Scientific Papers, Animal Science, Series D, vol. LV
CD-ROM ISSN 2285-5769, ISSN-L 2285-5750

EFFECTS OF COOKING METHODS ON THE HEAVY METAL CONCENTRATIONS IN THE FISH MEAT ORIGINATING FROM DIFFERENT AREAS OF DANUBE RIVER

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Abstract

Fish is a major source of mineral but it can also contain heavy metals. The present study has shown that the heavy metal concentration in fish meet can be affected by processing or cooking methods. Chromium (Cr), nickel (Ni), cadmium(Cd) and lead (Pb) were analyzed in cooked fish meat(4 sweet water fish species :bream, mackerel, carassius and perch, originated from the area of Sulina Arm and auxiliary canals). Various cooking methods were used such as grilling, frying, microwaving and baking. The Pb concentrations of the samples varied between 0.08 and 0.14 mg/kg . There were no significant differences ($P > 0.05$) in Pb concentrations between the raw, grilled, fried, baked and microwave-cooked fish. Ni contents decreased in grilled fish. Cr concentrations in grilled and microwave-cooked fish decreased significantly ($P < 0.05$).Cadmium was found only in fried meat fish. The results show that the grilling, microwave cooking and baking are suitable methods.

Key words: *heavy meta, fish meat, cooking methods*

INTRODUCTION

Fish meat has a special nutritive value due to its content of high quality proteins, fats rich in poli-unsaturated fat acids with a high efficiency in the human body, vitamins (especially A and D) and due to its high level of minerals (iron, phosphor, potassium, magnesium)[3]. Chromium (Cr) and nickel (Ni), which are present in fish meat, are essential for human life at low concentrations [4]. Heavy metals can be hazardous to consumers' health. Aquatic life environment makes it very easy to contaminate the fish meat with harmful heavy metals that reach the river waters through industrial residual waste, metals like: plumb, cadmium, mercury, copper, zinc. Unfortunately, some heavy metals and their compounds are considered cancerous for humans and animals [6]. The mineral content of fish can be affected by processing or cooking methods [2,5] and therefore, it is important to determine the concentrations of heavy metals in raw and cooked fish. In this context the present paper aims at determining the content of Cr, Ni, Cd and Pb from the meat of some 4 fish species : bream, carassius, perch and mackerel, originated from the area of Sulina Arm and auxiliary canals and highlighting how the concentration of these heavy metal can be affected by processing or cooking methods.

MATERIAL AND METHOD

Each of the fish species analyzed were collected during March-April 2012. We used fish weighing 200-250g on average and about 20-25 cm long. They were kept in an ice chest and transported to the laboratory. Fish were gutted, washed with tap water and filleted, and then fish fillets were divided into three groups (eight fish each). The first group was raw – not cooked (control). The other two groups (two replicates of each type of fish) were cooked in the microwave oven (2,450 MHz, 5 min.), baked in the oven (200^0C, 20 min.), in the grill oven (200^0C , 11 min) and fried (200^0C, 5 min) in sunflower oil. Raw and cooked samples were homogenized in a stainless-steel meat mince. Fish samples were digested according to the method using concentrated nitric acid (HNO_3), [1]. The digest was quantitatively transferred to a 50-mL volumetric flask and made up to volume with deionized water. A blank digest was carried out in the same way.

All metals were determined against aqueous and using a PERKIN ELMER-USA spectrophotometer by atomic absorption spectrophotometry.
The metal concentration was expressed as mg metal/kg dry weight (ppm).

RESULTS AND DISCUSSIONS

Table 1 gives the values of heavy metals content in cooked meat compared with raw fish.

Table 1. The mean heavy metal concentration of the raw and cooked meat of bream,perch,mackerel and carassius

No.	Product type	Cooking methods	Chemical element(mg/kg dry weight)			
			Pb	Cr	Cd	Ni
1	Sample Bream	Raw	0,12±0,01	1,18±0,03	ND	0,40±0,03
		Grilled	0,10±0,05	0,58±0,10	ND	0,26±0,10
		Fried	0,11±0,05	1,28±0,02	ND	0,52±0,03
		Microway	0,07±0,02	0,09±0,03	ND	0,50±0,11
		Backed	0,09±0,01	1,19±0,04	ND	0,31±0,04
2	Sample Perch	Raw	0,13±0,01	1,22±0,03	ND	0,45±0,03
		Grilled	0,11±0,05	0,60±0,10	ND	0,28±0,10
		Fried	0,12±0,05	1,30±0,02	ND	0,55±0,03
		Microway	0,08±0,03	1,01±0,03	ND	0,53±0,11
		Baked	0,09±0,01	1,20±0,04	ND	0,40±0,04
3	Sample Mackerel	Raw	0,14±0,01	1,30±0,03	ND	0,58±0,04
		Grilled	0,12±0,05	0,80±0,10	ND	0,30±0,10
		Fried	0,13±0,05	1,41±0,02	0,03±0,01	0,63±0,03
		Microway	0,09±0,03	1,11±0,03	ND	0,59±0,11
		Backed	0,11±0,01	1,27±0,05	ND	0,35±0,04
4	Sample Carassius	Raw	0,13±0,01	1,28±0,03	ND	0,50±0,04
		Grilled	0,11±0,05	0,78±0,10	ND	0,35±0,10
		Fried	0,12±0,05	1,40±0,02	0,03±0,01	0,60±0,03
		Microway	0,08±0,03	1,08±0,03	ND	0,52±0,11
		Backed	0,10±0,0	1,20±0,04	ND	0,40±0,04

ND, not determined (below the limits of detection).

The Pb concentration in raw fish had values between 0.12-0,14 mg/kg in all types of fish investigated. There was no significant difference in Pb concentrations between the raw, grilled, fried, microwave-cooked and baked fish($P > 0.05$). A previous study on the effect of cooking methods on heavy metal concentrations of African catfish done by *Ersoy(2011*) correlates with our results. The determined Cr concentration in raw fish had values betwen 1.18-1,30 mg/kg in all types of fish investigated. The highest value was found in the fried meat as 1,41 mg/kg, samples of mackerel, while the lowest value was detected in the grilled meat as 0,58 mg/kg samples of bream. The decrease in Cr concentration was significant ($P < 0.05$) for grilling and microwave cooking methods when compared with the raw control.
Ersoy (2011) showed higher values of Cr levels in African catfish fried meat.

The Cd concentration of raw, baked, grilled, microwave-cooked and fried samples of bream and perch were not detectable (below limits of detection 0.02 mg/kg).
Cd was detected in samples of meat fried mackerel and carassius and in our opinion, the increase of metal concentrations may be related to evaporation that occurs during frying processing.
The Ni concentration of raw fish had values between 0.40-0.58 mg/kg in all types of fish investigated. The increase in Ni concentrations of microwave-cooked and fried samples when compared with the grilled fish was significant

($P < 0.05$) and are slightly higher than ones found by the African catfish *Ersoy(2011)* samples fried, baked, grilled and microwave-cooked

CONCLUSIONS

Of all the species investigated, mackerel raw meat recorded a higher content of heavy metals. To all types of fish investigated, by frying, a more pronounced concentration raising effect was observed on the heavy metal contents in fish than in the other cooking methods. Therefore, this method was found inappropriate for human consumption. Baked, microwave cooked and grilled samples lost a moderate amount of heavy metals during cooking. It is possible to reduce the heavy metal concentration in fish samples by choosing a suitable method of cooking. Further studies should be carried out on cooking methods at different conditions (time, temperature, medium of cooking) for reducing the dangerous effect of heavy metals.

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