Available online at www.sciencedirect.com
SCIENCE DIRECT®
Food Chemistry 88 (2004) 271–273
Food Chemistry
www.elsevier.com/locate/foodchem

Fatty acid composition of the blue crab (*Callinectes sapidus* Rathbun, 1896) in the north eastern Mediterranean

Mehmet Çelik [a,*], Canan Türeli [a], Mustafa Çelik [b], Yasemen Yanar [a], Ünal Erdem [c], Aygül Küçükgülmez [a]

[a] *Department of Fishing and Fish Processing Technology, Faculty of Fisheries, University of Çukurova, Adana, Turkey*
[b] *Kahramanmaras Sutcuimam University, Faculty of Medicine, Department of Family Medicine Kahramanmaras, Turkey*
[c] *University of Marmara, Technical High School, Department of Fisheries Campus of Marmara University, Göztepe, İstanbul, Turkey*

Received 3 October 2003; received in revised form 8 January 2004; accepted 8 January 2004

Abstract

The fatty acid composition in muscle (claw and breast) and hepatopancreas of the Blue Crab (*Callinectes sapidus*) of the north-east Mediterranean were determined. Fatty acid compositions were analysed by gas chromatography. The results showed that the fatty acid profiles were significantly different between claw meat, breast meat and hepatopancreas of the crab. The percentage of total saturated fatty acids was higher in the hepatopancreas than in the claw or breast meats. The total *n*6 fatty acids were 8.61%, 7.80% and 5.34% in the hepatopancreas, claw meat and breast meat, respectively. The claw and breast meats contained significantly ($P < 0.05$) higher amounts of total *n*3 fatty acids than did the hepatopancreas. The *n*3/*n*6 fatty acids ratio was higher in the breast meat than in the claw meat or the hepatopancreas.

It is concluded that claw and breast meat are good sources of *n*3 PUFAs. Therefore, the results suggest that claw and breast meat of the blue crab are appropriate for human health.

Keywords: Blue crab; Fatty acids; Claw meat; Breast meat; Hepatopancreas

1. Introduction

The Blue Crab (*Callinectes sapidus*) is considered to be an important shell fishery product (Gangar, Huang, & Wei, 1996). It is well documented that crabs fetch good prices in markets due to their high nutritive value and irregular availability in the markets.

The Blue Crab is mainly distributed along the North American coasts. At the beginning of this century, it was dispersed in the north eastern Mediterranean sea and surrounding waters, in which most of the species have been recognised (Holthuis, 1961).

Various blue crab products, including soft shell crab, meat and cocktail claws, are consumed in US markets. As it is not well known in Turkish markets, the blue crab products are exported from the north eastern Mediterranean to Europe and the USA. A determination of the fatty acid profiles of blue crab tissues, such as muscle and hepatopancreas, might give information, to consumers, about how healthy it is for human consumption.

The biochemical compositions of different crab species have been reported to be different in various parts of the world (Chaufan et al., 2002; Krzynowek, Wiggin, & Donahue, 1982; Siddiquie, Akbar, & Qasim, 1987; Skonberg & Perkins, 2002; Tsai, Chen, & Tsai, 1984; Türeli, Celik, & Erdem, 2000; Wang & Stickle, 1988).

Theoretically, seafood products, including crustaceans, may promote human health. Crustaceans contain a large range of polyunsaturated fatty acids (PUFAs) in their tissues. The PUFA content has been shown to be beneficial for the reduction of coronary artery disease (Skonberg & Perkins, 2002). In previous studies, chemical indices (proximate composition and fatty acid profiles) and nutritive value of crab tissues have been reported for populations in various parts of the world (Krzynowek

* Corresponding author. Fax: +90-322-338-6439.
E-mail address: mcelik@cu.edu.tr (M. Çelik).

0308-8146/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodchem.2004.01.038

et al., 1982; Siddiquie et al., 1987; Skonberg & Perkins, 2002). It is well known that, due to the differences in biochemical properties among crab species, the fatty acid profiles may also vary from species to species.

The purpose of this work was to evaluate the fatty acid profiles of the blue crab caught in the north eastern Mediterranean. Investigation of the fatty acid profiles of the edible tissues, such as claw, breast meats and hepatopancreas, provides information on the relative nutritional value of this food, thereby encouraging the consumption and utilization of this regional species in Turkey.

2. Materials and methods

All crabs were harvested alive, during December 2002, off the Mediterranean coast of Akyazan Lagoon Karataş/Turkey. They were cooked in boiling water and the claw, breast meat and hepatopancreas were hand-picked at the laboratory. In each case, the claw and breast meat of 20 crabs were blended to comprise a sample.

The lipids were saponified and esterified for fatty acid analysis by the method of Metcalfe, Schmitz, and Pelka (1966). The fatty acid methyl esters (FAME) were analysed on a Hewlett–Packard (HP) 5880 gas chromatography (GC) with a flame ionisation detector (FID). The esters were separated on a 50 m × 0.20 mm i.d. wall-coated open tubular fused silica capillary column coated with Carbowax 20M. Column, injector, and detector temperatures were 200 and 300 °C, respectively. Carrier gas was helium; split ratio was, 100:1. Identification was made by comparison to retention times of authentic standards, argentation TLC, followed by GC, of the bands separated by degree of unsaturation, and mass spectrometry. The data with respect to fatty acid composition were subjected to analyses of variance at the 5% level using SPSS (1999) and Duncan's multiple range test was performed to separate differences among means.

3. Results and discussion

The results showed that the fatty acid profiles were significantly different between claw meat and breast meat or hepatopancreas of the blue crab (Table 1).

The content of total saturated fatty acids was higher in the hepatopancreas than the claw or the breast meats.

The total *n*6 fatty acids were 8.61%, 7.80% and 5.34% in the hepatopancreas, claw meat and breast meat, respectively. The content of arachidonic acid (20:4*n*6) was highest in the hepatopancreas. The arachidionic acid becomes elongated and desaturated which leads to the formation of long chain fatty acids (Kinsella, 1986).

The claw and breast meats of the crabs had significantly ($P < 0.05$) higher contents of the total *n*3 fatty acid, compared with the hepatopancreas. The total EPA (C20:5*n*3) and DHA (C20:6*n*3) contents averaged 10.6% and 8.41%, 7.78% and 5.92%, 6.75% and 5.30% for claw meat, breast meat and hepatopancreas, respectively. Sundarrao, Tinkerame, Kaluwin, Singh, and Matsuoka (1991) reported that fatty acid profiles in mud crabs (*Scylla serrata*) from the Port Maresby coast and Daru coast, Papua New Guinea, were in the range of 11% for eicosapentaenoic acid (C20:5*n*3) and 5.2–6.6% for docosahexaenoic acid (C22:6*n*3) in both crabs. Skonberg and Perkins (2002) indicated that EPA and DHA contents averaged 0.35 g/100 g and 0.68 g/100 g, respectively, for steamed claw meat and leg meat. Krzynowek et al. (1982), studied three species of crab: deep-sea crab, rock crab and jonah crab found in the north-west Atlantic and the C20:5*n*3 fatty acid was determined as the major PUFA in all species. Other researchers have also reported similarities in concentrations of EPA in meats from different body parts of Alaska king crab (Krzecykowski, Tenney, & Kelley, 1971) and snowcrab (Krzecykowski & Stone, 1974). Dyerberg (1986) reported that

Table 1
Fatty acid composition of blue crab meats (% of total fatty acids)[a]

Fatty acid	Claw meat	Breast meat	Hepatopancreas
C8:0	0.18 ± 0.01c	0.13 ± 0.07b	0.04 ± 0.00a
C10:0	0.17 ± 0.01c	0.14 ± 0.00b	0.03 ± 0.00a
C12:0	0.15 ± 0.07a	0.13 ± 0.01a	5.72 ± 0.02b
C14:0	1.13 ± 0.02a	2.03 ± 0.09b	21.6 ± 0.12c
C15:0	0.86 ± 0.05c	0.53 ± 0.02a	0.67 ± 0.03b
C16:0	13.5 ± 0.23b	15.0 ± 0.20c	3.71 ± 0.04a
C17:0	1.66 ± 0.01c	1.46 ± 0.00b	0.31 ± 0.00a
C18:0	6.29 ± 0.05b	5.56 ± 0.01b	2.64 ± 0.02a
C20:0	0.84 ± 0.05b	1.15 ± 0.10c	0.30 ± 0.00a
C22:0	0.00 ± 0.00a	0.18 ± 0.00b	0.45 ± 0.00c
C24:0	0.22 ± 0.00a	0.11 ± 0.00b	0.12 ± 0.01b
C14:1	0.14 ± 0.01b	0.09 ± 0.00a	0.09 ± 0.07a
C16:1	4.07 ± 0.02b	5.59 ± 0.08c	1.60 ± 0.01a
C17:1	1.58 ± 0.06c	1.27 ± 0.01b	0.62 ± 0.01a
C18:1*n*9 t	0.54 ± 0.01c	0.48 ± 0.00b	0.19 ± 0.01a
C18:1*n*9 c	12.9 ± 0.23b	13.7 ± 0.06c	6.85 ± 0.00a
C20:1*n*9	0.35 ± 0.00a	0.61 ± 0.01c	0.50 ± 0.01b
C22:1*n*9	0.00 ± 0.00c	0.09 ± 0.00b	0.12 ± 0.00a
C24:1*n*9	0.71 ± 0.02b	0.50 ± 0.04a	0.59 ± 0.02a
C20:2	0.65 ± 0.04a	0.67 ± 0.00a	0.89 ± 0.00b
C18:2*n*9 c	6.51 ± 0.16c	5.30 ± 0.04b	2.63 ± 0.09a
C22:2	0.00 ± 0.00a	0.39 ± 0.00c	0.20 ± 0.00b
C18:2*n*6 t	0.21 ± 0.00b	0.21 ± 0.00b	0.16 ± 0.00a
C18:3*n*6 g	0.11 ± 0.00b	0.11 ± 0.00b	0.23 ± 0.00a
C20:4*n*6	7.48 ± 0.16b	5.02 ± 0.03a	8.22 ± 0.04c
C18:3*n*3 a	1.44 ± 0.50b	1.70 ± 0.14b	0.32 ± 0.02a
C20:2*n*3	0.12 ± 0.00a	0.13 ± 0.00a	0.16 ± 0.00b
C20:5*n*3	10.6 ± 30.21c	8.41 ± 0.01b	7.78 ± 0.15a
C22:6*n*3	5.92 ± 0.05b	6.75 ± 0.10c	5.30 ± 0.00a
Σ *n*3	18.08	16.99	13.56
Σ *n*6	7.8	5.34	8.61
*n*3/*n*6	2.32	3.18	1.57
Unknown	21.62a	22.55b	27.92c

Means ± SD followed by different letter within a row are significantly different ($P < 0.05$).

[a] Data are expressed as mean ± SD ($n = 3$).

substantial amounts of *n*3 fatty acids changed between species and between their tissues. The variation in the *n*3 fatty acid in different parts of the blue crab may be explained by different accumulation levels in different tissues. An increase in the level of *n*3 fatty acids in the claw and breast meat was also effective in reducing the level of saturated fatty acids in the tissues of crabs, making them healthier for human consumption.

The long chain *n*3 and *n*6 fatty acids commonly called PUFAs and their ratios are also (*n*3/*n*6) considered to be important (Coetzee & Hoffman, 2002; Pigott & Tucker, 1987). These ratios in breast meat of blue crabs were higher than in claw meat and hepatopancreas. The *n*3/*n*6 ratios were 3.18, 2.32 or 1.57 for breast meat, claw meat or hepatopancreas of blue crabs, respectively. Dyerberg (1986) noted that an increase in the ratio of *n*3/*n*6 PUFA increases the availability of *n*3 PUFAs, which are beneficial for human health.

A comparison of values obtained in this study with values reported for other crab species shows considerable differences in the fatty acid composition (Krzynowek et al., 1982; Wen, Chen, Ai, Zhou, & Jiang, 2001). These considerable variations are apparently associated with variations in inter-species differences, age, sex and nutrient composition of the diet, surrounding medium, season, flavour, and other quality characteristics of crab products.

4. Conclusions

The blue crab, abundant in the north eastern Mediterranean, is not consumed by Turkish people as they are not familiar with it. The present results have shown that breast meat and claw meat had higher amounts of *n*3 fatty acids and lower amounts of *n*6 fatty acids than the hepatopancreas. Therefore, the results suggest that claw and breast meat of the blue crab are beneficial to human health.

Acknowledgements

The authors acknowledge the grant support provided by Çukurova University Research Fund.

References

Chaufan, G., Corvi, M., Armesto, A., San Martin de Viale, L. C., Luquet, C., & Rios de Molina, M. C. (2002). Comparison between crab hepatopancreas and rat liver uroporphyrinogen decarboxylase. *Comparative Biochemistry and Physiology, 133B*, 251–256.

Coetzee, G. J. M., & Hoffman, L. C. (2002). Effects of various dietary $n-3/n-6$ fatty acid ratios on the performance and body composition of broilers. *South African Journal of Animal Science, 32*(3), 175–184.

Dyerberg, J. (1986). Linolenate-derived polyunsaturated fatty acids and prevention of atherosclerosis. *Nutrition Reviews, 44*(4), 125–134.

Gangar, V., Huang, T. S., & Wei, C. I. (1996). Comparison of crab meat protein patterns by isoelectric focusing. *Food Control, 7*(6), 295–307.

Holthuis, L. B. (1961). Report on the Collection Crustacean decapoda and stomatopoda from Turkey and Balkans. *Zoologisesche Verhändlingen., 47*(1–6).

Kinsella, J. E. (1986). Dietary fish oils. Possible effects of $n-3$ polyunsaturated fatty acids in reduction of thrombosis and heart disease. *Nutrition Today* (November/December), 7–14.

Krzynowek, J., Wiggin, K., & Donahue, P. (1982). Cholesterol and fatty acid content in three species of crab found in the Northwest Atlantic. *Journal of Food Sciences, 47*, 1025–1026.

Krzecykowski, R. A., & Stone, F. E. (1974). Amino acid, fatty acid and proximate composition of snow crab (*Chionoecetes bairdi*). *Journal of Food Science, 39*, 386.

Krzecykowski, R. A., Tenney, R. D., & Kelley, C. (1971). Alaska king crab: Fatty acid composition, carotenoid index and proximate analysis. *Journal of Food Science, 36*, 604.

Metcalfe, L. D., Schmitz, A. A., & Pelka, J. R. (1966). BF3- methanol procedure for rapid quantitative preparation of methyl esters from lipids. *Analytical Chemistry, 38*, 514.

Pigott, G. M., & Tucker, B. W. (1987). Science opens new horizons for marine lipids in human nutrition. *Food Revives International, 3*(1–2), 105–138.

Siddiquie, P. J. A., Akbar, Z., & Qasim, R. (1987). Biochemical composition and calorific values of the three edible species of portunid crabs from Karachi. *Pakistan Journal of Science, 30*(2), 119–121.

Skonberg, D. I., & Perkins, B. L. (2002). Nutrient composition of green crab (*Carcinus maenus*) leg meat and claw meat. *Food Chemistry, 77*, 401–404.

SPSS (1999). Computer program, MS. for windows, version 10.01. USA: SPSS Inc.

Sundarrao, K., Tinkerame, J., Kaluwin, C., Singh, K., & Matsuoka, T. (1991). Lipid content, fatty acid, and mineral composition of mud crabs *(Scylla serrata)* from Papua New Guinea. *Journal of Food Composition and analysis, 4*(3), 276–280.

Tsai, D. E., Chen, H., & Tsai, C. (1984). Total lipid and cholesterol content in the blue crab, *Callinectes sapidus* Rathbun. *Comparative Biochemistry and Physiology, 78B*(1), 27–31.

Türeli, C., Celik, M., & Erdem, U. (2000). Comparison of meat composition and yield of blue crab (*Callinectes sapidus* RATHBUN, 1896) and sand crab (*Portunus pelagicus* LİNNE, 1758) caught in Iskenderun Bay, Northeast Mediterranean. *Turkish Journal of Veterinary and Animal Sciences, 24*(3), 195–203.

Wang, S. Y., & Stickle, W. B. (1988). Biochemical composition of the blue crab *Callinectes sapidus* exposed to the water-soluble fraction of crude oil. *Marine Biology, 98*, 23–30.

Wen, X., Chen, L., Ai, C., Zhou, Z., & Jiang, H. (2001). Variation in lipid composition of Chinese mitten-handed crab, *Eriocheir sinensis* during ovarian maturation. *Comparative Biochemistry and Physiology, Part B, 130*, 95–104.