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Determination of Nutritional Quality of Warty Crab (*Eriphia verrucosa* Forsskal, 1775)

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Abstract: *Eriphia verrucosa* is the largest Black Sea crab and can reach up to 9 cm in width. Crude protein, crude lipids, moisture and ash contents of warty crab meat, on a wet weight basis, were 19. 66, 0. 66, 76.13 and 2.35 g/100 g, respectively. The cholesterol content of warty crab meat was 55.78 mg/100 g. The fatty acid composition of warty crab was found to be 37.89% saturated (SFAs), 29.41% monounsaturated (MUFAs) and 20.05% polyunsaturated acids (PUFAs). Among the SFAs, palmitic acid (C1 6:0) was the dominant saturated fatty acid and it occupied 19.65% of the total fatty acid. Oleic acid (C1 8:1) was the dominant MUFAs (15.88%). The highest PUFAs were eicosapentaenoic acid (EPA, C20:5n-3) and docosahexaenoic acid (DHA, C22:6n-3) contributing approximately 39 and 22% to the total PUFA content of the lipids, respectively. The highest essential amino acids were leucine, valine, lysine and isoleucine while the highest non-essential amino acids were aspartic acid, glutamic acid, alanine, glycine in warty crab meat, respectively.

Key words: *Eriphia verrucosa*, crab meat, proximate analysis, fatty acids, amino acids, nutrition

INTRODUCTION

Generally, fish and shellfish meat is considered to be highly nutritious, owing to its content of Ω3 fatty acids, essential amino acids and proteins. In addition to their dietary importance, proteins affect food texture, as also do small peptides and amino acids contribute to food flavour (Cruz-García *et al*., 2000; Vilosoa-Martínez *et al*., 2007). 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 (Gökoglu and Yerlikaya, 2003). Crab is caught in large amounts on the coast of the Middle Black Sea. *Eriphia verrucosa* is the largest Black Sea crab and can reach up to 9 cm width. It is inhabits stony coastal zones (Zaitsev and Mamaev, 1997).

Eriphia verrucosa is one of those with commercial value in Mediterranean countries (Altinelataman and Dinçer, 2007) but they are rarely utilized by Turkish people due to lack of knowledge and not traditional food.

Many studies were examined the proximate composition of different crab species in various parts of the world (Akbar *et al*., 1988; Adeyeye, 2002; Skonberg and Perkins, 2002; Nackzk *et al*., 2004; Musaiger and Al-Ruaidh, 2005; Chen *et al*., 2007; Vilosoa-Martínez *et al*., 2007; Adeyeye, 2008) But, available data on the proximate composition of crab (especially *Eriphia verrucosa*) in Turkey are limited (Türeli *et al*., 1998; Gökoglu and Yerlikaya, 2003; Celik *et al*., 2004; Kücükgülmez *et al*., 2006; Altinelataman and Dincer, 2007; Kuley *et al*., 2007; Kücükgülmez and Celik, 2008).

Crab is highly nutritious and healthy owing to its content essential amino acids, proteins, unsaturated fatty acids and minerals (Adeyeye, 2002; Skonberg and Perkins, 2002; Gökoglu and Yerlikaya, 2003; Celik *et al*., 2004; Nackzk *et al*., 2004; Musaiger and Al-Ruaidh, 2005; Vilosoa-Martínez *et al*., 2007; Chen *et al*., 2007; Kuley *et al*., 2007; Kücükgülmez and Celik, 2008; Adeyeye, 2008). Therefore, determining of the proximate, fatty acids, amino acids and minerals composition of different crab species have a great importance due to the good effects on human health. The aim of present study, was determining the proximate, fatty acid and amino acid of the crab species *E. verrucosa* caught in Sinop.

MATERIALS AND METHODS

Twelve warty crab (*E. verrucosa*) (154.91±18.13 g), were purchased from local fish market in Sinop (Black Sea,

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Turkey) and transported immediately to the laboratory in plastic boxes. Meats in the body, leg and claw portions were separated manually, mixed, homogenized and then stored at -25±2°C until the analyzed.

Proximate composition and cholesterol analyses: The moisture content of crabs was determined by drying of the meat in an oven at 105°C until a constant weight was obtained (AOAC, 1995). Crude ash content was determined by ashing the samples in the furnace at 550°C for 8-12 h (AOAC, 1995). Crude protein content was determined according to the AOAC procedure (AOAC, 1995). Protein content was calculated as ₦×6.25. Crude lipid content was determined by acid digestion prior to continuous extraction using petroleum ether (bp 40-60°C) in a Soxtec system (AOAC, 1995). Cholesterol concentration was measured by chromatographic method in laboratory TUBITAK, M.A.M, Izmit, Turkey.

Fatty acid analyses: Fatty acid analyses were carried out using the IUPAC II.D.19 method (IUPAC, 1979). Fatty acids of the warty crab were analyzed using a Perkin Elmer Auto System XL gas chromatograph (Perkin-Elmer, Beaconsfield, UK) equipped with a SP-2330 column and a flame ionization detector. Separation of fatty acid methyl esters was achieved using a fused silica capillary column (30 m×0.25 mm×0.20 μm film thickness). The oven temperature was set at 120°C for 2 min, then increased to 220°C with a ramp rate of 58°C min^{-1} and then held for 15 min. The injector and detector temperatures were maintained at 240 and 250°C, respectively. The carrier gas was 10 psi helium with a split ratio of 1/50. The air and hydrogen pressures were 338 and 45 mL min^{-1}, respectively. Results were expressed as the percentage of each fatty acid with respect to the total fatty acids. The fatty acid analyses were conducted in duplicate.

Amino acid analyses: Amino acid analyses were carried out using the hydrolysis method (Anonymous, 1998). The samples were hydrolysed with 6 ₦ HCI in sealed vacuum tubes at 110°C for 24 h. The HCI was removed from the hydrolysed samples using a rotary evaporator. The samples were analysed using a Varian CP-3800 GC (Varian, Holland). The amino acid analyses were conducted in triplicate.

RESULTS AND DISCUSSION

The results of proximate analyses of the warty crab are shown in Table 1. Crude protein and crude lipid contents of crab meat, on a wet weight basis, were 19.66 and 0.66 g/100 g, respectively. These values are similar to those published by Chen *et al*. (2007) for Chinese mitten crab (*Eriocheir sinensis*), by Kücükgülmez *et al*. (2006) for blue crab (*Callinectes sapidus*), by Musaiger and Al-Ruaidh (2005) for *Portunus pelagicus* and by Skonberg and Perkins (2002) for green crab (*C. maenus*), but somewhat lower than those reported by Kuley *et al*. (2007) for blue crab (*Callinectus sapidus*), by Gökoglu and Yelikaya (2003) for swim crab (*P. pelagicus*) and higher than those reported by Altinelataman and Dincer (2007) for warty crab (*Eriphia verrucosa*).

The moisture and crude ash contents in meat average 76.13 and 2.35 g/100 g, respectively. These values are in good agreement with *P. pelagicus* reported as average 77.4 moisture and 2.4 g/100 g ash (Musaiger and Al-Ruaidh, 2005), green crab (*Carcinus maenus*) reported as average 78.95 moisture and ash 2.2 g/100 g (Skonberg and Perkins, 2002), blue crab (*C. sapidus*) reported as average 76.89 moisture and 2.10 ash g/100 g (Kücükgülmez *et al*., 2006). But the moisture and ash content are somewhat higher than values reported for the *Callinectus sapidus* (three different area and body and claw meat average) 67.30 and 1.33% (Kuley *et al*., 2007). Proximate composition is influenced by season, water temperature and spawning cycle, which is also determined by species (Ockerman, 1992).

The cholesterol content of warty crab meat was 55.78 mg/100 g (Table 1). This value is lower than those reported for Dungeness crab (claw meat, 76 mg/100 g), Rock crab (claw meat, 70.9 mg/100 g), Jonah crab (claw meat, 78.4 mg/100 g) and green crab (leg meat and claw meat 57.12, 64.8 mg/100 g, respectively) (Ackman and Mc Leod, 1988; King *et al*., 1990; Skonberg and Perkins, 2002).

The fatty acid composition of warty crab is shown Table 2. The fatty acid composition of warty crab was found to be 37.89% saturated (SFAs), 29.41% monounsaturated (MUFAs) and 20.05% polyunsaturated acids (PUFAs). Among the SFAs, palmitic acid (C16:0) was the dominant saturated fatty acid and it occupied 19.65% of the total fatty acid, followed by stearic acid (C18:0) 11.17%. These results are in agreement with previous studies on fatty acids of other crab species (King *et al*., 1990; Nackzk *et al*., 2004; Celik *et al*., 2004; Kuley *et al*., 2007). Oleic acid (C18:1) was the dominant MUFAs. This value is higher than those reported by Nackzk *et al*. (2004) for green crab and by Celik *et al*. (2004) for blue crab.

Table 1: Proximate composition (g/100 g) and cholesterol (mg/100 g) concentrations of warty crab (*E. verrucosa*)

	Cholesterol[a]	Moisture[b]	Protein[b]	Fat[a]	Ash[b]
Crab meat	55.78±0.13	76.13±0.04	19.66±0.02	0.66±0.01	2.35±0.01

[a]Results are mean value of 2 replicates ±standard error; [b]Results are mean value of 3 replicates ±standard error

Table 2: Fatty acids composition (%) of warty crab (*E. verrucosa*)

Fatty acids	Crab
C10:0	0.022±0.01
C12:0	0.014±0.01
C13:0	ND
C14:0	0.936±0.01
C15:0	1.420±0.01
C16:0	19.65±0.40
C17:0	2.080±0.04
C18:0	11.17±0.20
C20:0	0.890±0.00
C21:0	0.910±0.11
C22:0	0.520±0.02
C23:0	0.280±0.01
C24:0	ND
Total SFA	37.890
C14:1	ND
C15:1	0.310±0.01
C16:1	6.620±0.13
C17:1	5.440±0.10
C18:1 n-9t	0.260±0.01
C18:1 n-9c	15.620±0.35
C20:1n-9	1.020±0.01
C22:1n-9	ND
C24:1n-9	0.140±0.01
Total MUFA	29.410
C18:2n-6t	0.360±0.01
C18:2n-6c	2.230±0.02
C18:3n-6g-	0.170±0.02
C18:3n-3a-	0.400±0.02
C20:2n-6	1.140±0.02
C20:3n-3	0.330±0.02
C20:4n6	ND
C22:2n-6	3.160±0.05
C20:5n-3	7.870±0.15
C22:6n-3	4.390±0.1
Total PUFA	20.050
Total n-3	12.99
Total n-6	7.06
n-3/n-6	1.84
Unkonown	12.4

Results are mean value of 2 replicates ±standard error; ND: Not Determined; SFA: Saturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; PUFA: Polyunsaturated Fatty Acids

Total PUFA content of lipid was 20.05%. The highest PUFAs were eicosapentaenoic acid (EPA, C20:5n-3) and docosahexaenoic acid (DHA, C22:6n-3) contributing approximately 39 and 22% of the total PUFA content of the lipid, respectively. Similar results were reported by Celik *et al.* (2004) for blue crab, by Nackzk *et al.* (2004) for green crab and Kuley *et al.* (2007) for blue crab. Pigott and Tucker (1990) suggested that the n-3/n-6 ratio is a better index for comparing the relative nutritional value of fish oils of different species. A ratio of 1:1 for n-3/n-6 is considered optimal for nutritional purposes (Simopoulos, 2002). In this study, ratio of n-3/n-6 of warty crab was 1.84%.

Table 3: Amino acid composition (g/100 g in wet basis)[a] of warty crab (*E. verrucosa*)

Essential amino acids	Crab meat
Valine	1.106±0.04
Leucine	1.762±0.07
Isoleucine	1.051±0.01
Lysine	1.090±0.01
Methionine	0.522±0.01
Threonine	0.85±0.010
Phenylalanine	0.76±0.010
Histidine	0.316±0.01
Tryptophan	NA
Arginine	NA
Total	7.458
Non-essential amino acids	
Alanine	1.808±0.01
Glycine	1.714±0.01
Serine	0.587±0.01
Proline	1.254±0.01
Aspartic acid	2.842±0.01
Hidoksil-L-proline	NA
Glutamic acid	2.518±0.01
Tyrosine	0.658±0.01
Total	11.381
Essential/Nonessential ratio	0.655

[a]Results are mean value of 3 replicates ±standard error; NA: Not Analyzed

The amino acid composition of warty crab meat is shown in Table 3. The highest essential amino acids were leucine, valine, lysine and isoleucine while the highest non-essential amino acids were aspartic acid, glutamic acid, alanine and glycine in warty crab meat, respectively. Leucine amount determined in this study was found higher than leucine amounts in blue crab (Kücükgülmez and Celik, 2008) and Chinese mitten crab (Chen *et al.*, 2007) compared to in present study. The ratio essential amino acid to non-essential amino acids in warty crab meat was 0.66. Kücükgülmez and Celik (2008), indicated that essential amino acids/non-essential amino acid ratio of blue crab is average 0.81 (claw and breast meat).

The world health organization recommended leucine and isoleucine requirements for adults of 14 and 19 mg amino acid kg^{-1} body weight/day (FAO/WHO/UNU, 1985). Kücükgülmez and Celik (2008), reported that 100 g claw meat of the blue crab consisted of 1309 mg leucine and 941 mg isoleucine, assuming an adult human consumes 50 g blue crab, this can provide the daily amino acid requirement determined by WHO. In also our study, was found similar result.

CONCLUSION

The results determined in this resaerch show that warty crab meat is value food due to high quality protein, well-balanced essential amino acids and unsaturated fatty acids.

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