PORK MEAT ENRICHED WITH ORGANIC SELENIUM AND ITS EFFECT ON SELENIUM CONCENTRATION AND TOTAL ANTIOXIDANT STATUS IN HEALTHY POPULATION

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Abstract

It is well known that organic selenium (Sel Plex®) supplemented to pig feed mixture becomes significant for effective transport of essential element selenium to food chain. It enables to create important body deposits of selenium in skeletal muscles and it also increases selenium transfer in natural metabolic form of selenomethionine to functional food. The intake of feed mixture with increased organic selenium at the dose of 0.3 $mg.kg^{-1}$ results in increased selenium concentration not only in MSM (musculus semimembranosus) – in experimental selenium group 1.293 $mg.kg^{-1}$ and control group 0.513 $mg.kg^{-1}$ but also in MLT (musculus longissimus thoracis)- in experimental selenium group 1.364 $mg.kg^{-1}$ and control group 0.506 $mg.kg^{1}$ respectively. The aim of this study was to evaluate status selenium and total antioxidant status (TAS) in a selected group of healthy people. Twenty-five volunteers consumed pork meat enriched with organic selenium three times a week during one month. At the beginning the average selenium concentration in blood serum was at 75.41 ± 14.18$\mu g.l^{-1}$ in men and 75.21 ± 15.20$\mu g.l^{-1}$ in women. After two weeks of consumption of pork enriched with selenium, the average selenium concentration in blood serum in men and women increased to 86.69 ± 11.72 $\mu g.l^{-1}$ and 87.93 ± 16.22 $\mu g.l^{-1}$ respectively. In the selected group of healthy people the total antioxidant status increased from 1.68 $mmol.l^{-1}$ to 1.86 $mmol.l^{-1}$ after two weeks of consumption of pork enriched with selenium. However, at the end of the research the decrease in TAS was recorded. Since the improvement in selenium status has positive effect on human health, our research results may contribute to new trends in the production of functional food.

Key Words: Supplementation selenium of pork**,** organic selenium, selenium status, total antioxidant status

Introduction

At present much attention is devoted to the effect of nutrition on health with respect to the antioxidant intake, especially that of vitamins and essential trace elements such as zinc, copper and selenium, which are constituents of antioxidant enzymes. One of the vital nutritional antioxidant element is trace element selenium (Se). It was found out that its nutritional deficit in people caused cardiomyopathia, degenerative osteoarthropathia and thyroid function disorders. Selenium belongs to the group of antioxidants since it is a co-factor of antioxidant enzyme glutathione peroxidase (GPx) which catalyzes the reduction of organic hydroperoxide and oxygen peroxide and thus protecting cells against damaging. The status of essential microelement selenium is primarily determined by its food intake. The low selenium levels in food chain elements correspond to its low levels in people. Selenium levels in plasma/serum in the European countries range from 63 to110 $\mu g.l^{-1}$ where as selenium status in the Slovak population is at the bottom of this scale (Kadrabová, Maďarič, 1997).

Optimum activity of this antioxidant enzyme is achieved in serum/plasma at Se levels between 90-100 μg/l. It was found out that certain simple nucleotide polymorphisms (SNPs) in seleno-proteine genes can affect the risk of cancer and hence increase the demand on selenium intake by organism (Rayman, 2005). This trace element is included in total antioxidant capacity of the organism.

This paper deals with the evaluation of pig feed mixtures supplemented with organic selenium in form of yeast preparations. The main attention was focused on the significant selenium deposits in pig carcass. Moreover, selenium status and total antioxidant capacity were evaluated in a selected group of people who consumed pork enriched with organic selenium.

Material and Methods

Carcass hybrid pigs were tested in the experimental centre of farm animals at the Depatment of Special Zootechnics of the Slovak Agricultural University in Nitra. The individual groups of tested pigs were as follows: control group – 16 pigs and experimental group – 17 pigs. The experimental group was fed on standard mixtures OŠ-3 and OŠ-6 supplemented with 0.3 $mg.kg^{-1}$ organic selenium (Sel Plex®). After disjointing the carcass parameters were analyzed and MLT samples of 700 g weight were also

submited to analysis. Some samples were analyzed in the Institute of Physiology of Farm Animals (IPFA) of the Slovak Academy of Sciences (SAS) in Košice where selenium ratio in meat was estimated by spectrophotometric method.

After the meat having been analysed, the heat processed pork supplemented with organic selenium was served to volunteers as dinner menu (all volunteers were healthy people without any pathological changes concerning the basic hematological and biochemical parameters). Twenty-five persons taking part in the experiment were represented by 9 men at the average age 51.2 years and 16 women at the average age 39.06 years. All the volunteers consumed meat enriched with selenium three times a week during one month (in total 450 g/week). After the volunteers having filled out the nutritional protocol, the daily intake of selenium in men and women was evaluated by Alimenta software, version 4.3. The experimental group of people was taken blood samples in the following intervals: at the beginning, after two weeks and after the finishing of consumption. The concentration of selenium in blood serum was estimated by spectrophotometric method in IPFA SAS in Košice. The total antioxidant status of heparined plasm was estimated by means of a diagnostic device (TAS®, fy Randox) in biochemical analyzer LISA 200 (BIOCODE-HYCEL) at the University of Agriculture in Nitra. The achieved results were statistically processed and evaluated by Anova programme, Tukey test.

Results

Selenium concentration in meat dry matter was found higher in the experimental group SE where in MSM (musculus semimembranosus) and in MLT (musculus longissimus thoracis) represented 1.293 $mg.kg^{-1}$ and 1.364 $mg.kg^{-1}$ respectively in comparison with control group where values were lower, namely in MSM 0.513 $mg.kg^{-1}$ and MLT 0.506 $mg.kg^{-1}$ respectively. These differences in the experimental group with organic selenium (Tab.1) were also confirmed by Anova and Tukey test at significance $P< 0.001$.

A higher representation of selenium in meat with a higher selenium supplement to the feed mixture was also confirmed by Mahan et al. (1999), Ľahučký et al.(2001) and Vernerová et al. (2008) who reported that organic selenium supplement to feed mixture during pig fattening increased selenium content in pork meat.

In the second stage of our research heat processed pork meat enriched with selenium was integrated in the menu of a selected group of people. The concentration of selenium in blood serum on average 75.41 ± 14.18 $\mu g.l^{-1}$ in men and 75.21 ± 15.20 $\mu g.l^{-1}$ in women was set up before consumption. After the consumption of the average selenium for two weeks, the concentration in blood serum in men and women increased to 86.69 ± 11.72 $\mu g.l^{-1}$ and 87.93 ± 16.22 $\mu g.l^{-1}$ respectively. At the end of the research the average selenium concentration decreased in men and women to 85.75 ± 2.72 $\mu g.l^{-1}$ and 84.07 ± 15.62 $\mu g.l^{-1}$ respectively (Tab.2; Graph1). After consumption of pork enriched with selenium for two weeks a significantly inreased concentration of selenium at $P< 0,01$ (after the second blood sample) was found in blood serum of the tested group of people. The difference between the initial and after consumption blood samples was also significant ($P<0,05$).

Total antioxidant status was estimated in heparined plasma in the first blood sample averaged at 1.68 ± 0.12 $mmol.l^{-1}$, in the second blood sample at 1.86 ± 0.09 $mmol.l^{-1}$ and in the last blood sample at v 1.67 ± 0.14 $mmol.l^{-1}$ respectively. The total antioxidant status increased proportionally to the selenium status during a two-week consumption of pork enriched with selenium. The experiment having been finished, the values in a selected group of people dicreased to those measured at the beginning of the experiment.

In the evaluation of total antioxidant capacity a significant increase $P<0,001$ was found after the second sample. The experiment having been finished, the total antioxidant status decreased again to the initial level. The difference between the initial and after consumption samples was statistically insignificant.

The research results indicate that the addition of selenium supplement (Sel Plex®) in the feed mixtures of carcass hybrid pigs significantly contributed to the effective transport of essential microelement-selenium to the food chain. The achieved results pointed out to the main advantages of organic selenium application in carcass pigs, namely to selenium retention in muscles and tissues of a carcass body. Supplementation of pork in human nutrition leads to increased selenium status and hence to protection of immune system cells against the damaging caused by oxidation stress.

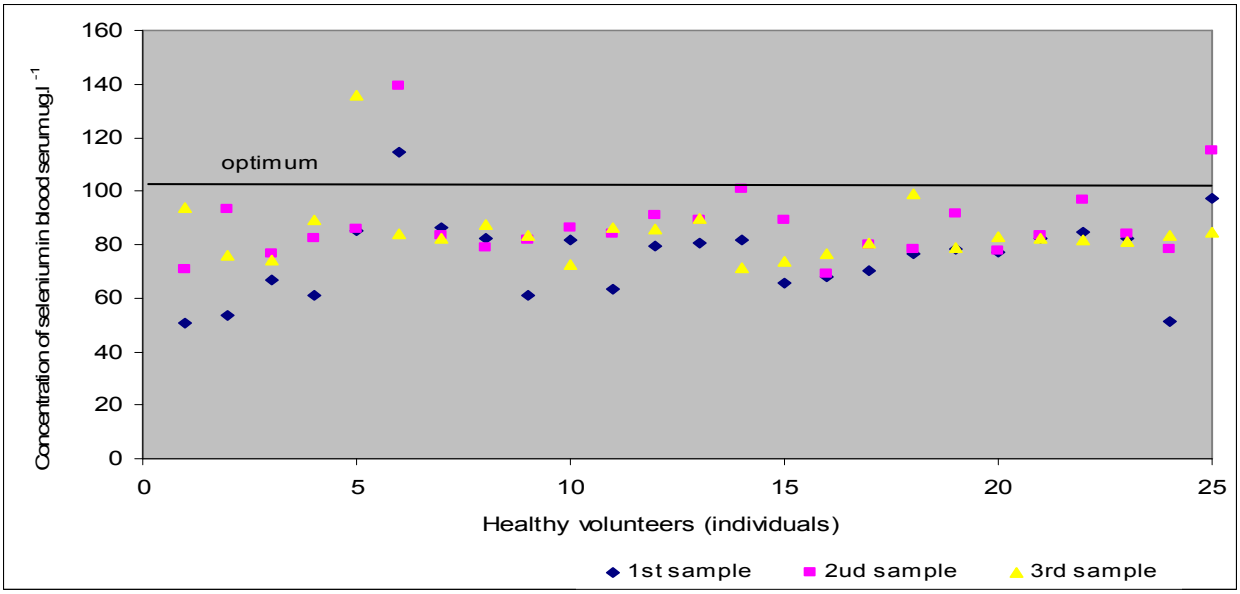
Table 1. Characteristics of selenium concentration in pork dry matter MSM and MLT

Parameter	Control group			Experimental group			
	$\bar{x}$	s	min-max	$\bar{x}$	s	min-max	Tukey test
Selenium in meat dry matter MSM ($mg.kg^{1}$)	0.513	0.041	0.422 – 0.545	1.293	0.158	1.113 – 1.351	+++
Selenium in meat dry matter MLT ($mg.kg^{-1}$)	0.506	0.036	0.443 – 0.562	1.364	0.206	1.134 – 1.463	+++

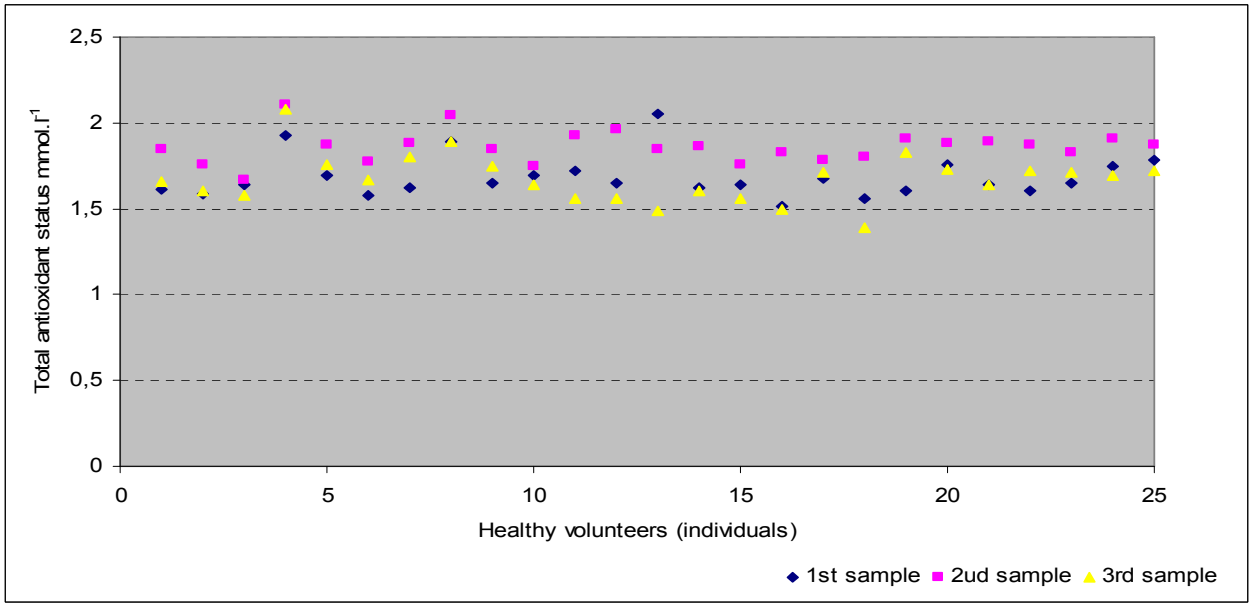
Table 2. Evaluation of selenium concentration in human blood serum

Sex	1st sample µg.l^{-1}			2nd sample µg.l^{-1}			3rd sample µg.l^{-1}		
	$\bar{x}$	s	min-max	$\bar{x}$	s	min-max	$\bar{x}$	s	min-max
Men (n=9)	75.41	14.18	51,23 - 97,15	86.69	11.72	77.70-115.34	85.75	2.72	82.28-89.62
Women (n=16)	75.21	15.20	50.42 - 114.65	87.93	16.22	69.05-139.50	84.07	15.62	71.15-135.57
Total (n=25)	75.28	14.54	50.42 - 114.65	87.48	14.51	69.05-139.50	84.68	12.48	71.15-135.57

Graph 1. Selenium status of individuals in a selected group of people



Graph 2. Total antioxidant status of individuals in a selected group of people



Discussion

Clinical and experimental studies confirmed the relation between selenium and oncological or cardiovascular diseases. Critical Se level in blood serum was reported at 45 $\mu g.l^{-1}$. Our research has not recorded Se values in serum lower than the reported critical level. The concentration of selenium in plasma lower than 60 $\mu g.l^{-1}$ was reported by Hać et al. (2001). In his study reported the concentration of selenium 60 $\mu g.l^{-1}$ in 22 % examined individuals and the level of selenium in blood serum lower than 60 $\mu g.l^{-1}$ in 12 % examined individuals.

Kadrabová, Maďarič (1997) reported the results of clinical studies which included 1056 tested people coming from various regions of Slovakia where concentrations of selenium in plasma ranged from 45.8 to76.9 $\mu g.l^{-1}$. Comparing the results it was found out that selenium concentration in the first blood sample ranged from 50.42 to 114.65 $\mu g.l^{-1}$ while its concentration in the second blood sample increased, ranging from 69.05 to139.5 $\mu g.l^{-1}$. These results indicate that a higher concentration of selenium in blood serum is conditioned by the intake of this element in food.

Based on the filled out nutritional protocol before the consumption of supplemented pork, the average daily intake in men and women was 110 µg. During the consumption of pork enriched with selenium there was an increase by 35 µg. Recommended daily selenium intake of 50-200 µg is stated by the World Health Organization (WHO).

The estimation of antioxidant substances is based on the radical of a well-known concentration which eliminates antioxidants of the assessed sample to the extent proportional to its content (Béderová et al., 1997).

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