

**EFFECT OF SELENIUM AND VITAMIN E
SUPPLEMENTATION ON THE QUANTITY AND QUALITY
OF THE PORK PRODUCTION AND SELENIUM
ACCUMULATION IN ORGANISM OF FATTENING PIGS**

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Key words: selenium, supplements, performance, carcass, meat quality, pigs.

Abstract

Selenium accumulates in the organism of livestock and thus increases the additive value of meat, prolongs its storage time, and improves culinary properties. In addition, selenium in meat is an important source of selenium in human nutrition. The aim of present research was to determine the effects of supplementation of diet with antioxidant preparation containing Se and vitamin E (0.1 mg and 20 mg kg⁻¹, respectively) on the growth of fattening pigs, to assess the selenium accumulation in their organism, and to evaluate its effects on the physical-chemical properties of the meat. Two groups (12 pigs in each) of analogous pigs' hybrid were investigated. Experimental group got the supplements of antioxidants. Addition of Se and vitamin E preparation to diet had no significant effect on feed intake, animal growth and meat quality indicators. Blood analyses showed the accumulation of trace element selenium in fattening pigs.

**WPLYW DODATKU SELENU I WITAMINY E NA ILOŚĆ I JAKOŚĆ
PRODUKOWANEJ WIEPRZOWINY ORAZ AKUMULACJĘ SELENU
W ORGANIZMIE TUCZNIKÓW**

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Słowa kluczowe: selen, dodatki, wyniki produkcyjne, jakość tuszy i mięsa, świnie.

Abstrakt

Selen gromadzi się w organizmie zwierząt gospodarskich i w ten sposób dodatkowo podnosi jakość mięsa, przedłuża czas jego przechowywania oraz poprawia właściwości kulinarne. Selen zawarty w mięsie jest ponadto ważnym źródłem Se w żywieniu ludzi. Celem badań było określenie wpływu dodatku preparatu antyoksydacyjnego zawierającego Se i witaminę E (odpowiednio, 0,1 mg i 20 mg kg⁻¹ mieszanki) na wzrost tuczników i akumulację selenu w ich organizmie oraz właściwości fizykochemiczne mięsa. Badania przeprowadzono na grupie 24 świń mieszańców podzielonych metodą analogów na dwie grupy, po 12 sztuk w każdej. Grupa doświadczalna otrzymywała dodatek preparatu antyoksydacyjnego. Zastosowanie dodatku selenu i witaminy E do mieszanek paszowych nie miało istotnego wpływu na pobranie paszy, wzrost i wskaźniki jakości mięsa. Analiza krwi wykazała akumulację selenu w organizmie tuczników.

Introduction

The productivity and well-being of animals depends on number of factors. Therefore, the ration composition plays a key role in sustaining the wellness of animals and preventing from diseases (SAHNOUN et al. 1997, MABRY 1998, DROCHNER et al. 2000). The antioxidants are particular agents among the various elements of ration (SAHNOUN et al. 1997, WHANGER 2002).

The selenium supplements are widely used in the diets of livestock because of strong antioxidative properties of trace element selenium (Se). The supplement of selenium reduces the diseases risk and improves organism immunity. Selenium is included in the composition of glutathione peroxidase (GSH-Px), the enzyme that is natural cell protector from oxidation, involved in a number of biochemical reactions, and is essential for various organism functions (BENEYTOU 1992, JEROCH et al. 1999, SAHNOUN et al. 1997, WHANGER 2002). Moreover, the selenium while accumulating in the livestock organism increases the additive value of meat and prolongs its storage time (FULBERT, CALS 1992, HARPER 2000, MATEO et al. 2007, WHANGER 2002, ZHAN et al. 2007). Selenium in meat is an important source of selenium in human nutrition (OBERLEAS et al. 1999).

The aim of present study was to determine the effects of antioxidant preparation containing Se and vitamin E on the performance of growing-fattening pigs, to assess the selenium accumulation in their organism, and to evaluate its effects on the physical-chemical properties of the meat.

Material and Methods

Two groups of analogous growing pigs hybrid (F1: Landras x Lithuanian White) were investigated: control ($n = 12$) and experimental ($n = 12$) one. Piglets were fed from 15 kg to 90 kg of weight during the period I (from

15 to 50 kg of weight) and period II (from 50 to 90 kg of weight) of feeding. The conditions of keeping and feeding in both pigs groups during the whole period of experiment were the same. The animals were kept in two separate nearby pens of one section, fed with dry diet twice a day and given water as much as they wanted. The diet for both the control and experimental groups' pigs was made of the same raw material. Table 1 presents the composition and nutritive value of the experimental diets. As Se and vitamin E source the preparation of Suplex E/Selenium (0.1 mg and 20 mg kg⁻¹, respectively) was used. Total selenium amount reached 0.2 mg kg⁻¹ diet, because the wholesome combined feed already had 0.1 mg kg⁻¹ Se.

Table 1

Composition (%) and nutritive value of experimental diets (as fed)

Specification	First period of fattening (15–50 kg)		Second period of fattening (50–90 kg)	
	control	experimental	control	experimental
Barley	78.20	78.20	83.10	83.10
Sunflower meal	9.50	9.50	12.00	12.00
Soybean meal	6.70	6.70	2.30	2.30
Fish meal	0.50	0.50	–	–
Soybean oil	2.00	2.00	–	–
Salt	0.30	0.30	0.30	0.30
Dicalcium phosphate	0.90	0.90	0.30	0.30
Limestone	0.90	0.90	1.00	1.00
Premix*	1.00	1.00	1.00	1.00
Se source**	–	+	–	+
EM, MJ kg ⁻¹	12.60	12.60	12.10	12.10
Crude protein, %	15.60	15.60	14.70	14.70
Lys, %	0.84	0.84	0.74	0.74
Met+Cys, %	0.61	0.61	0.59	0.59
Thr, %	0.58	0.58	0.54	0.54
Trp, %	0.18	0.18	0.17	0.17
Ca, %	0.84	0.84	0.68	0.68
P, %	0.61	0.61	0.50	0.50
Na, %	0.14	0.14	0.13	0.13

* Premix provided per kilogram of diet: 10 000 IU vitamin A, 2000 IU vitamin D₃, 20 mg vitamin E, 1.5 mg vitamin K₃, 1.5 mg vitamin B₁, 4.0 mg vitamin B₂, 20 mg niacin, 10 mg pantothenic acid, 3.0 mg vitamin B₆, 25 µg vitamin B₁₂, 2.0 mg folic acid, 300 mg choline chloride, 100 mg Fe, 40 mg Mn, 20 mg Cu, 100 mg Zn, 1.2 mg J, 0.6 mg Co

**„Suplex E/Selenium“

The change in the pigs weight was determined before and after the experiment, and after finish of every feeding period by weighing every animal before morning feeding, with electronic scales of ±0.1 kg precision.

Based on the weighing data, we calculated the general increase in weight (kg), the amount of animal feed used (kg), the feed intake per kg of weight gain, and the number of days to achieve 90 kg mass. The control slaughter performed in the end of experiment. The physical and chemical properties of the meat determined in the samples of loin muscle (*Longissimus dorsi*) in three animals of each control and experimental group.

Following 48 hours the slaughter the quality of the meat determined in the loin muscle based on the following indices: the dry matter (desiccating till dry mass at 105°C), fat amount and cooking waste were determined according to standard methods described in the official methods of analysis of the (AOAC 1990), ash (incineration in the muffle furnace at 400–600°C), pH (pH-meter), water adhesion (method by GRAU, HAMM 1953), meat colour (CIF-LAB method). To determine the accumulation of selenium, four pigs – 2 males and 2 females – were selected from each group, and samples of their hair and blood ($n = 4$) were taken. The amount of Se was determined using the method of atomic absorption spectrometry with the thermo chemical atomizer (ADAC/986.15).

The investigation data was processed using the statistics package “STATISTICA 5.0” (STATISTICA for Windows, 1995). The entire investigated indices given as mean if not indicated differently.

Results and Discussion

The physical observation of pigs showed that during the investigation period (up to 4 months) pigs in both groups were healthy, lively and had a good appetite. The pigs in the experimental group grew faster than control ones during the feeding period I (Figure 1). During this period, the increase of experimental pigs weight was 4.4 kg (9.2%) higher ($P > 0.05$) as compared to that in the control group. During feeding period II, the increase in experimental pigs' weight was negligible, and was merely 0.87 kg (0.09%) as compared to the control ones. The pigs getting

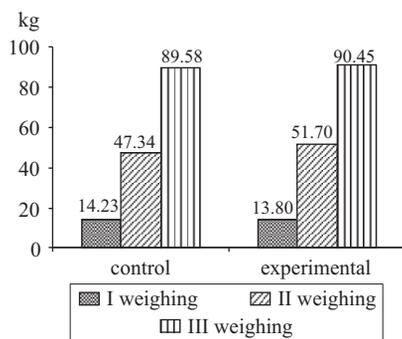


Fig. 1. Dynamics of pigs' growth – pigs weight (mean), kg

the supplement of antioxidant preparation consumed less diet to achieve final weight (Figure 2). At the same time, a few pigs had diarrhoea in the control group.

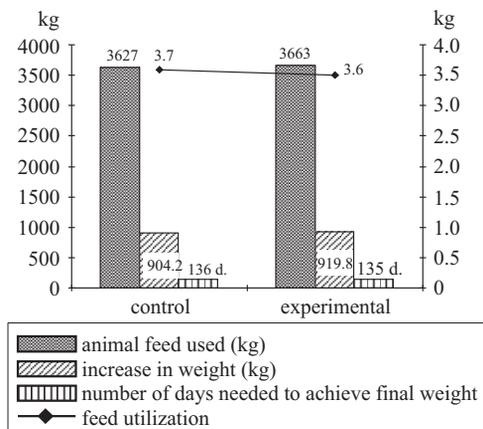


Fig. 2. Feed utilization (mean, kg)

Analogous observations pointed out in the other studies (HARPER 2000, WHANGER 2002), indicating that pigs, getting rations with not enough amounts of Se or a lack of vitamin E, get diarrhoea more often, experience more stress and eat less.

Data show that diet supplemented with antioxidant preparation accelerated the growth by 1 day and makeweight by 1.7%. During the whole investigation, the feed utilization per 1 kg gain was less by 2.7% as compared to the control group. However, the differences of all the indicators studied were statistically insignificant.

The indices and characteristics altogether describe the meat quality, which conditions its nutritive value, conversion and human health (SEGERSON et al. 1986, SHEGLOV, BOYARSKYI 1990, TCHELEKPAEV, NAURUZOV 1990, RIBIKAUSKIENE, DZIAUGYS 2002, RAZMAITE, JANCIENE 2003). Entire meat indices e.g., pH, colour intensity, amount of muscles, fats, dry matter, meat adhesion, meat toughness, cooking waste, ashes etc., are essential. All these indices investigated in experimental and control pigs (Table 2).

The commodity exterior and culinary properties were different in the investigated groups. Experimental pigs' meat colour was lighter by 15.1%, and had higher amount of dry matter by 0.4%. The increase of meat colour light is associated with major level of dry matter (TCHELEKPAEV, NAURUZOV 1990, SOSNICKYI 1998, WHANGER 2002). The suitability of meat for further technological processing usually evaluated by meat colour (SHEGLOV, BOYARSKYI 1990, RIBIKAUSKIENE, DZIAUGYS 2002). The meat colour depends on pH as well. We found similar meat pH of 5.47 in both pigs groups as well as the content of ashes did not differ. The tenderness is one of the

Table 2

Physical-chemical properties (mean, statistical deviation SD)
of meat (*longissimus dorsi*)

Indices	Control pigs		Experimental pigs	
	\bar{x}	SD	\bar{x}	SD
Dry matter, %	24.89	± 0.84	25.43	± 0.96
pH	5.47	± 0.09	5.47	± 0.03
Colour intensity, EK	64.0	± 4.42	54.33	± 3.89
Water adhesion, %	46.76	± 2.57	49.63	± 3.11
Cooking waste, %	32.26	± 1.35	31.98	± 1.17
Tenderness, kg cm^{-2}	1.86	± 0.44	1.80	± 0.32
Fat, %	2.15	± 0.58	1.94	± 0.04
Ash, %	1.04	± 0.04	1.05	± 0.04

essential properties of meat savour, which directly affects pork value and relish. Muscles have least connective tissue and is considerably mild, although the correlation is not reliable (SHEGLOV, BOYARSKYI 1990). The tenderer meat have more hydrated proteins, more adhered water and emit less sap while cooking and keeping (SHEGLOV, BOYARSKYI 1990, RADIENE et al. 2004). Our study confirms these results. We found that experimental pork was tender by 3.2%, had fewer fats by 0.2%, more adhesion water by 2.9% and excreted less sap while cooking by 0.3% as compared to the control. However, the differences of all the indicators studied were statistically insignificant. Therefore, the productivity, meat quality, additive value of livestock depends on number of factors, the most important among those are animal age, fattening mode and grade, condition, species, gender and castration.

The obtained data (Figure 3) show that the experimental pigs had almost triple amount ($\bar{x} \pm \text{SD}$) of Se in blood $0.016 \pm 0.0004 \text{ mg dm}^{-3}$. That is 266.7% higher (Student criterion value $t_d = 9.26$; $P < 0.001$) than in the blood of the control group. The selenium level ($\bar{x} \pm \text{SD}$) in the covering hair of experimental animals was $0.151 \pm 0.028 \text{ mg kg}^{-1}$. That is 1.2% higher

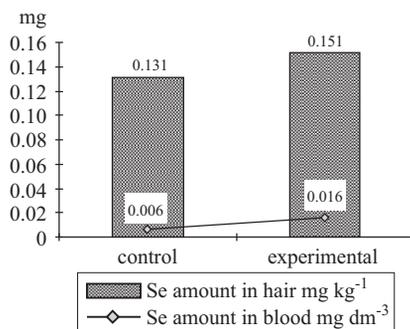


Fig. 3. Amount of Se (mean, mg) in pigs' organism

(Student criterion value $t_d = 0.74$; $P > 0.05$) as compared to the control ones. These results are generally consistent with previous report (KIM, MAHAN 2001). The selenium in blood contributes to the selenium content in meat of animal and thus considered as rather important source in human nutrition (OBERLEAS et al. 1999).

The trace element selenium in antioxidant preparation was in inorganic form. Therefore, the accumulation of Se in the pigs' organism was obvious. The similar data show other studies (SEGERSON et al. 1986, SAHNOUN et al. 1997, FLORES et al. 1998, HARPER 2000, WHANGER 2002).

Conclusions

Supplement of antioxidant preparation in pigs diet had no significant effect on feed intake, animal growth and meat quality indicators. The selenium level in blood was 266.7% higher ($P < 0.001$) in experimental pigs blood and 1.2% higher ($P > 0.05$) in covering hair as compared to the control ones.

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