Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol. 7, No. 14, 2017

Major Mineral (P, K, Ca) Contents and Proximate Compositions of the Male and Female Blue Swimming Crab (Portunus segnis Forskal, 1775) from Northeastern Mediterranean Sea, Mersin Bay, Turkey

İlkan Ali Olgunoglu* Mine Perçin Olgunoglu
Department of Aquaculture and Fisheries Program,
Kahta Vocational Training School, Adiyaman University, Turkey

Abstract
The aim of this study was to demonstrate the nutritive value of blue swimming crab (*Portunus segnis* Forskal, 1775). Selected major mineral (P, K, Ca) contents, proximate compositions and fatty acids contents in female and male specimens of blue swimming were investigated. Crab samples used in this research were obtained from Northeastern Mediterranean Sea, Mersin Bay, Turkey. There were no significant differences in the nutritive value between the sexes ($p>0.05$). The protein was identified as 20.16% and 19.03% for female and male crab respevtively. This species was found to be rich in minerals and low in fat (0.66% for male, 0.91% for female) when compared with other economical crab species from Mediterranean Sea/Turkey. In fatty acid composition, the saturated fatty acid fraction was dominant, followed by monounsaturated fatty acid and polyunsaturated fatty acid for both sexes. In conclusion, from a nutritional point of view, both male and female blue swimming crab are demonstrated acceptable quality.
Keywords: Minerals, Proximate analysis, Blue swimming crab; *Portunus segnis*; Mediterranean sea

1. Introduction

Portunus segnis, (Forskal, 1775) known as the blue swimming crab is one of the commercially important species that inhabit a wide range of inshore and continental shelf areas, including sandy, muddy and sea grass habitats, from the intertidal zone to at least 50 m depth (Safaie *et al*., 2013; Noori *et al.,* 2015). The species is often considered a benthic carnivore and eats mainly sessile mollusk and other invertebrates (Pazooki *et al.,* 2012). It is distributed from eastern Mediterranean to east coast of Africa in the western Indian Ocean and to Pakistan, Red Sea and Persian Gulf (Lai *et al.,* 2010; Pazooki *et al.,* 2012). This species entered to the Mediterranean with Suez Canal. Because of its large size and good flavor, this crab is consumed as food in Turkey and sold for 0.25 to 0.42 Euro at local fish markets in Mersin and Iskenderun Bays (Özcan, 2012). The global capture production of this crab was more than 200 000 tons in 2013 (Noori *et al.,* 2015). In general peoples are eating crabs because of its taste, easy availability and affordability but are often unaware of the health benefits (Soundarapandian *et al.,* 2015). Crab is commonly marketed either as refrigerated fresh product, frozen or pasteurized chilled meat and is usually consumed by European and Far East countries (Segner, 1992; Chung and Cadwallader 1993; Adeyeye, 2002; Olgunoglu, 2010). Its meat is often recommended for pregnant women (Adeyeye 2002; Kuley *et al.,* 2008). Because crab meat is highly nutrious and healthy owing to its high protein and low fat content, rich mineral and fatty acid contents (FA) (Gokoglu and Yerlikaya 2003; Sudhakar *et al.,* 2011). The minerals participate in several biochemical reactions and serve as components of bones, soft tissues and co-factorsand and co-activators of various enzymes important in human nutrition. Phosphorus (P) and calcium (Ca) are crucial in the formation of bones and teeth; potassium (K) is important for the transmission of nerve impulses and keeping electrolyte balance. When these elements are not adequately provided to the body, mainly by dietary intake, the individual may suffer from mineral deficiency diseases (Sudhakar *et al*., 2009; Mogobe *et al.,* 2015). On the other hand polyunsaturated fatty acids (PUFAs) have been recognized to have special pharmacological and physiological effects on human health. They were benificial for the reduction of coronary artery disease (Cherif *et al.,* 2008). Therefore, many authors have recently investigated mineral contents and the fatty acid profiles of different crab species in various parts of the world (Gokoglu and Yerlikaya 2003; Çelik *et al*., 2004; Cherif *et al.,* 2008; Kuley *et al*., 2008; Ayas and Ozogul 2011a, 2011b; Moronkola *et al.,* 2011; Sudhakar *et al.,* 2011; Soundarapandian *et al.,* 2014). But, literature reviews have been showed that, there are no studies been done to investigate the mineral and FA composition of *P. segnis* from Mediterranean Sea.

The purpose of this work was to evaluate the nutritional value and the fatty acid profiles of male and female blue swimming crab caught in the Northeastern Mediterranean.

2. Material and methods

Collection and preparation of samples

The male and female specimen of *P. segnis* was collected by dip net from Mersin Bay in the coast of Northeastern Mediterranean Sea of Turkey in February 2016. (Mersin Bay is located along the southern

Mediterranean coast of Turkey (Figure 1). Covering 3. 300 km2, the bay receives fresh water from the Seyhan River, and from Berdan, Delicay, Muftu, and Lamas creeks. Its deepest part is 200 m (Karakaya and Evrendilek 2010)). Immediately after capture, crabs were placed in plastic bags over a layer of ice in a cooler and transported to the laboratory. The carapace meats of each sex group including 18 individuals were taken out by hand and placed in labeled polyethylene bags and stored at -20°C until processing for mineral analysis.

Figure 1. Sampling area in the Northeastern Mediterranean Sea

Proximate composition analysis

The moisture content of crabs was determined by drying the meat in an oven at 105°C until a constant weight was obtained (AOAC 1990). Ash content was determined by dry ashing in a furnace oven at 525 °C for 24 h. Lipid was determined by the method described by Bligh and Dyer (1959). Crude protein content was calculated by converting the nitrogen content, determined by Kjeldahl's method (6.25x N) (AOAC 1990).

Mineral analysis

The carapace meat samples of male and female specimen of blue swimming crab were transported with dry ice to the Accredited Industrial Services Laboratory of Turkey/Istanbul. 2g of meat (wet weight) were weighed and placed in a digestion vessel with 5 ml of concentrated (65%) nitric acid (HNO_3) and 2 ml (30%) hydrogen peroxide (H_2O_2) and digested in a microwave oven system (NMKL, 2007). Inductively coupled plasma-optical emission spectrometry (ICP-MS-Agilent 7700) was used to determine phosphorus (P), potassium (K) and calcium (Ca) in the samples. The analyses were performed at least in triplicate and the concentrations were expressed as mg/100g wet weight.

Fatty Acid Analysis

The methyl esters of fatty acids of samples were prepared according to IUPAC Methods II. D. 19 (1979). The analyses were carried out by using a Perkin Elmer Autosystem. XL Gas Chromotography and Flame Ionization Detector (FID) equipment and a Supelco 2330 fused silica capillary column (30 mx 0.25 mm x 0.20 µm film thickness) for determining the fatty acid composition.

Sample working conditions on the gas chromatography device

Column temperature program: 2 min at 120ºC, and 10 min at 220 ºC with 15 ºC increase, total analysis time:32 min ; injector temperature: 240 ºC ; carrier gas: 0.5 ml/min He; detector temperature: 260 ºC ; H_2: 45 ml/min ; air:450 ml/min ; sample injection volume: 2 µl ; max. column temperature: 280 ºC ; split flow: 50 ml.

Data analysis

For data analysis independent samples t-test was used to identify significant differences in all parameters. Statistical significance was defined at $p<0.05$. The mean values were obtained from 3 experiments and reported as X±SD (Dinçer and Aydın 2014).

3. Results and Discussion

Table 1 shows, the mean carapace width (CW), mean carapace length (CL) (cm) and weights (g) of the species examined in the study. The mean size and weight of female crabs are close to the size and weight of male crabs in this study. There were no significant differences in crab size and weight between the sexes ($p>0.05$).

Table 1. Carapace width (CW), carapace length (CL) (cm) and weights (W) (g) of male and famale blue swimming crab (*Portunus segnis*)

Sexes	CW (cm)	CL (cm)	W (g)
Female Crab	13.44±1.08[a]	7.5±0.70[a]	151.84±30.75[a]
Male Crab	12.90±0.90[a]	6.6±0.96[a]	150.60±60.70[a]

Values are shown as means ± SD. Mean values in the same column having the same superscript are not significantly different ($p>0.05$)

The proximate composition of blue swimming crab (*P. segnis*) is shown in Tables 2. There were no significant differences (p>0.05) in the protein, lipid, moisture and ash contents between the sexes of blue swimming crab. The levels of lipid and protein vary depending upon season, age, maturity, sex, water temperature, spawning cycle and availability of food, types of diet and feeding system of organism (Oksuz *et al.,* 2009; Turan *et al.,* 2011; Rosli *et al.,* 2012). In a study from Mediterranean Sea, Türeli *et al.,* (2002) determined that protein and lipid of *Callinectes sapidus* ranged between 12.11-21.96% and 0.21-3.89% repectively. Türeli *et al.,* (2000) also reported that protein in *Portunus pelagicus* varied from 17.50% to 18.83% and lipid from 1.45% to 1.53%

Table 2. Proximate composition of female and male blue swimming crab (*P. segnis*)

Parameters	Female (%)	Male (%)
Protein	20.16±0.02[a]	19.03±0.03[a]
Lipid	0.91±0.00[a]	0.66±0.00[a]
Ash	2.02±0.37[a]	1.55±0.56[a]
Moisture	76.08±4.08[a]	77.92±0.11[a]

Values are shown as means ± SD. Mean values in the same row having the same superscript are not significantly different (p>0.05)

Gökoglu and Yerlikaya (2003) reported that the lipid in the *C. sapidus* and *P. pelagicus* caught off Mediterranean Sea varied from 0.64% to 0.79% and from 0.81% to 1.21% respectively. Protein contents were also reported as 14.71% for *C. sapidus* and 22.64% for *P. pelagicus*. In an other study on *C. sapidus* from Mersin Bay, protein and lipid contents were reported as 22.45% and 0.96% for female crab and 21.40% and 1.11% for male crap by Ayas and Ozogul (2011a). Ayas and Ozogul (2011b) also reported that protein and lipid as 23.20% and 1.18% for male speciemen of *P. pelagicus* and 21.93% and 1.39% for female speciemen of *P. pelagicus.* The results obtained in this study showed that crabs caught from the Mersin Bay have high protein (19.03-20.16%) and low fat contents (0.66–0.91%).

The major mineral contents of *P. segnis* are given in Tables 3. There were no significant differences (p>0.05) in P, K, Ca contents between female and male specimens of *P. segnis*. Gokoglu and Yerlikaya (2003) reported the contents of P, K and Ca respectively as 165.4 mg/100g, 244.4 mg/100g and 64.9 mg/100g for *C. sapidus* and 154.2 mg/100g, 303.8 mg/100g and 87.6 mg/100g for *P. pelagicus* caught from Mediterranean Sea. In the present study the content of minerals were identified higher than those reported previously for other crab species. The main reason for this is thought to be related to variation in seasonal feeding habits and nutrient composition of the diet, age, sex, spawning, surrounding medium and season.

Table 3. Mineral contents of female and male blue swimming crab (*P. segnis*) mg/100g

Parameters	Female Crab	Male Crab
P	226.65±0.05[a]	235.50±0.05[a]
K	293.96±0.06[a]	322.97±0.07[a]
Ca	139.58±0.07[a]	154.61±0.03[a]

Values are shown as means ± SD. Mean values in the same row having the same superscript are not significantly different (p>0.05)

The fatty acids analyzed were grouped as saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs). The total saturated, mono and polyunsaturated fatty acids (%) in female and male blue swimming crab (*P. segnis*) are presented in Table 4.

Table 4. Total saturated, mono and polyunsaturated fatty acids (%) in female and male blue swimming crab (*P. segnis*)

Parameters	Female %	Male %
Satureted fatty acids (SFA)	47.43	47.55
Monounsaturated fatty acids (MUFA)	24.24	24.17
Polyunsaturated fatty acids (PUFA)	28.18	25.95
MUFA + PUFA	52.42	50.12
PUFA/SFA	0.59	0.54

In the present study, in both groups, SFA was the highest followed by PUFA and MUFA. In a study Ayas and Ozogul (2011a) reported SFA, MUFA and PUFA rates in female *C. sapidus* at 24.76%, 29.57% and 39.15% in male *C. sapidus* at 23.27%, 26.63% and 42.80% respevtively. In another study, SFA, MUFA and PUFA rates were reported as 24.02%, 23.31% and 44.51% for female *P. pelagicus* and 27.16%, 26.73% and 42.35% for male *P. pelagicus* by Ayas and Ozogul (2011b). Kuley *et al.,* (2008) found that SFA, MUFA and PUFA of *C. sapidus* from different regions of the Mediterranean coast ranged between 25.98-31.84% ; 7.55-22.04% and 39.73-43.78% respectively. A comparison of values obtained in this study with values reported for other crab species shows considerable differences in the rate of MUFA and PUFA. These considerable variations are apparently associated with variations in inter-species differences, maturity period, size, age, sex and nutrient composition of the diet, surrounding medium, season, flavour, and other quality characteristics of crab products

(Çelik *et al.*, 2004).

The indice of PUFA/SFA ratio was widely used to evaluate the nutritional value of fat for human consumption. According to some nutritional recommendations the PUFA/SFA ratio in human diets should be above 0.45 (Alfaia *et al*., 2010). In the present study the PUFA/SFA of *P. segnis* (for both female and male crabs) was within the range reported for human diets. It could be demonstrated that the blue swimming crab (*P. segnis*) is a desirable item in human diet when the levels PUFA/SFA ratios was considered.

The result of the present study indicated that blue bwimming crab (*Portunus segnis*) from Northeastern Mediterranean Sea, Mersin Bay, Turkey is rich in mineral contents when compared with other economical crab species from Mediterranean Sea/Turkey. In addition, this species is desirable item in the human diet, especially when the rate of PUFA/SFA is considered for the maintenance of human health. This study also showed that this species has high protein and low fat contents.

Acknowledgements
The Authors are grateful to Associate Professor Alper DOGAN who identified the specimen.

References

Adeyeye, E.I. (2002). Determination of the chemical composition of the nutritionally valuable parts of male and female common West African fresh water crab *Sudananautes africanus africanus*. Int J Food Sci Nutr. 53: 189-196.

Alfaia, C.M.M., Alves, S.P., Lopes, A.F., Fernandes, M.J.E., Costa, A.S.H., Fontes, M.L.F., Castro, C.M.G.A., Bessa, R.J.B. & Prates, J.A.M. (2010). Effect of cooking methods on fatty acids, conjugated isomers of linoleic acid and nutritional quality of beef intramuscular fat. *Meat Sci.* 84: 769-777.

AOAC (1990). Official Methods of Analyses of Association of Analytical Chemists International. (15th Ed.). Washington DC: AOAC.

Ayas, D. & Ozogul, Y. (2011a). The chemical composition of carapace meat of sexually mature blue crab (*Callinectes Sapidus*, Rathbun 1896) in the Mersin Bay. J FisheriesSciences.com. 5 (3): 262-269.

Ayas, D. & Ozogul, Y. (2011b). The chemical composition and Meat yield of mature blue swimmer crab (*Portunus Pelagicus*, Linnaeus 1758) in Mersin Bay, Northeastern Mediterranean, Turkey. Adv Food Sci. 33 (3):179-184.

Bligh, E.G. & Dyer, W.J. (1959). A rapid method of totallipid extraction and purification. Bioch. Cell Biol. 37 (8): 911-917.

Cherif, S., Frikha, F., Gargouri, Y. & Miled, N. (2008). Fatty acid composition of green crab (*Carcinus mediterraneus*) from the Tunisian mediterranean coasts. Food Chem. 111: 930–933.

Chung, H.Y. & Cadwallader, K.R. (1993). Volatile components in blue crab (*Callinectes sapidus*) meat and processing by- product. J. Food Sci. 58:1203–1211.

Çelik, M., Türeli, C., Çelik, M., Yanar, Y., Erdem, Ü. & Küçükgülmez, A. (2004). Fatty acid composition of the blue crab (*Callinectes sapidus* Rathbun, 1896) in the north eastern Mediterranean. Food Chem. 88:271-273.

Dinçer, M. T. & Aydın, I. (2014). Proximate composition and mineral and fatty acid profiles of male and female jinga shrimps (*Metapenaeus affinis*, H. Milne Edwards, 1837). Turk. J. Vet. Anim. Sci. 38:445-451.

Gökoglu, N. &Yerlikaya, P. (2003). Determination of proximate composition and mineral contents of blue crab (*Callinectes sapidus*) and swim crab (*Portunus pelagicus*) caught off the Gulf of Antalya. Food Chem. 80:495-498.

IUPAC (1979). *Standard Methods for Analysis of Oils, Fats and Derivatives*, 6th Edition (Fifth Edition Method II.D.19) 96-102. Pergamon Pres, Oxford

Karakaya, N. & Evrendilek, F. (2011). Monitoring and validating spatio-temporal dynamicsof biogeochemical properties in Mersin Bay (Turkey) using Landsat ETM. Environ. Monit. Assess. 181, 457.

Kuley, E., Özogul, F., Özogul, Y. & Olgunoglu İA. (2008). Comparision of fatty acid and proximate composition of body and claw of male and female blue crab from Mediterranean coast. *Int. .J Food Sci. Nutr.* 59(7): 573 – 580.

Lai, J.C.Y., Ng, P.K.L. & Davie, P.J.F. (2010). A revision of the *Portunus pelagıcus* (Linnaeus, 1758) Species complex (crustacea: brachyura: portunidae), with the recognition of four species. Raffles B Zool. 58(2):199-237.

Moronkola, B. A., Olowu, R.A., Tovide, O.O. & Ayejuyo, O.O. (2011). Determination of proximate and mineral contents of crab (*Callinectes amnicola*) living on the shore of Ojo River, Lagos, Nigeria. Sci. Rev. Chem. Comm. 1(1):1-6.

Noori, A., Moghaddam, P., Kamrani, E., Akbarzadeh, A., Neitali, B.K. & Pinheiro, M.A.A. (2015). Condition factor and carapace width versus wet weight relationship in the blue swimming crab *Portunus segnis.* Anim. Biol. 65:87-99.

NMKL (2007). Nordic Committee on Food Analysis method No.186. Trace elements - As, Cd, Hg, Pb and other

elements. Determination by ICP-MS after pressure digestion.

Mogobe, O., Mosepele, K. & Masamba, W.R.L. (2015). Essential mineral content of common fish species in Chanoga, Okavango Delta, Botswana. Afr. J. Food Sci. 9(9):480-486.

Oksüz, A., Ozylmaz, A., Aktas, M., Gercek, G. & Motte, J. (2009). A comparative study on proximate, mineral and fatty acid compositions of deep seawater rose shrimp (*Parapenaeus longirostris*, Lucas, 1846) and red shrimp (*Plesionika martia*, A. Milne-Edwards, 1883). J. Anim. Vet. Adv. 8(1):183-189.

Olgunoglu, İ.A. (2010). Determination of picrobiological contamination sources of blue crabmeat (*Callinectes sapidus* Rathbun, 1896) during pasteurization process. Pak. J. Zool. 42(5):545-550.

Özcan, T. (2012). The swimming crab *Portunus segnis* (Forskål, 1775): host for the barnacle *Chelonibia platula* (Ranzani, 1818) from the Turkish coast. J. Black Sea/Mediterr Environ. 18(3):271-278.

Pazooki, J., Hosseini, M. & Zadeh, A.V. (2012). The Dietary compositions of the blue swimming crab, *Portunus segnis* (Forskal, 1775) from Persian Gulf, South Iran. World Appl. Sci J. 20(3):416-422.

Rosli, W.W.I., Rohana, A.A.J., Gan, S.H., Fadzlina, N.H., Rosliza, H., Helmy, H., Mohd, N.S., Mohd, I.I., Shaiful, B. I., Wan, M.W.B. & Kamarul, I.M. (2012). Fat content and EPA and DHA levels of selected marine, freshwater fish and shellfish species from the east coast of Peninsular Malaysia. Int. Food. Res. J. 19 (3): 815-821.

Safaie, M., Pazooki, J., Kiabi, B. & Shokr, M.R. (2013). Reproductive biology of blue swimming crab, *Portunus segnis* (Forskal, 1775) in coastal waters of Persian Gulf and Oman Sea, Iran. Iran J. Fish. Sci. 12(2):430-444.

Segner, P.W. (1992). Spoilage of pasteurized crabmeat by a nontoxigenic psychrotropic anaerobic spore former. J. Food Microbiol. 55:176–181.

Soundarapandian, P., Varadharajan, D. & Ravichandran, S. (2014). Mineral composition of edible crab *Podophthalmus vigil* Fabricius (Crustacea: Decapoda). Arthropods 3 (1): 20-26

Soundarapandian, P., Varadharajan, D., Jaganathan, K. and Ravichandran, S. 2015. Fatty acid composition in long-eyed swimming crab *Podophthalmus vigil* (Fabricius). *Ntr. Food Sci.* 5(3):1-4.

Sudhakar, M., Manivannan, K. and Soundrapandian, P. 2009. Nutritive value of hard and soft shell crabs of *Portunus sanguinolentus* (Herbst). *Int. J. Anim. Vet. Adv.* 1(2):44-48.

Sudhakar, M., Rafa, K., Anathan, G. & Sampathkaumar, P. (2011). Compositional charecteristics and nutritional quality of *Podopthalamus vigil* (Fabricius). Asian J. Biol. Sci. 4(2):166-174.

Turan, H., Kaya, Y. & Erdem, E. 2011. Proximate composition, cholesterol, and fatty acid content of brown shrimp (*Crangon crangon* L. 1758) from Sinop Region, Black Sea. J. Aquat Food Prod. Tech. 20(1):100-107.

Türeli, C., Çelik, M. & Erdem, Ü. (2000). Comparison of meat composition and yield of blue crab (*Callinectes sapidus* Rathbun, 1896) and Sand Crab (*Portunus pelagicus* Linne, 1758) Caught in Iskenderun Bay, North-East Mediterranean. Turk. J. Vet. Anim. Sci. 24:195-203.

Türeli, C., Erdem, Ü. & Çelik, M. (2002). Seasonal Variation and Meat Composition of Blue Crab (*Callinectes sapidus*, Rathbun, 1896) Caught in İskenderun Bay, North-East Mediterranean. Turk J Vet Anim Sci. 26:1435-1439.