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Compositional characteristics and nutritional quality of Chinese mitten crab (*Eriocheir sinensis*)

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Abstract

Chinese mitten crab (*Eriocheir sinensis*) was analyzed for proximate composition, minerals, amino acids and fatty acid composition, and also evaluated for nutritional quality. The yields of crab meat and edible viscera were 24.2% and 9.2%, respectively. The crab meat contained 18.9% crude protein. About 80% of the protein resided in the crab meat portion, while about 90% of the fat was in the viscera. Chinese mitten crab was an excellent source of minerals, particularly zinc, iron, copper and phosphorus. The crab protein contained high amounts of glutamic acid (151 mg/g), aspartic acid (99 mg/g), arginine (99 mg/g), lysine (81 mg/g) and leucine (77 mg/g), and it was a high quality protein with well-balanced essential amino acid compositions. Twenty six fatty acids were found in the crab oil. The monounsaturated fatty acids were predominant with a percentage of 49.8. Oleic acid (18:1) was the dominant fatty acid, followed by palmitoleic acid (16:1), palmitic acid (16:0) and linoleic acid (18:2$n-6$); and the percentages were 31.0, 14.3, 14.2 and 11.9, respectively. The ratio of $n-6/n-3$ polyunsaturated fatty acids (PUFAs) was 2.2, and this is a $n-3$ PUFA-rich food. In short, the results showed that Chinese mitten crab is a nutritious food.
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Keywords: Chinese mitten crab; Nutrition; Protein; Fatty acid; Mineral

1. Introduction

Chinese mitten crab (*Eriocheir sinensis*) is native to the coastal rivers and estuaries of the Yellow Sea. It has now spread throughout Europe and California (Rudnick, Hieb, & Grimmer, 2003). Although Chinese mitten crab is considered as an annoying invasive species in Europe and the USA, it constitutes a promising fresh-water fishery industry in China. Its annual output has increased during the past decade in China, from 200,000 tons in 2000 to 420,000 tons in 2004 (Yuan, 2005). Thus, the Chinese mitten crab has become a common food today.

The best crabs are those available during the autumn as they store enough energy for the coming winter. Chinese mitten crab is a traditional savory food in China. The crab not only has a delicious taste and unique pleasant aroma, but also has good nutritive value (Naiguang, 2004).

Crab meat is an excellent source of minerals, particularly calcium, iron, zinc, potassium and phosphorus (Adeyeye, 2002; Gökoğlu and Yerlikaya, 2003; Naczk, Williams, Brennan, Liyanapathirana, & Shahidi, 2004; Sifa et al., 2000).

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

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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). Amino acid score is widely used for evaluating the nutritional quality of protein (Iqbal, Khalil, Ateeq, & Khan, 2006).

The nutritional quality of fish is to a great extent, associated with the content of essential fatty acids (EFAs), namely α-linolenic acid (ALA, 18:3$n-3$), linoleic acid (LA, 18:2$n-6$), and other omega-3 polyunsaturated fatty acids ($n-3$ PUFAs). ALA is a precursor of the $n-3$-family, eicosapentaenoic acid (EPA, 20:5$n-3$) or docosahexaenoic acid (DHA, 22:6$n-3$), while LA is a precursor of arachidonic acid (AA, 20:4$n-6$) which, in turn, is the main precursor of eicosanoids (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 & Neuringer, 1999; Innis, 2000). High levels of AA may promote the pathogenesis of many diseases, such as Crohn's disease (Shoda, Matsueda, Yamato, & Umeda, 1996) and inflammatory diseases (Gil, 2002). Seafood is known as a rich source of the $n-3$ PUFAs, and most marine oils are good sources of EPA and DHA. Several studies have shown that the consumption of foods containing long-chain $n-3$ fatty acids, such as EPA and DHA, is associated with decreased risk of coronary heart disease (Harper & Jacobson, 2005) and cancer (Roynette, Calder, Dupertuis, & Pichard, 2004).

A GC/MS (gas chromatograph/mass spectrometry), in full scan mode, method is suitable for both quantitative purposes and fatty acid identification in food samples, and this is only slightly worse than GC/FID (flame ionization detection) (Thurnhofer & Vetter, 2005). Because of the complex fatty acid composition in Chinese mitten crab, we used the GC/MS method, in full scan mode, to quantify and identify fatty acids in this study.

Several papers have reported the compositions of crab; however, most of them are about the salt-water crab, such as the green crab (Naczk et al., 2004; Skonberg & Perkins, 2002), blue crab and swim crab (Çelik et al., 2004). The objectives of this study were to analyze the compositional characteristics, and to evaluate the nutritional quality of Chinese mitten crab.

2. Materials and methods

2.1. Sample preparation

Ten male Chinese mitten crabs (first grade, individually weighed, 150–160 g) were picked and transported live to our laboratory in October, 2005, from a crab company (the aquafarm of the company located in Yangchenghu Lake, which is the most famous Chinese mitten crab locality in Suzhou City, Jiangsu Province, China). The crabs were steamed at 100 °C for 15 min. Edible viscera (hepatopancreas and gonads, because some of them were mixed in the abdomen and hard to separate, therefore, we combined them as edible viscera) and meat (from claws, legs and abdomen) were manually separated. After calculating the yields, the meat and edible viscera were separately homogenized. The samples were stored at −20 °C prior to further use.

2.2. Proximate composition analyses

Moisture content was determined by drying the sample in an oven at 105 °C until a constant weight was obtained (AOAC, 1990). Crude protein content was determined by the Kjeldahl method (AOAC, 1990), and a conversion factor of 6.25 was used to convert total nitrogen to crude protein. Fat was determined by using the Soxhlet extraction method (AOAC, 1990). Ash was determined by ashing the samples in the furnace at 550 °C for 8–12 h (AOAC, 1990).

2.3. Mineral analyses

The samples were digested in $HNO_3/HClO_4$ for mineral determination. The elements Na, K, Mg, Ca, Fe, Zn, Mn, Cu, were measured by atomic absorption spectrophotometry (AOAC, 1990), using a Varian Spectra atomic absorption spectrophotometer (model 220, Varian, US), and P (phosphorus) was measured by spectrophotometric methods (AOAC, 1990). Standard curves were used for the determination of the elements.

2.4. Amino acid analyses

Crab meat sample was weighed (0.2000–0.2500 g), placed in 15 ml ampoules, and 8 ml of (6.0 N) HCl was added. Ampoules were vacuum-sealed, and samples were hydrolyzed at 110 °C for 24 h (Blackburn, 1968). Following hydrolysis, 1 ml of hydrolyzate was withdrawn and evaporated to dryness under vacuum at 45 °C to remove HCl. The hydrolyzate was dissolved in 5 ml of 0.02 N HCl, and then centrifuged at 5000 rpm and filtered. One microliter of supernatant was used for amino acid analysis, using pre-column OPA and FMOC (for Pro) derivatization.

The tryptophan content was determined in a separate analysis (Hugli & Moore, 1972). The weighed samples were hydrolyzed in 5 N NaOH containing 5% $SnCl_2$ (w/v) for 20 h at 110 °C. After hydrolysis, the hydrolyzate was neutralized with 6 N HCl and centrifuged, and then the supernatant was subjected to derivatization, as described above.

Amino acids were separated by Agilent 1100 HPLC (Agilent, USA) using a 4.0 × 125 mm Hypersil ODS C18 column. The solvents and gradient conditions were as described by Henderson, Ricker, Bidlingmeyer, & Woodward (2000). Detection wavelengths were set at UV 338 nm and 262 nm (for Pro). The identity and quantity of the amino acids were assessed by comparison with the retention times and peak areas of the standard amino acids (Sigma).

2.5. Amino acid score

Essential amino acid score was calculated with respect to the FAO/WHO reference amino acid pattern of the pre-school child (2–5 year) (FAO/WHO/UNU, 1985).

Amino acid score

= Sample amino acid/Reference amino acid * 100

2.6. Fatty acid analyses

Fatty acids were extracted and fatty acid methyl esters (FAMEs) were prepared according to the ISO method (ISO5509, 2000): first, Soxhlet extraction, then saponification, followed by esterification, and finally, extraction of FAMEs in hexane. FAMEs were subsequently analyzed by the GC/MS (Trace GC/MS, Finnigan, US) in the full scan mode method (Thurnhofer & Vetter, 2005).

FAMEs (0.5 μl) solution was injected into the GC/MS. The GC condition was as follows: capillary column: PEG-20M (30 m × 0.25 mm I.D., 0.5 μm film thickness; Supelco); carrier gas: helium with a flow rate of 1.0 ml/min; injection temp.: 250 °C the oven temperature was programmed from an initial temperature of 180 °C (0.5 min hold), rising to 215 °C at 6 °C/min, then rising to 230 °C at 4 °C/min, and held isothermal for 15 min. Quantitative data were calculated using the peak area ratio (% of total fatty acids).

MS was operated with an ionization of 70 eV, emission current of 200 μA, ion source temp 250 °C, scan range 33–450m/z and detector voltage 350 V. Identifications of peak components were achieved by matching their mass spectra with those in the WILEY, MAINLIB, REPLIB and NISTDEMO libraries with similar index (SI) > 800 (SI < 800 was not reported). Nine important FAMEs were fully identified by comparing GC retention times against the standard compounds. Peak area was quantified and expressed as % of total fatty acids.

2.7. Statistical analyses

All analyses were repeated three times, except yields ($n = 10$). Results were expressed as mean values ± standard deviation (SD) ($n = 3$). The differences between the mean values of crab meat and edible viscera were calculated using one-way analysis of variance (ANOVA), and statistically significant differences were reported at $p < 0.05$. Data analyses were done with the use of SPSS 10.0 software.

3. Results and discussion

The proximate composition of Chinese mitten crab is shown in Table 1. There were significant differences ($p < 0.05$) in the yield, moisture, protein, fat and ash contents of meat and edible viscera. The yields of crab meat and edible viscera were only 24.2% and 9.2%, respectively. The total yield of the Chinese mitten crab was 33.4%, and about 2/3 of the crab was inedible waste. Crude protein (NX6.25) and crude fat contents of crab meat were 18.9% and 0.9%, respectively on a wet weight basis, while those of edible viscera were 12.5% and 20.2%, respectively. Crab meat had about 80% protein and the viscera contained about 90% of fat, which suggested that crab muscle could be a good source of low fat meat. Because of its high fat content, the crab hepatopancreas could have a smooth and creamy mouth-feel.

The proximate composition of meat of Chinese mitten crab is in good agreement with the previous reports (Sifa et al., 2000), and is also similar to those published for green crab (Skonberg & Perkins, 2002), blue crab and swim crab (Gökoğlu and Yerlikaya, 2003), with slightly lower moisture content and slightly higher protein content.

The crude protein content was a little higher than the total amino acid content, where a conversion factor of 6.25 was used to convert total nitrogen to crude protein when determining the protein content by the Kjeldahl method. It should be noted that some non-protein nitrogen (NPN), such as trimethylamine oxide (TMAO) and urea, would give an overestimate of the crude protein content.

The mineral content of crab is summarized in Table 2. Phosphorus, potassium and sodium contents were high in

Table 2
Mineral content of Chinese mitten crab

	A.I. (mg/day)	Crab meat (mg/100 g)	Edible viscera (mg/100 g)
Zn	12.0	9.1 ± 1.7^a	3.3 ± 1.5^b
Fe	12	3.9 ± 0.8^a	14.6 ± 1.0^b
K	1500	273 ± 6^a	171 ± 5^b
Na	900	190 ± 5^a	198 ± 6^a
Mn	3.5	0.09 ± 0.01^a	0.13 ± 0.01^b
Cu	1.0	1.60 ± 0.03^a	1.40 ± 0.05^b
Mg	150	22 ± 1^a	24 ± 1^a
Ca	800	67 ± 7^a	183 ± 10^b
P	500	514 ± 14^a	318 ± 10^b

A.I.: Adequate intakes of Chinese children (4–6 years) (China Nutrition Institute, 2001). Mn: the data (3.5 mg/day) were from adults, no A.I. data from children were available.

Values in the same line not sharing the same superscript are significantly different ($p < 0.05$), based on ANOVA.

Table 1
Proximate composition (%) of Chinese mitten crab

	Yield (%)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Crab meat	24.2 ± 0.9^a	78.8 ± 0.8^a	18.9 ± 0.5^a	0.9 ± 0.1^a	1.39 ± 0.01^a
Edible viscera	9.2 ± 0.6^b	61.7 ± 0.9^b	12.5 ± 0.4^b	20.2 ± 0.1^b	1.90 ± 0.08^b

Yield: Results were mean values from 10 crabs; others were mean values ($n = 3$) from the same sample.

Values in the same column not sharing the same superscript are significantly different ($p < 0.05$), based on ANOVA.

Table 3
Amino acid composition of Chinese mitten crab

Amino acid	Content (g/100 g meat) Mean ± SD	Content (mg/g protein)
Aspartic acid	1.79 ± 0.02	99
Glutamic acid	2.74 ± 0.03	151
Serine	0.75 ± 0.02	41
Histidine	0.43 ± 0.01	24
Glycine	1.16 ± 0.01	64
Threonine	0.86 ± 0.01	47
Alanine	1.25 ± 0.02	69
Arginine	1.78 ± 0.01	99
Tyrosine	0.63 ± 0.01	35
Cysteine	0.18 ± 0.01	10
Valine	0.86 ± 0.05	47
Methionine	0.23 ± 0.17	13
Tryptophan	0.51 ± 0.05	28
Phenylalanine	0.78 ± 0.01	43
Isoleucine	0.78 ± 0.03	43
Leucine	1.39 ± 0.01	77
Lysine	1.46 ± 0.02	81
Proline	0.52 ± 0.06	28
Total	18.11	999

Table 4
Amino acid score of Chinese mitten crab meat

Amino acid	Content (mg/g protein)	Reference (mg/g protein)	Score
Threonine	47	34	138
Tryptophan	28	11	255
Cysteine + methionine	23	25	92
Valine	47	35	134
Phenylalanine + tyrosine	78	63	124
Isoleucine	43	28	154
Leucine	77	66	117
Lysine	81	58	140
Total	424	320	

Reference: Reference amino acid pattern of preschool children (2–5 years) (FAO/WHO/UNU, 1985).

both crab meat and edible viscera. The contents of zinc, iron, potassium, manganese, copper, calcium and phosphorus of crab meat were significantly different ($p < 0.05$) from that of edible viscera; however, no such significant differences ($p > 0.05$) were observed in the case of sodium and magnesium contents. Zinc, potassium, copper and phosphorus contents were higher in crab meat than in edible viscera. By contrast, iron, manganese and calcium contents were higher in edible viscera.

There were significant differences in mineral contents between Chinese mitten crab and the salt-water crab, such as green crab (Skonberg & Perkins, 2002), blue crab and swim crab (Gökoğlu & Yerlikaya, 2003). Sodium, copper, calcium, manganese and magnesium contents were lower, while zinc, iron and phosphorus contents in Chinese mitten crab meat were higher than in blue crab. The values of adequate intakes of minerals by Chinese children (4–6 years) (China Nutrition Institute, 2001), indicated that Chinese mitten crab was a good mineral source of zinc, iron, copper and phosphorus, and Chinese mitten crab meat seemed to be balanced in mineral composition especially in zinc, iron and copper contents.

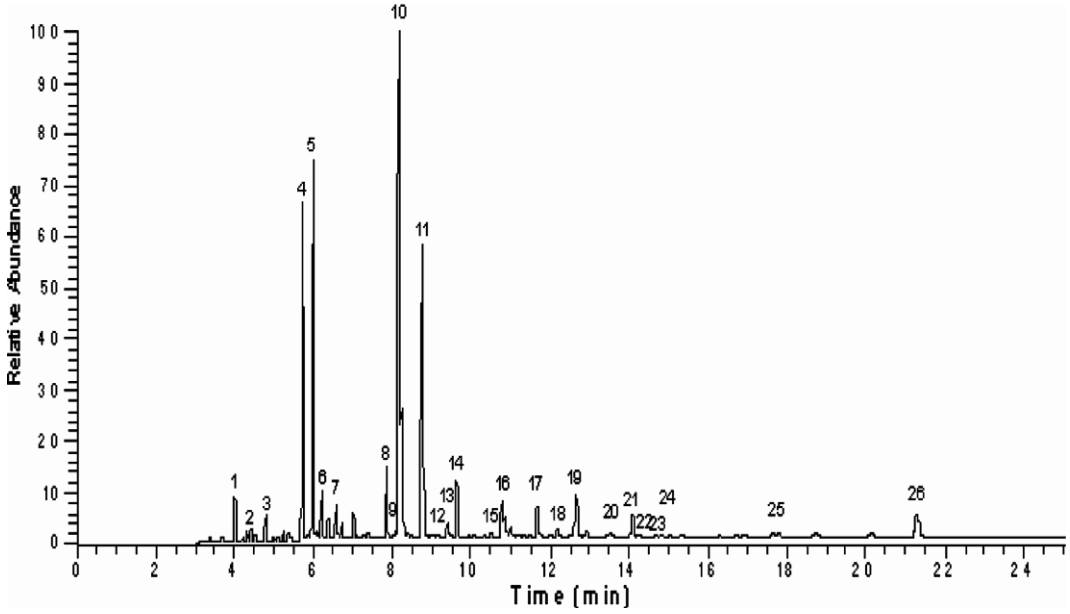

Fig. 1. The total ion chromatogram of crab fatty acid. 1.14:0; 2.14:1; 3.15:0; 4.16:0; 5.16:1$n-7$; 6.17:0; 7. 3,7,11,15-tetramethyl-hexadecanoic acid; 8.18:0; 9.18:1$n-5$; 10.18:1$n-9$; 11.18:2$n-6$,9; 12.19:0; 13.19:1$n-9$; 14.18:3$n-3$,6,9; 15.20:0; 16.20:1$n-9$; 17.20:2$n-7$,9; 18.20:3$n-7$,10,13; 19.20:4$n-6$,9,12,15; 20.20:3$n-3$,6,9,15; 21.20:5$n-3$,6,9,12,15; 22.22:0; 23.22:1$n-9$; 24.23:0; 25.20:4$n-6$,9,12,15; 26. 22:6$n-3$,6,9,12,15,18. *Note:* FAMEs of peaks 4, 8, 10, 11, 14, 19, 21, 25 and 26 were fully identified by both standards and MS; others were tentatively identified by MS.

The amino acid composition of crab meat is given in Table 3. The crab protein contained high amounts of glutamic acid (151 mg/g of protein), followed by aspartic acid, arginine, lysine, leucine, alanine and glycine in a decreasing order. Amino acid scores are summarized in Table 4. When compared to the reference amino acid pattern of preschool children (2–5 years old), all of the amino acid scores were more than 100, except that of sulphur-containing amino acids (cysteine and methionine).

When compared with the amino acid composition of green crab (Skonberg & Perkins, 2002), there was no significant difference in the non-essential amino acid composition. Tryptophan content in green crab meat (10 mg/g protein) was low, which was the limiting amino acid in green crab meat protein. By contrast, the tryptophan content in Chinese mitten crab was relatively higher, and its content (28 mg/g protein) was almost three times higher than that in green crab meat. According to the amino acid score, the S-containing amino acids (cysteine and methionine) seemed to be the limiting amino acids in Chinese mitten crab. However, considering that there was about $55 \pm 14\%$ of cysteine loss when meat and bone meal were hydrolyzed without performic acid oxidation (Spindler, Stadler, & Tanner, 1984), the real S-containing amino acid score would be over 100. Therefore, the proteins from Chinese mitten crab meat were well-balanced in their essential amino acid compositions, which indicated that it is a high quality protein source.

Fig. 1 is the total ion chromatogram of crab fatty acid, using GC/MS in the full scan model method, and it indicates 26 fatty acids found in crab oil. The percentage composition of fatty acid of the Chinese mitten crab is shown in Table 5. The fatty acid profile of Chinese mitten crab seemed dominated by monounsaturated fatty acids (MUFAs), which comprised about half (49.8%) of the total fatty acids. Among the MUFAs, oleic acid (18:1) was the dominant monounsaturated fatty acid, and it occupied 31.0% of the total fatty acid, followed by palmitoleic acid (16:1) (14.3%). Saturated fatty acids (SFAs) and polyunsaturated fatty acids (PUFAs) were in approximately equal amounts, 24.9% and 23.9%, respectively, and 1.40% was unknown. The main saturated fatty acids were palmitic acid (16:0), which accounted for 14.2%, followed by stearic acid (18:0), margaric acid (17:0) and myristic acid (14:0), but all of them were less than 3%. It is interesting to note that there was a branched-chain fatty acid (3,7,11,15-tetramethyl-hexadecanoic acid) found in this study. In our early study of the volatile compounds in Chinese mitten crab (Chen & Zhang, 2006), branched-chain hydrocarbons, such as 2,6,10,14-tetramethylhexadecane and 3,7,11,15-tetramethyl-2-hexadecene were found, and 2,6,10,14-tetramethylpentadecane was reported to contribute a green, sweet aroma to crayfish processing waste (Spurvey, Pan, & Shahidi, 1998). Those branched-chain hydrocarbons might have originated from 3,7,11,15-tetramethyl-hexadecanoic acid. The dominant PUFA was LA ($18{:}2n-6$), accounted for 11.9% of the total fatty acid, followed by DHA ($22{:}6n-3$), AA ($20{:}4n-6$), ALA ($18{:}3n-3$) and EPA ($20{:}5n-3$). However, all of those four PUFAs were in minor amounts, within the range of 2.1–3.0%. The $n-3$ and $n-6$ PUFAs accounted for 7.44% and 16.4% of the total fatty acids, respectively, and the ratio of $n-3/n-6$ was 0.45.

Table 5
Fatty acid composition (%) of Chinese mitten crab

Fatty acid	Mean ± SD
Saturated fatty acid (SFA) composition (%)	
14:0	1.72 ± 0.02
15:0	1.24 ± 0.07
16:0	14.22 ± 0.71
17:0	2.84 ± 0.04
18:0	2.88 ± 0.06
19:0	0.20 ± 0.01
20:0	0.18 ± 0.01
22:0	0.16 ± 0.02
23:0	0.16 ± 0.01
3,7,11,15-tetramethyl-hexadecanoic acid	1.31 ± 0.07
∑SFA	24.91
Monounsaturated fatty acid (MUFA) composition (%)	
$14{:}1n-3$	0.27 ± 0.02
$16{:}1n-7$	14.32 ± 0.45
$18{:}1n-13$	0.28 ± 0.01
$18{:}1n-9$	30.96 ± 0.14
$19{:}1n-9$	0.79 ± 0.04
$20{:}1n-9$	3.04 ± 0.16
$22{:}1n-9$	0.15 ± 0.01
∑MUFA	49.81
Polyunsaturated fatty acid (PUFA) composition (%)	
$18{:}2n-6$	11.91 ± 0.27
$20{:}2n-6$	1.41 ± 0.06
$18{:}3n-3$	2.42 ± 0.09
$20{:}3n-6$	0.42 ± 0.07
$20{:}4n-6$	2.69 ± 0.09
$20{:}5n-3$	2.17 ± 0.07
$22{:}6n-3$	2.85 ± 0.08
∑PUFA	23.87
Others fatty acid composition (%)	1.40 ± 0.18
∑PUFA $n-3$	7.44
∑PUFA $n-6$	16.43
∑PUFA $n-3$/∑PUFA $n-6$	0.45
∑PUFA $n-6$/∑PUFA $n-3$	2.2

The fatty acid composition was similar to those in hepatopancreas of the female Chinese mitten crab at stages IV (ovarian, fully matured) and V (after spawning) (Wen, Chen, Ai, Zhou, & Jiang, 2001), but the $n-3$ PUFAs content (10.4%) and $n-3/n-6$ (1.09) values at stage IV were higher than ours, while $n-3$ PUFAs content (4.6) and $n-3$ to $n-6$ (0.36) value at stage V were lower than ours. The male crab used in this study was at the stage of fully matured gonad, equal to stage IV of the female crab (Wen et al., 2001). The discrepancy may be due to the existing differences, such as sex, diet, season and living conditions.

Compared with the salt-water crabs, such as green crab (Naczk et al., 2004) and blue crab (Çelik et al., 2004), there were significant differences in the fatty acid compositions. In salt-water crab, PUFAs were the predominant fatty

acids, accounting for about half of the total fatty acids. EPA and DHA were the dominant fatty acids in salt-water crab. Furthermore, the $n-3$ fatty acid content and $n-3/n-6$ values were higher than those in Chinese mitten crab. Although oleic acid (18:1$n-9$) was the dominant MUFA in salt-water crab, its content (10–18%) was lower than that (31%) in Chinese mitten crab.

As normal diets have lower amounts of $n-3$ fatty acids than $n-6$ fatty acids, a dietary intake of fish with a high ratio of $n-3/n-6$ would be beneficial. The $n-3/n-6$ ratio is a good index for comparing relative nutritional value of fish oils of different species, and a higher ratio of $n-3/n-6$ PUFAs has often been cited as an index of high nutritional value. The ratio of $n-3/n-6$ PUFAs in Chinese mitten crab was only 0.45 in our study, while the values were1.57 in blue crab hepatopancreas and 3.18 in breast meat (Çelik et al., 2004). The $n-3$ PUFAs content and $n-3/n-6$ value in salt-water crab were greater than those in Chinese mitten crab. Therefore, the nutritional value of Chinese mitten crab was lower than that of the salt-water crab according to $n-3$ PUFAs content and $n-3/n-6$ value. Because the $n-6$ and $n-3$ fatty acids compete for the same metabolic substrates and have different biological roles, the balance between them in the diet can be of considerable importance. FAO experts have recommended that ratio of $n-6/n-3$ PUFAs in the diet should be between 5:1 and 10:1(FAO/WHO, 1994). Therefore, the Chinese mitten crab must be an $n-3$ PUFA-rich food in normal diets, since the ratio of $n-6/n-3$ PUFAs was 2.2.

4. Conclusion

Chinese mitten crab, which has a yield value of 33.4%, could be a good source of minerals, such as zinc, iron, copper and phosphorus. Further, its meat could be a high quality protein source because of its well-balanced essential amino acid composition. Having a $n-6/n-3$ PUFA value 2.2 and predominant monounsaturated fatty acids, it could also be an $n-3$ PUFA-rich food in a normal diet. In short, the results clearly indicate that Chinese mitten crab is a nutritious food.

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