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Amino Acid Composition of Blue Crab (*Callinectes sapidus*) from the North Eastern Mediterranean Sea

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Abstract

The amino acid composition in tissues (claw, breast meats and hepatopancreas) of the blue crabs (*Callinectes sapidus*, RATHBUN, 1896), caught off the North Eastern Mediterranean Sea (Turkey) were investigated. The amounts of the amino acid contents of the claw, breast meat and hepatopancreas of the blue crab were found to be significantly different. Glutamic acid was major amino acid in all parts of the blue crab. The total essential amino acids ranged from 7.24 to 7.83 g/ 100 g fresh wt. The ratios of essential to nonessential amino acids were reported. This ratio was the highest for hepatopancreas (1.03), followed by breast meat (0.83) and claw meat (0.78) respectively. Moreover, methionine and lysine amino acids, which are often limiting amino acids in staple foods, were found to be abundant in this species. Methionine was the highest in the hepatopancreas (3.38 g/100g protein) and lysine was the highest in the breast meat (6.82 g/100g protein). Amino acid results showed that protein contained nutritionally useful quantities of most of the essential amino acids.

Key words: Blue Crab, Amino acids, Mediterranean Sea

INTRODUCTION

Although most of the animal protein for people need is provided from land animals, nowadays, the tendency of benefiting from seafood for protein supply is increasing rapidly worldwide [1, 2].

An adequate supply of dietary protein is required for survival, growth and development, reproduction and maintaining health throughout life. Amino acids are the building blocks of protein. Food and tissue proteins contain 20 different amino acids of nutritional importance. Eight of these, threonine, valine, methionine, isoleucine, leucine, phenylalanine, lysine and histidine cannot be synthesized by the human body. They are therefore essential or indispensable nutrients that must be obtained from the diet. The other 10 types, aspartic acid, arginine serine, glutamic acid, glutamine, glycine, alanine, tyrosine proline, taurine, are also supplied ordinarily by daily food intake, and the body can synthesize them. They are, therefore, nutritionally dispensable or nonessential. They are nevertheless equally as important as the indispensable amino acids for the nutrition of cells and for normal cell and organ function [3, 4].

Shellfish is one of the most important sources of the proteins provided from sea, and blue crab is one of the most important of them. Blue crab originally occurs along the eastern coast of America between Nova Scotia and Uruguay. Its main distribution is on the North American coast, where it forms an important fishery resource [5]. It also widely distributes in Mediterranean and Aegean costs of Turkey. According to Fisheries Statistics [6] reported, 61.3 % of the total catch of crab was caught in the Mediterranean region of Turkey.

Many publications are available on the chemical composition [7-11] and amino acid composition [12, 13] of different crab species in various parts of the world. However, nothing is known of amino acid composition of blue crab meat. Therefore, this study has been carried out to determine the amino acid composition of blue crab (*C. sapidus*) from the North Eastern Mediterranean Sea.

MATERIALS AND METHODS

Samples

All crabs (*Callinectes sapidus*, RATHBUN, 1896) were caught from the Agyatan lagoon (Karataş/Adana), the coast of North Eastern Mediterranean of Turkey. After catching, they were transferred to the laboratory alive. The crabs were divided into three homogeneous groups randomly and cooked by steaming for 10 min. Subsequently the claw meat, breast meat and hepatopancreas of each group were hand picked and blended to homogenize.

Protein and Amino Acid Analysis

Crude protein content was calculated by converting the nitrojen content, determined by Kjeldahl's method [14].

For amino acid analysis, samples were hydrolysed in 6 N HCl at 110°C for 24 h [15] in an evacuated sealed ampoule. Excess acid from the hydrolysate was removed by flash evaporation under reduced pressure. The analysis was carried out using an Eppendorf Biotronic LC 3000 Amino acid Analyzer (Eppendorf- Biotronic, Hamburg, Germany), according to standard program. The results are given as means of triplicate.

Statistical Analysis

The data with respect to amino acid composition were subjected to analysis of variance at the 5 % level using SPSS [16] and Duncan multiple range test was performed to separate differences among means.

Table 1. Protein content and amino acid composition of blue crab tissues (g amino acid / 100 g edible portion)[1]

	Claw meat	**Breast meat**	**Hepatopancreas**
Crude protein (g/100g)	19.56	18.81	18.81
Amino acids	**Claw meat**	**Breast meat**	**Hepatopancreas**
Aspartic acid	1.609±0.03b[2] (8.22)**	1.596±0.03b (8.48)	1.390±0.04a (7.38)
Threonine*	1.045±0.00b (5.34)	0.967±0.00a (5.14)	1.071±0.00c (5.69)
Serine	0.873±0.00b (4.46)	0.884±0.05b (4.69)	0.616±0.00a (3.27)
Glutamic acid	2.600±0.37a (13.29)	2.581±0.00a (13.72)	2.227±0.24a (11.83)
Glycine	1.244±0.01a (6.35)	1.182±0.00a (6.28)	1.477±0.08b (7.85)
Alanine	0.697±0.00b (3.56)	0.778±0.01c (4.71)	0.638±0.00a (3.39)
Valine*	0.925±0.00b (4.72)	0.887±0.01a (4.71)	1.190±0.00c (6.32)
Methionine*	0.586±0.00b (2.99)	0.545±0.01a (2.89)	0.637±0.00c (3.38)
Isoleucine*	0.941±0.00ab (4.81)	0.996±0.04b (5.29)	0.890±0.00a (4.73)
Leucine*	1.309±0.11b (6.69)	1.405±0.02b (7.46)	1.044±0.00a (5.55)
Tyrosine	0.674±0.04a (3.44)	0.658±0.01a (3.49)	0.655±0.00a (3.48)
Phenylalanine*	0.744±0.01a (3.80)	0.749±0.01a (3.98)	0.346±0.06b (7.15)
Histidine*	0.448±0.01a (2.29)	0.415±0.02a (2.20)	0.650±0.03b (3.45)
Lysine*	1.311±0.02b (6.70)	1.283±0.04b (6.82)	0.809±0.04a (4.30)
Arginine	1.579±0.06c (8.07)	1.034±0.00b (5.49)	0.600±0.01a (3.18)
Total essential amino acids	7.309	7.247	7.837
Total nonessential amino acids	9.276	8.713	7.603
Essential/Nonessential ratio	0.787	0.831	1.030

[1] data are expressed as mean ±SD.
[2] means ±SD followed by different letter within a row are significantly different ($p<0.05$).
* Essential amino acid
** the values are calculated as g amino acid / 100 g protein.

RESULTS AND DISCUSSION

The protein content and amino acid composition of the blue crab are given in Table 1. Significant differences, except glutamic acid and tyrosine, were observed among the amino acid values for the claw, breast meat and hepatopancreas. The content of total essential amino acids was higher in the hepatopancreas than the breast meat or the claw meat.

Among amino acids of the three parts analyzed, glutamic acid was the highest amino acid (2.60; 2.58; 2.22 g/100g claw, breast meat and hepatopancreas, respectively). The levels of aspartic acid, serine, glutamic acid, glycine, isoleucine, leucine, tyrosine were not significantly ($p<0.05$) different between claw meat and breast meat. Arginine concentration was significantly ($p<0.05$) higher in claw meat than the other two parts. Hepatopancreas contained the highest levels of glycine, phenylalanine, valin, threonine, histidine, and methionine. Allen [17] reported a similar distribution in the meat of Dungeness crab. Isoleucine and alanine contents were the highest in breast meat. Phenylalanine concentration was significantly ($p<0.05$) higher in hepatopancreas than the breast meat or the claw meat. Krzeczkowski and Stone [18] found lower phenylalanine quantities in snow crab compared to this study. The present essential amino acid values are favorably comparable with the published reports in milk, beef and egg [19].

In the present study, methionine was the highest (3.38 g/100g protein) in hepatopancreas, while the lowest (2.99 g/100 g protein) in breast meat. Seo *et al.* [20] reported a similar methionine content in the myctophid fishes (1.9-3.3 g/100 g protein).

Lysine was the most concentrated in breast meat (6.82 g/100g protein), but lowest (4.30 g/100g protein) in hepatopancreas. These values are lower than the reported values in cod (10.6 g/100g protein) [1]. Leu *et al*. [21] also found similar results in Atlantic mackerel (7.6 g/100 g protein). Wesselinova [22] reported that the amino acid composition of fish differ depending on a variety of factors such as the species, size, seasonal conditions and geographical location.

Both histidine and arginine are particularly essential for children [19] and the current results showed that the blue crab tissues were good sources of both amino acids. The hepatopancreas of the crabs had significantly ($p<0.05$) higher contents of the histidine, compared with the breast and claw meats, while arginine concentration was higher significantly ($p<0.05$) in the claw meat than in the breast meat or hepatopancreas.

Comparison between the amino acid content and the FAO/WHO/UNU [19] amino acid reference values showed that most of the amino acids would meet the recommended range of amino acid requirement for children and adults. The World

Health Organization recommended leucine and isoleucine requirements for adults of 14 and 10 mg amino acid / kg body weight / day [19]. For example, a 60 kg adult will require 740 and 600 mg of leucine and isoleucine per days respectively. In this study, it was found 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 of blue crab, this can provide the daily amino acid requirement determined by WHO. The same type of calculation can also be hold for the other amino acids.

The ratios of essential amino acids to nonessential amino acids in claw meat, breast meat and hepatopancreas were 0.78, 0.83 and 1.03, respectively. Iwasaki and Harada [23] reported that essential amino acid/nonessential amino acid ratio of many fish species is 0.70 on average.

The present amino acid values of blue crab tissues compared well with the USDA Nutrient Database for Standard Reference [24] pattern. However in the present study, threonine was found to be high whereas glutamic acid and aspartic acid had lower ratios according to this study.

CONCLUSION

Though blue crab has a widespread distribution in the lagoons of the North Eastern Mediterranean coasts of Turkey, its consumption is not common in Turkey due to food tradition and lack of knowledge; however, it is a highly demanded food source in developed countries. By this study, the amino acid composition of blue crab is determined and it was demonstrated how important the consumption of blue crab meat is for human health. Results show one portion blue crab meat (nearly 50 g) can meet approximately all of the amino acids need to by an adult.

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