic acid 0.7065%) was recorded. Finally, 9 minerals were analyzed (Ca> P> I> Na> K> Cu> Mn> Zn) among these calcium was maximum (15.67 mg g^{-1}) and manganese was minimum (0.2121 mg g^{-1}). The results showed that *P. vigil* crab is a nutritious food.

Key words: *Podopthalmus vigil*, proximate composition, amino acid, fatty acid and minerals

INTRODUCTION

Seafood products are currently in high demand as they are considered healthy and nutritional (Leu *et al*., 1981; Connor and Lin, 1982; King *et al*., 1990; Skonberg and Perkins, 2002). The crabs rank third after shrimps and lobsters for their esteemed seafood delicacy and also the value of fishery they support (Savad and Rahavan, 2001). As a result, capture of marine shellfish has increased exponentially during the last century and now exceeds 13 million t, (FAO, 2008). Marine brachyuran crabs (true crabs) represent one tenth of this total 1.38 million t in 2006 (FAO, 2008). Marine invertebrates are widely used as food and feed supplements throughout the world. Crabs among many other invertebrates, are considered to be important shell fishery products (Gokoglu and Yerlikaya, 2003). Most of marine crabs occurring along Indian coast are belonging to the family portunidae (Radhakrishnan, 2000). The commercially important portunid crabs found along Parangipettai coast are *Scylla serrata, S. tranquebarica, Portunus sanguinolentus, P. pelagicus, Podopthalmus vigil, Chrybdis feriata, C. lucifera, C. natator, C. granulata* and *C. truncata* (Samuel *et al*., 2004). Crab is highly nutrious and healthy owing to its content essential amino acids, proteins, unsaturated fatty acid and minerals (Skonberg and Perkins, 2002; Gokoglu and Yerlikaya, 2003; Celik *et al*., 2004; Naczk *et al*., 2004; Musaiger and Al-Rumaidh, 2005; Chen *et al*., 2007; Kuley *et al*., 2007; Kucukgulmez and Celik, 2008; Adeyeye, 2008). Protein is a fundamental nutrient for humans. The essential amino acid composition is one of the most important nutritional qualities of protein. Amino acid score is a method for evaluating protein

quality by comparing a test protein's amino acid patterns with that of a reference protein. Once the amino acid score is derived, it is compared against the amino acid requirements of preschool-aged children. The rationale behind using the requirements of this age group is that, if a protein effectively supports a young child's growth and development, it will meet or exceed the requirements of older children and adults (FAO/WHO/UNU, 1985). High levels of amino acids may promote the pathogenesis of many diseases, such as crohn's disease (Shoda *et al.,* 1996) and inflammatory diseases (Gil, 2002). AA and DHA are major components of cell membrane phospholipids and are the predominant long-chain PUFAs of the central nervous system. Long-chain PUFAs accumulate rapidly in the brain during the period of maximal brain growth, which lasts from the last trimester of pregnancy to about 2 years of age in humans (Carlson and Neuringer, 1999; Innis, 2000). Crab meat is an excellent source of minerals, particularly calcium, iron, zinc, potassium and phosphorus (Gokoglu and Yerlikaya, 2003; Naczk *et al.,* 2004; Sifa *et al.,* 2000). Mineral components such as sodium, potassium, magnesium, calcium, iron, phosphorus and iodine are important for human nutrition (Sikorski *et al.,* 1990).

Many studies were examined the proximate composition of different crab species in various part of the world (Akbar *et al.*, 1988; Skonberg and Perkins, 2002 Naczk *et al.*, 2004; Musaiger and Al-Rumaidh, 2005; Chen *et al.*, 2007; Adeyeye, 2008). But available data on the proximate composition of crab *Podopthalmus vigil* are limited. Therefore, determining of the proximate composition, fatty acid, amino acid and minerals composition of different crab species have a great importance due to the good effect on human health. The aim of the present study, was determining the proximate composition (protein, lipid, carbohydrate), fatty acids, amino acids and minerals content of the *P. vigil* from Parangipettai coast.

MATERIALS AND METHODS

The healthy crabs are collected from Parangipettai coast (Lat. 11° 29'N and Long. 79° 46'E) during the period of March-2010. They were brought to the laboratory and acclimatized to the laboratory conditions (Salinity 30-34 ppt; Dissolved oxygen 5.0-6.0 ppm; Temperature 28-30°C and pH 7.5-8.5). After acclimatization, *P. vigil* crab were dried at 60°C in an oven and used for biochemical analysis. The protein, carbohydrate and lipid contents were estimated by adopting the standard methods of Raymont *et al.* (1964), Dubois *et al.* (1956) and Folch *et al.* (1956), respectively. The estimation of amino acids in the HPLC (Merck Hitachi L-7400) following the method of Baker and Han (1994). The fatty acid methyl ester of the samples were injected in to the gas chromatograph (HP 5890) Capillary column coated with 5% phenyl silicane at a temperature from 170 to 310°C for 23.33 min flame ionization detector was used for the analysis. Based on the retention time the different fatty acids of the samples were identified. To the 5 g of wet tissue samples, mixture of hydrochloric acid, nitric acid and perchloric acid at a ratio of 10;5;1 was added for digestion at 30°C. The digests were filtered suitably and aspirated in digital flame photometer (Modal No. CL 22D, Elico pvt, India) the obtained values were expressed in mg/100 g (Guzman and Jimenez, 1992).

RESULT AND DISCUSSION

The Proximate composition of *P. vigil*, protein, carbohydrate and lipid were 19.5, 1.57, 1.38%, respectively Table 1.

In *P. vigil* 9 essential amino acids recorded in the following order (arginine> methionine> threonine> histidine> lysine> leucine> isoleucine> phenylalanine> valine). Tryptophan was not detectable. The total essential amino was found 8.93 g/100 g (Table 2).

Table 1: Proximate composition of *P. vigil*

Composition (%)	Values
Protein	19.5
Carbohydrate	1.57
Lipid	1.38

Table 2: Essential amino acids (g/100 g dry b.wt.) contents of *P. vigil*

Amino acids	*P. vigil*
Threonine	1.300
Valine	0.390
Arginine	1.840
Methionine	1.570
Isoleucine	0.554
Leucine	0.790
Lysine	0.956
Phenylalanine	0.545
Histidine	0.985
Tryptophan	ND
Total	8.93

ND: Not detected

Table 3: Non essential amino acids (g/100 g dry b.wt.) contents of *P. vigil*

Amino acids	*P. vigil*
Aspartic acid	0.346
Glutamic acid	0.810
Cystine	0.930
Tyrosine	1.830
Taurine	ND
Alanine	1.530
Aspargine	0.317
Glycine	1.910
Proline	1.000
Serine	1.720
Total	10.393

ND: Not detected

Among 10 non essential amino acids, 9 amino acids are recorded in order (Glycine> Tyrosine> Serine> Alanine> Proline> Cystine> Glutamic acid> Aspartic acid> Aspargine). The non essential amino acids totally contributed (10.393 g/100 g) in *p. vigil* (Table 3).

The fatty acids composition saturated fatty-acids palmitic 0.8141% and stearic acids 0.297. Monounsaturated fatty acid- oleic acid 0.9912% and poly-unsaturated fatty acid, linoleic 1.112% and alpha linoleic acid 0.7065 were reported in *P. vigil* (Table 4).

Totally 8 minerals were analyzed in the following order: Ca> K> P> I> Na> Zn> Co> >Mn) in *P. vigil* (Table 5).

Biochemical studies are very important from the nutritional point of view. The biochemical constituents in animals are known to vary with season, size of the animal, stage of maturity, temperature and availability of food etc. Protein is essential for the sustenance of life and accordingly exists in the largest quantity of all nutrients as a component of the human body

Table 4: Fatty acid composition of *P. vigil* (%)

Fatty acid	%
Saturated fatty acid	
Palmitic acid	0.8141
Stearic acid	0.297
Mono-unsaturated fatty acid	
Oleic acid	0.9912
Poly-unsaturated fatty acid	
Linoleic acid	1.112
Alpha-linoleic acid	0.7065

Table 5: Mineral composition of *P. vigil* (mg g^{-1})

Minerals	mg g^{-1}
Calcium	15.670
Phosphorus	4.560
Iron	3.570
Sodium	3.010
Potassium	4.780
Copper	0.450
Manganese	0.210
Zinc	1.565
Total	34.250

(Okuzumi and Fujii, 2000). In the present study, protein content was 19.5%. In the present study are agree with other studies. The protein value in *P. vigil* was 15.75 to 20.16%. (Radhakrishnan and Natarajan, 1979) and in *C. affinins* was 17.8% (Vasconcelos and Braz, 2001). In *S. serrata*, the protein content of the body meat and claw meat was 20.11 and 18.54%, respectively (Prasad and Neelakantan, 1989). Anonymous (1999) reported that the protein value in blue crab was 17.17%. The protein content of *P. pelagicus* and *P. sanguinolentus* was 0.47 to 15.91% and 12.81 to 13.6%, respectively (Radhakrishnan, 2000). Zafar *et al.* (2004) reported that the protein values in *S. serrata* male were 17.69 and 19.39% for females. Khan (1992) investigated 11.60% protein in body meat of male and 19.92% protein in females' body meat of *S.serrata*. Thirunavukkarasu (2005) recorded the protein values in *S. tranquebarica* from different parts viz., body meat (65.48 to 72.24%), claw meat (69.5 to 80.29%) and leg meat (69.47 to 74.7%). Carbohydrates constitute only a minor percentage of total biochemical composition. Carbohydrates in fishery products contain no dietary fiber but only glucides, the majority of which consist of glycogen. They also contain traces of glucose, fructose, sucrose and other mono and disaccharides (Okuzumi and Fujii, 2000). In the present study, carbohydrate content was 1.57(%). The previous studies were suggested that the carbohydrate in the muscle varied from 0.3 to 0.63% in *P. vigil* (Radhakrishnan and Natarajan, 1979), 2.4 to 3.4% in *C. smithii* (Balasubramanian and Suseelan, 2001), 0.17% in body meat, 0.24% in claw meat of *S. serrata* (Prasad and Neelakantan, 1989), 0.16 to 0.55% in *P.pelagicus* and 0.44 to 0.73% in *P. sanguinolentus* (Radhakrishnan, 2000). In *S. tranquebarica*, the carbohydrate values of body meat, claw meat and the leg meat was 0.59 to 2.23%, 0.68 to 2.87% and 0.76 to 2.76%, respectively (Thirunavukkarasu, 2005). Murugesan *et al.* (2008) reported that carbohydrate content of hard shell crabs (1.42%) of *C. lucifera* was little bit lower than eye stalk ablated crabs (1.45%). Lipids are highly efficient as sources of energy and they contain more than twice the energy of carbohydrates and proteins (Okuzumi and Fujii, 2000). In

the present study, lipid was 1.38(%). In *P. vigil* the lipid values assessed from 5.13 to 9.73% by Radhakrishnan and Natarajan (1979). Balasubramanian and Suseelan (2001) recorded that the lipid values from 6.2 to 7.6% in *C. smithii*. In *Chaceon affinis,* the lipid values were 0.7% (Vasconcelos and Braz, 2001) in blue crab it was 1.5% (Anonymous, 1999). Prasad and Neelakantan (1989) noticed that the lipid content in *S. serrata* from body meat was 1.65% and claw meat was 2.01%. George and Gopakumar (1987) assessed the lipid values in *S. serrata* with egg (0.43%), without egg (0.7%), body meat (1.07%) and claw meat (1.0%). In *P. pelagicus* the lipid value was 3.3 to 5.6% and *P. sanguinolentus* it was 3.8 to 5.5% (Radhakrishnan, 2000). The lipid content of the body meat (0.9 to 1.6%) claw meat (1.83 to 2.06%) and leg meat (1.58 to 2.08%) was estimated by Thirunavukkarasu (2005).

Biological value of protein is obviously reflected upon its essential amino acids concentration. In general, the shellfish have a balanced distribution of all essential amino acids required for an adult per day. There are 20 amino acids found in fish proteins. Some of these are listed as Essential Amino Acids (EAA), i.e., arginine, histidine, isolucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine because these are not synthesized in the body. The essential amino acids are required for maintenance of life, growth, synthesis of vitamins and reproduction. The lowest level of any one of these essential amino acids in a protein source, which limits the utilization of that protein, makes it the First limiting amino acid (Paulraj and Sridhar, 2001). The world health organization recommended leucine and isoleucine requirements for adults of 14 and 10 mg amino acid kg^{-1} b.wt./day (FAO/WHO/UNU, 1985). Kucukgulmez and Celik (2008) reported that 100 g claw meat of the blue crab consisted of 1309 mg leucine and 941 mg ispleucine, assuming an adult human consumes 50 g blue crab, this can provide the daily amino acid requirement determined by WHO In the present study the total essential amino acids 8.93 (g/100 g) was analyzed in *P. vigil*. Among 10 essential amino acid 9 were reported in *P. vigil* viz., (Arginine> Methionine> Threonine> Histidine> Lysine> Leucine> Isoleucine> Phenylalanine> Valine). Prasad and Neelakandan (1989) was reported essential amino acid composition in *S. serrata* The Histidine, leucine, thronine and cystine were possessed in higher proportion and the total contribution was 36.82%. in blue crab arginine, lysine, leucine and isoleucine, reported by Anonymous (1999). Thirunavukkarasu (2005) recorded amino acids in the following order: arginine >leucine >lysine >valine >isoleucine >threonine >phenylalanine >methionine >histidine in *S. traquebarica*. Sudhakar *et al.* (2009a) reported the essential amino acids with eye stalk ablated and control crabs *P.sangiunolentus* were leucine >arginine >lysine >valine >isoleucine >threonine >histidine> methionine, respectively. Kaya *et al.* (2009) was found total essential amino acids in warty crab (*Eriphia verrucosa*) 7.458%. Among 10 non essential amino acid 9 were reported in *P. vigil* viz, (Glycine> Tyrosine> Serine> Alanine> Proline> Cystine> Glutamic acid> Aspartic acid> Aspargine). The total amount of non essential amino acids was 10.39 g/100 g. Thirunavukkarasu (2005) reported non essential amino acids in the following order: Glutamic acid >aspartic acid >alanine >glycine >serine in *S. tranquebarica*. Sudhakar *et al.* (2009b) assessed the non essential amino acids with hard and soft shell crabs *P. sangiunolentus* were leucine >arginine >lysine >valine >isoleucine >threonine >histidine> methionine respectively. Kucukgulmez and Celik (2008) assessed the Blue Crab (*Callinectes sapidus)* the total nonessential amino acids 9.276 to 8.713 g/100g fresh w.t. Wu *et al.* (2010) recorded the non essential amino acids value in *P. pelagicus* from female and male meat (93.9, 90.8%) and gonads (121, 107%). Opstvedt (1997) found marine oils rich in long-chain (C20 and C22) fatty acids (i.e., certain natural marine oils and partially hydrogenated fish oil) may affect the haemostatic balance in a favorable way with regard

to coronary heart disease. In the present study, fatty acid composition was saturated fatty acid (palmitic acid 0.81% and stearic acid 0.29%), mono saturated fatty acid (oleic acid 0.99%) and polyunsaturated fatty acid (linoleic acid 1.11% and alphalinoleic acid 0.70%) found. The previous studies were suggested that the Cherif *et al.* (2008) was analyzed the fatty acid composition Green crab (*Carcinus mediterraneus*) crab claw meat and hepatopancreas were 24.9-26.1% and 8.8-9.2%, respectively (Sullivan *et al.,* (2001) Fatty acid content between different edible portions of the Australian blue Swimming crab (*Portunus pelagicus),* Total n-6 PUFA, muscle, gonad, hepatopancreas were (6.9, 46.8 and 96.1 mg/100g) and total N-3 PUFA (23.8, 83.1 and 123.8 mg/100 g), respectively. The amount of saturated fatty acid in crab eggs (*Portunues pelagigus*) was 12.78%. Monounsaturated fatty acid was 02.97% and polyunsaturated was 12.66% reported by Soundarapandian and sing (2008). Naczk *et al.* (2004) Found fatty acid composition of green crab (*Carcinus maenas*) was saturated fatty acid (18.1-20.7%), Monounsaturated fatty acid (24.2-25.2%) and polyunsaturated fatty acid (47.1-50.5%). Celik *et al.* (2004) studied the claw and breast meats of the crabs had significantly (p<0:05) higher contents of the total n3 fatty acid, compared with the hepatopancreas. The total EPA (C20:5n3) and DHA (C20:6n3) contents averaged 10.6, 8.41, 7.78 and 5.92% and 6.75 5.30% for claw meat, breast meat and hepatopancreas, respectively. Crab meat is an excellent source of minerals, particularly calcium, iron, zinc, potassium and phosphorus Gokoglu and Yerlikaya, 2003; Naczk *et al.,* 2004; Sifa *et al.*, 2000). Ca and P are necessary to maintain an optimal bone development with more of both minerals being required during childhood and growing stages to prevent rickets and osteomalacia. Iron has several vital functions in the body. It serves as a carrier of oxygen to the tissues from the lungs by red blood cell hemoglobin, as a transport medium for electrons within cells and as an integrated part of important enzyme systems in various tissues. Adequate iron in the diet is very important for decreasing the incidence of anemia, which is considered a major health problem, especially in young children. Iron deficiency occurs when the demand for iron is high, e.g., in growth, high menstrual loss and pregnancy and the intake is quantitatively inadequate or contains elements that render the iron unavailable for absorption (Belitz *et al.*, 2001; Camara *et al.,* 2005). Zinc is known to be involved in most metabolic pathways in plants, animals and humans (Hambidge, 2000). In this present study investigate the minerals contents *P. vigil* in following the order (Calcium 15.67, Phosphorus 4.56, Iron 3.57, Sodium 3.01, Potassium 4.78, Copper 0.4567, Manganese 0.2121 and Zinc 1.565) the present study similar with previous studies (Mohapatra *et al.,* 2009) Found the concentration of nine elements (K, Ca, Mn, Fe, Cu, Zn, Se, Br and Pb) in different tissues of mud crab *Scylla serrata,* values were (9916±467μg g^{-1}, 115±13 μg g^{-1}, 10.3±1.2 μg g^{-1}, 191± 18 μg g^{-1}, 157± 10 μg g^{-1}, 130±1 μg g^{-1}, 0.71±0.05 μg g^{-1}, 10.1±1.1 μg g^{-1}, 0.128±0.003 μg g^{-1}), respectively. Mohapatra *et al.* (2007) studied the concentration of 10 elements in (ppm), (K, Ca, Mn, Fe, Cu, Zn, Se, Br, Sr and Pb) various crustaceans, in *S. serrata* (10,342±375, 1961±11, 12.3±2.8, 167±6, 127±13, 291±37, 0.36±0.10, 152±11, 9.1±1.2 and 0.164±0.09), in *S. tranquebarica* (8040±340, 2846±12, 11.2±2.5, 156±6, 121±12, 270±36, 0.40±0.10, 295±23, 13.5±1.3 and 0.201±0.08), in *P. monodon* (9095±342, 665±19, 15.2±3.3, 297±8, 77±11, 58±21, 0.33±0.14, 27±6, 2.55±1.3 and 0.147±0.10, in *P. indicus* (8695±250, 824±17, 11.8±2.4, 107±4, 70±8, 54±15, 0.37±0.10, 19±5, 2.52±1.2 and 0.352±0.10), in *M. rosenbergii* (10,016±207, 616±15, 11.5±1.7, 164±4, 98±6, 78±12, 0.24±0.02, 19±*Callinectes sapidus* 5, 0.51±0.11 and 0.10±0.09), respectively. Trace elements content in haemolymph of normal and red sternum mud crab (Calcium 342.15, Magnesium 252.68, Iron 2.46, Chloride 715, Copper 122.55, Manganese 6.76 and Zinc 23.76) and (Calcium 372.90, Magnesium 400.95,

Iron 10.80, Chloride 728, Copper 37.44, Manganese 3.44 and Zinc 5.78) respectively reported by Salaenoi *et al.* (2006). Gokoglu and Yerlikaya (2003) investigated the mineral contents of blue crab and swim crab (*Portunus pelagicus*), Na, K, Ca, Zn and Cu values for blue crab and swim crab were not significantly different. There were no significant differences between Na, K, Mg, Zn, Fe, Mn and Cu contents of claw and body meats of the two species. In the present study results showed that *P. vigil* crab is a nutritious food.

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