SHORT COMMUNICATION

EVALUATION OF TOTAL MERCURY CONTENT IN MUSCLE TISSUE OF MARINE FISH AND ANIMALS

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ABSTRACT

Nowdays, a degree of contamination by heavy metals can be observed in the environment. Heavy metals have serious effects on all living organisms because they can accumulate in lethal or sublethal concentrations in the various parts of food chain and so they can cause different health problems like cardiovascular and cancer deseases. Marine fish and animals are one of the bigges source of mercury in human food. Therefore this work is focused to the rate of mercury content in muscle tisuues of marine fish and animals. We analyzed mainly frozen or otherwise preserved marine fish and animals that were purchased in retail network in Slovakia. Mercury content in samples was analyzed by cold vapor AAS with mercury analyser AMA254. The contents of mercury in analysed samples were in the interval 0.0057 – 0,697 mg.kg^{-1}. Our results shows, that no analyzed samples of marine fish and animals had over-limit concetration of Hg, so they are safe for human nutrition.

Keywords: AAS, marine fish, mercury

INTRODUCTION

Foreign substances are an important group that occur in foodstuffs. One of the most important group of contaminants in foods are heavy metals (HM). Heavy metals belong to non-degradable contaminants having different origin, properties as well as affecting to living organisms **(Tóth *et al*., 2005)**. Biologically important microelements /Cu, Zn, Mn, Co, Cr, etc. / and a number of non-essential chemical elements /Cd, Pb, Hg, etc./ belongs to HM **(Vollmannová *et al*., 2007)**. HM occur in soils in different concentrations, oxidation states and bonds. Their risks consist in ecotoxicity and acummulation in biotic and abiotic components of the environment. Biologically essential microelements become also toxic, when their concentration will exceed critical level **(Tomáš, 2000; Vollmannová *et al.,* 2003)**.

Mercury is an important toxic contaminant of the food chain. Although the body contains trace amount of Hg, its biological significance was not found. Mercury is most often found in form of cinnabar (HgS) in lithosphere **(Zmetáková and Šalgovičová, 2006)**. Mercury is a naturally occurring element that is released into the environment from natural sources and also as a result of industrial pollution. Hg gets into the environment through weathering of rocks, burning fossil fuels, metallurgical roasting ores, long-term use of stain seeds, dyes and paints, disinfectants, electrical equipment, etc. **(Toman *et al.,* 2003)**. Inorganic mercury in water by the action of microorganisms changes to much more toxic methylmercury, which accumulates in the tissues of animals. Aquatic animals receive mercury from food and water, and trace amounts of mercury were found in almost all fish. Some fish species (e.g. shark, swordfish, tuna and others) may accumulate more mercury because they eat other fish. Generally, the rule is that the older and greater fish contains more methylmercury **(Tóth *et al.,* 2010)**. The fact that some fish accumulate during the life more mercury than others, reflect the European legal acts /Commission Regulation No. 1881/2006 from 19th December 2006/ **(Sokol *et al.,* 2009)**. About 7% of mercury is absorbed in small intestine from food. Absorbed mercury accumulates in liver, kidney and brain. Hg partially accumulates in hair and nails **(Velíšek, 2002)**. The form of mercury is critical for its effect on the human body. Elemental mercury is often eliminated after intake without affecting the organizm. Organic mercury compounds are considered to be several times more toxic than the inorganic forms of mercury **(Kafka, 1996)**. Toxic effects of mercury and its compounds are related to the high affinity of Hg to thiol groups in peptides and proteins **(Velíšek, 2002)**. The concentration of mercury in most of the food is in the ten-thousandth to a hundredth $mg.kg^{-1}$. High levels of mercury were found in some edible mushrooms, shellfish and crustaceans. The predominant source of mercury in human food are fish and seafood **(Együdová and Šturdík, 2004)**.

The aim of this work was monitoring of the concentrations of total mercury in frozen or otherwise preserved marine fish and animals.

MATERIAL AND METHODS

We analyzed 23 samples of marine fish and animals purchased in the retail network in Slovak Republic in the years 2009 - 2011.

Table 1 Analyzed samples of the marine fish and animals a their characteristics

Sample	Spiece of marine fish or animal	Fishing area	Type of the treatement and storage
R1	sea bass (*Dicentrarchus labrax*)	Greece	freezing
R2	hake (*Merluccius merluccius*)	Pacific ocean	freezing
R3	blue mussel (*Mytilus edulis*)	North-East Atlantic ocean	freezing
R4	salmon (*Salmo salar*)	North America	freezing
R5	herring (*Clupea harengus*)	North Atlantic	conserving
R6	salmon (*Salmo salar*)	Norway	smoking, freezing
R7	shrimp (*Pandalus borealis*)	Greenland	cooling
R8	salmon (*Salmo salar*)	Poland	smoking, freezing
R9	salmon (*Oncorhynchus*)	Norway	cooling
R10	salmon (*Salmo salar*)	China	freezing
R11	sardine (*Sardina pilchardus*)	North-East Atlantic ocean	cooling
R12	sprat (*Clupea sprattus*)	Baltic sea	smoking, cooling
R13	pacific oyster (*Crassostrea gigas*)	North-East Atlantic ocean	cooling
R14	salmon (*Salmo salar*)	Norway	freezing
R15	salmon (*Salmo salar*)	USA	freezing
R16	hake (*Merluccius merluccius*)	Pacific ocean	cooling
R17	salmon (*Salmo salar*)	Ireland	smoking, freezing
R18	mackerel (*Scomber scombrus*)	Atlantic ocean	conserving
R19	halibut (*Hippoglossus hippoglossus*)	Germany	freezing
R20	gilthead seabream (*Sparus aurata*)	Greece	freezing
R21	tuna (*Thunnus spieces*)	Mediterranean sea	conserving
R22	butterfish (*Ruvettus pretiosus*)	Vietnam	cooling
R23	blue shark (*Prionace glauca*)	Spain	freezing

Sampling was focused on frozen, canned or otherwise prepared marine fish and animals originating from different fishing areas. Their characteristics are specified in Tab. 1.

Total mercury content in samples was determined by cold vapour atomic absorption spectrometry (mercury analyzer *AMA 254,* Altec, Czech Republic). The analysis took place without pretreatment of the sample immediately after weighting the amount of muscle tissue sample. The results of total Hg content, presented in this work are the average value of two measurements.

RESULTS AND DISCUSSION

Maximum levels for certain contaminants in foodstuffs are set in Commision Rugulation (ES) No. 1881/2006. Limit value for mercury content in fishery products and muscle meat of fish is 0.5, resp. 1.0 mg.kg^{-1}, in dependence of type of the fishery product.

Table 2 Total mercury content in analyzed samples of the marine fish and animals (mg.kg^{-1})

Sample	Type of marine fish and animal	Hg content	Maximum Hg level
R1	sea bass	0.006	0.5
R2	hake	0.110	0.5
R3	blue mussel	0.017	0.5
R4	salmon	0.022	0.5
R5	herring	0.024	0.5
R6	salmon	0.024	0.5
R7	shrimp	0.025	0.5
R8	salmon	0.027	0.5
R9	salmon	0.028	0.5
R10	salmon	0.032	0.5
R11	sardine	0.033	0.5
R12	sprat	0.036	0.5
R13	pacific oyster	0.036	0.5
R14	salmon	0.040	0.5
R15	salmon	0.042	0.5
R16	hake	0.050	0.5
R17	salmon	0.110	0.5
R18	mackerel	0.083	0.5
R19	halibut	0.012	1.0
R20	gilthead seabream	0.053	1.0
R21	tuna	0.205	1.0
R22	butterfish	0.514	1.0
R23	blue shark	0.697	1.0

The results of the determination of total mercury in analyzed samples are presented in Tab. 2 and Fig. 1. The content of Hg in marine fish ranged from 0.006 to 0.697 mg.kg^{-1}, the mercury content did not exceeded the limit value in any of analyzed samples. The highest content of Hg was found in the blue shark muscle and muscle of fish containing high levels of fats (tuna, butterfish), what is in agreement with the results published by **(Tóth *et al.*, 2010)**. The content of Hg in marine animals ranged from 0.017 to 0.036 $mg.kg^{-1}$ and the Hg content did not exceeded the limit value in any sample of marine animals.

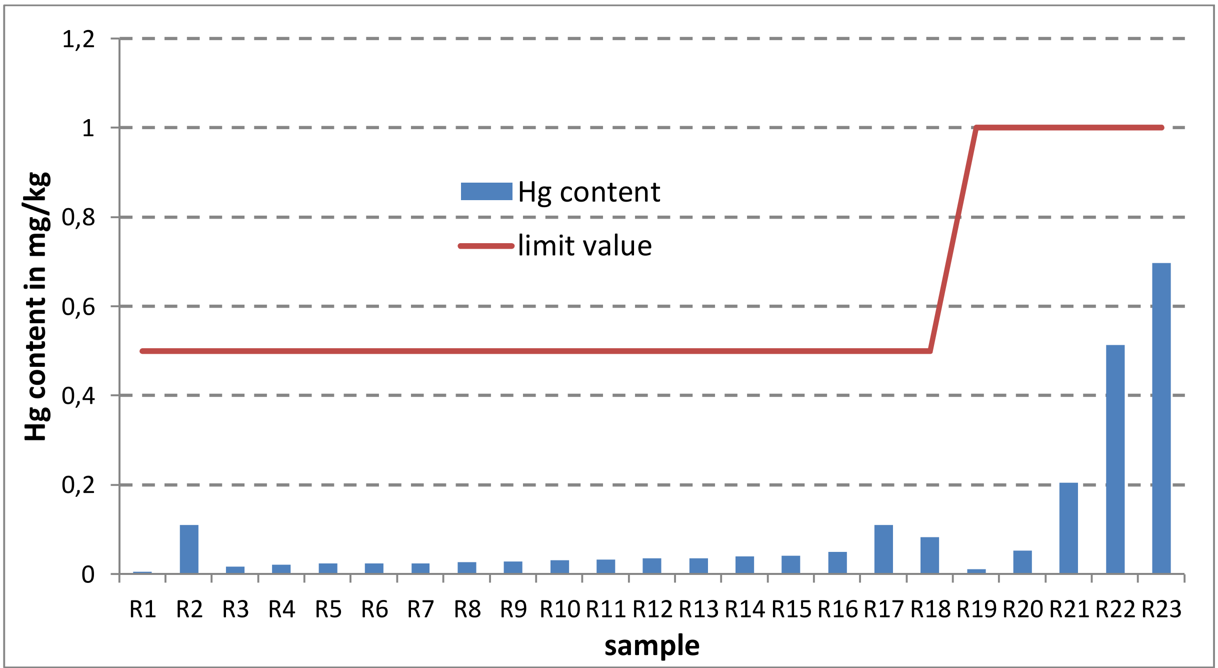

Figure 1 Total Hg content in analyzed samples ($mg.kg^{-1}$)

Similar results heve been found by **Kružíková *et al.* (2009)** and **Mišáková (2010). Kružíková *et al.* (2009)** analyzed 46 samples of marine fish and animals, which were purchased in the retail network in Czech Republic. In Czech Republic, similary to Slovakia, the same limit values are valid for Hg content in marine fish and animals. These authors found out over-limit Hg content only in 2 samples, that is only 4.3% of all samples. **Mišáková (2010)** analyzed Hg content in 39 fish samples and 18 seafood samples. She found out that the Hg content in two samples of blue shark exceeded 1.3 - 1.5 times the limit value.

Kimáková a Bernasovská (2006) monitored the content of Hg in 350 samples of fish and fish products and they found to over-limit Hg content in 160 (45.7%) analyzed samples.

CONCLUSION

Based on our results we can conclude that the contents of mercury in all analyzed samples of frozen or otherwise preserved marine fish and animals were lower than the limit value. All marine fish and animals products satisfy requirements of the Slovak and EU legislation for food safety. On the other hand, many authors found out exceeding the limit values for mercury in marine fish, so it is still necessary to pay attention to the quality and safety of the products of marine fish in terms of mercury content.

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