THE OCCURRENCE OF IRON AND MANGANESE IN BEEF

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SUMMARY

The aim of the study was to determine the occurrence of Fe and Mn concentrations in beef. Samples of 18 muscles were collected from 2 farms in eastern Slovakia. After microwave digestion, levels of metals were analysed by atomic absorption spectrophotometer. Mean value of Fe concentrations in muscles from animals originating from the farm A were found to be higher than in muscles of animals from the farm B (23.788; 15.789 mg.kg^{-1}, respectively). On the other hand, the mean of Mn concentrations were found to be higher at the farm B than at the farm A (0.242; 0.566 mg.kg^{-1}, respectively). The obtained results were compared with results of various similar studies in the world.

Key words: *iron, manganese, beef meat, muscle*

INTRODUCTION

Meat is a very rich and convenient source of nutrients including, to a large extent, also microelements. Chemical composition of meat depends on both the kind and degree of animal feeding. The need for mineral compounds depends on the age, physiological state, and feed intake as well as on living conditions (Kalafová et al., 2007). Mineral compounds represent nearly 1% of meat. They have specific functions both from the viewpoint of metabolism and of technology (Šutiak et al., 2000). Meat contains in particular the salts of P, Ca, Na, and Fe. In addition, there are also elements such as Cu, Zn, Al, Mn etc. occurring only in insignificant amounts.

Iron is widely spread in living organisms; in the organism of adult animals there is nearly two times more Fe than Zn and 20 times more than Cu. Fe compounds have oxidative functions in an organism. Iron is a component of a prosthetic group of the enzymes pherophlavoproteins. With an excess of Fe, the assimilation of Fe and Cu in the liver of young animals is deteriorating (Gierogievskij et al.1982). Particularly with the formation of haemoglobin, Fe is very important together with other elements (Cu, Mn, Co). In meat, Fe is present in haemic stains, both free and in ionic form, in ferritin and elsewhere. Its importance is given here mainly because of its good efficiency for human organism.

Manganese is inevitable for the life of living beings. There is 0.45-0.56 mg.kg^{-1} b.w. of Mn in the farm animals. It participates in oxidative and reduction processes as well as in the conversion of fats, sugars, and proteins. It influences the growth, reproduction, and functions of endocrine organs. High doses of Mn decrease the level of haemoglobin. Absorbed Mn is quickly carried away from blood and it passes into liver and bones (Švehla et al. 1997). The aim of the study was to determine the occurrence of both iron and manganese in muscle of beef cattle.

MATERIALS AND METHODS

Samples (18) of biological material came from two agricultural farms from eastern Slovakia. The samples of beef cattle muscles were processed by mineralisation system (MLS-1 200 MEGA) Milestone and analysed on atomic absorption spectrophotometer of the firm Unicam Solar 939 (UK) for the presence of Mn, Fe (at wavelength 279.5; 248.3 nm). Determinations of Mn and Fe were performed after the method of Kocourek et al. (1992).

RESULTS AND DISCUSSION

The determined amount of Fe and Mn in muscle of beef cattle has been compared between individual farms, because in the Codex alimentorum there are no limits for Fe and Mn.

The mean values of Fe in muscle of beef cattle were 23.787 mg.kg^{-1} and 15.788 mg.kg^{-1} from the farms A and B, respectively. The maximum values were 48.600 mg.kg^{-1} and 33.550 mg.kg^{-1}on farms A and B, respectively. The comparison of the levels revealed lower levels of Fe in muscle of beef cattle on farm B.

The mean values of Mn in muscle were observed on farm A (0.242 mg.kg^{-1}). On farm B, the values of manganese were higher (0.566 mg.kg^{-1}). Bruggemann and Kumpulainen (1995) determined the mean concentration

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of manganese in muscle of beef cattle - i.e. 1.2 mg.kg^{-1}.

The obtained results agree with those of Gallo et al. (1996) who reported that in the region exposed to emissions, the highest deposition of manganese occurs mainly in the internal organs of beef cattle. The highest levels of Mn were found in the liver, bones, and kidneys. The lowest levels are in the skeletal muscles. The concentration of Mn is quite stable in most important tissues of adult animals. Falandysz et al. (1994) found out that the meat of roe, wild boar, duck and goose contains on average more Mn than the meat of dairy cows, hares, turkeys, and chickens. The concentrations of Mn in game meat amounted to 0.013 mg.kg^{-1}, in beef meat 0.016 mg.kg^{-1} and in pork meat 0.02 mg.kg^{-1}.

Three quarters of organism's iron occur in haemoglobin and myoglobin. It is natural that the highest concentration is in blood and in organs having haemopoetic, haemolytic, and deposit function. In adult mammals, the content of Fe varies in different organs and tissues. Total iron levels in individual animals are different. In muscles of game, the amount of Fe was 3.4 mg, in beef meat 2.4 mg, and in pork meat 1.9 mg. Miranda et al. (2006) recorded in industrially exposed region of Spain mean values of Fe in muscle and in liver of beef cattle 56.0; 96.2 mg.kg^{-1}. Mean levels of Mn in the liver were 3.11 mg.kg^{-1}. López - Alonso et al. (2007) recorded mean levels of Fe - 26.5mg.kg^{-1} and Mn - 1.01 mg.kg^{-1} in muscle of pigs. Bellof et al. (2007) observed the occurrence of Fe in lambs 1.31 mg/100g of meat and Mn 0.028 mg/100g of sample.

In summary, our results showed the content of microelements from agricultural farms in eastern Slovakia, mainly of Fe, Mn. The hygienic control of beef meat from localised sources of pollution (urban and industrial contamination) should be intensified with respect to human consumption. We consider it necessary to implement permanent ecological measures in the area of observation as well as to improve the hygienic control of agricultural products.

ZUSAMMENFASSUNG

VORKOMMNIS VON EISEN UND MANGAN IN RINDFLEISCH

Das Ziel der Arbeit war die Bestimmung der Konzentration von Fe und Mn in Rindfleisch. Es wurden 18 Muster von Rindfleischmuskeln, gezüchtet auf zwei Farmen im östlichen Teil der Slowakei, gesammelt. Nach der mikrowellen Digestion wurden die Metallkonzentrationen mit Hilfe von atomaren absorptionem Spektrophotometer analysiert. Die mittleren Werte der Fe Konzentration in den Muskeln der Tiere von der Farm A waren höher als bei den Tieren von der Farm B (23.788, bzw. 15.789 mg.kg¯ą). Andererseits waren die mittleren Mn Konzentrationen auf der Farm B höher als auf der Farm A ((0.242, bzw. 0.566 mg.kg¯ą). Die bekommenen Resultate wurden mit den Resultaten verschiedener ähnlicher Forschungen durchgeführt in der Welt verglichen.

Schlüsselwörter: *Eisen, Mangan, Rindfleisch, Muskel*

▼ **Table 1.** Concentrations of manganese and iron in beef meat (mg.kg^{-1})

	Mn		Fe	
	A	B	A	B
median	0,183	0,103	20,960	15,655
x	0,242	0,566	23,788	15,789
sd	0,115	1,333	9,773	8,643
xmax	0,463	3,856	48,600	33,550

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