Effects of organic selenium yeast administration on perinatal performance, growth efficiency and health status in pigs

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SUMMARY

Selenium is a vital necessary element, and its insufficiency observed in the soil and feed in a number of countries of Eastern Europe, adversely affects the health status and productivity of animals. The aim of the research was to study the possibility of using Selenium Yeast for correction of productivity of pig's producing capacity, haematological, biochemical and antioxidant parameters of pigs in different periods of growth and development.

Experiment was carried out to establish the influence of organic selenium on 75 healthy sows in farrow, milking sows and piglets before slaughtering. SELENIUM YEAST (CENZONE TECH INC, USA) contains a selenium-methionine was mixed into the concentrates in ratio of 250 g/t, given by all the animals during feeding. Preparation from the yeast basis included 0.1% of active matter.

The obtained results showed SELENIUM YEAST preparation can increase the birthrate of piglets up to 6 %, the litter weight – up to 11.1 % ($P<0.05$), milking capacity – up to 16 % ($P<0.001$) of sows in farrow and milking sows. Preparation has a positive influence on the growth and piglets preserving. The preparation showed the most remarkable influence upon the indices of the functioning of the liver. Both sows and piglets showed trustworthy 35 and 43% decreased bilirubin level and ALT activity of 18 and 77% respectively after the application of SELENIUM YEAST. Under the influence of preparation a trustworthy decrease of lipid peroxidation processes in the blood of animals occurred.

Improves culinary and chemical characteristics of pork and gives a possibility to get more valuable food products enriched with selenium. The level of selenium in the muscle of animals increases up to 27.8 % ($P<0.001$).

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The Selenium Yeast in quantity of mixed fodder of 250 g/t accelerates growth of weight, increases haematological parameters of blood, zootechnical parameters of sows during the in farrow and sorts, as well as pigs in the first month of life. Using the Selenium Yeast enriches the fabrics of sows and pigs in selenium that can be a base to improve the nutritional value.

Keywords: pigs, organic selenium, productivity, reproduction characteristics, meat characteristics.

INTRODUCTION

The achievement of balanced, rational nutrition of full value for man is the main aim of modern science and agriculture (Adams, 2004). In the last 20 years it concerns the necessary level of microelements as well, which is connected with the establishment of their role in metabolism of endogenous and exogenous substratum, the maintenance of the body's internal homeostasis and in the etiology of a number of endemic diseases. Selenium, recognized as an irreplaceable growth factor in 1957 (Schwarz, 1958), is one of the most important factors in human's and animal's nutrition (Xia et al., 2004).

Selenium is a part of many hormones and enzymes, a part of the ferment of glutathione peroxidase in particular, which forms complexes with peroxides and prevents the development of oxidative stress (Bertinato and Hidiroglou, 2007). Selenium takes part in the processes of the reproduction, development and aging of organism (O'Grady et al., 2001). In case of deficiency in selenium in organism, carbo-hydrate, lipid, and protein metabolisms are disturbed, liver infiltration and dystrophy occurs in tissues and organs, destructive changes occur in skeleton and heart muscles, capillary penetrability increases, animal growth slackens, natural resistance and reproductive function are reduced (Smith and Akinbamijo, 2000). Selenium deficiency in mammals' feeding can induce such diseases as exudative diathesis, encephalomalacia, pancreas atrophy, muscle dystrophy. Microelements deficiency causes the destruction of immunocompetence, carbo-hydrate, lipid and protein metabolisms and the deterioration of productive and reproductive animal properties (Kolb and Seehawer, 2001).

The regulation of selenium consumption is especially of great importance for Belarus, Baltic States and the north-western part of Russia where vast biogeochemical regions with the reduced content of selenium in soil and drinking water are exposed (Surai, 2002a).

Many cases of Se deficiency in Poland were reported in different husbandry animal species including horses, sheep and cows (Debski et al., 1992, Jakubowski et al., 2002). In horses Se deficiency symptoms are muscular stiffness and very often foals are unable to nurse. At necropsy alopecia and

degeneration of skeletal muscles are stated. Low Se level in grass is the main factor having adverse effect on lamb production. The manifestation of white muscles disease affects mostly lambs to 10 weeks of age and the reduced growth rate is noticed. Sudden death, a prominent feature of Se deficiency, hepatic necrosis, lungs edema and bilateral muscle paleness of skeletal muscles (white muscles disease) are often found in pigs. Areas of Se deficiency have been mapped worldwide (Grodzinska et al., 2003). Based on Se concentration analysis of cows' milk, it was calculated that on about 80 % territory of Poland moderate or severe Se deficiency appears. For Se level evaluation cows' milk was chosen because, as it was shown, it relates to Se concentration in serum and muscles, and also because of low cost and easy method of sample collection. The only problem is very low Se concentration in the skim cow milk, what might create analytical problems (Studziński et al., 2006).

Lately the search for opportunities of applying organic selenium when breeding pigs has been intensified (Mateo and Spallholz, 2007). Organic selenium medicine favoured the decrease in the loss of cattle by 15-40%, the increase in the weight by 3-16%, the improvement of physiological and biochemical parameters (Van Ryssen et al., 1987).

On the other hand, the facts of improving pork's quality by sensory and biochemical parameters when using organic selenium preparation DAFS-25 are already known (Smith and Akinbamijo, 2000; Surai, 2002b). One of the main mechanisms of the microelement's regulating activity is its participation in the antioxidant system (Demelash et al., 2004; Bertinato et al., 2007). It has been established that the preparation prevents peroxidation of mitochondrial membranes and oxidation of fatty acids, apoptosis caused by hydrogen peroxide. The ability of selenium to neutralize free radicals is shown not only in the experiments *in vitro,* but also *in vivo* (Surai, 2002a).

The aim of the research was to study the possibility of using Selenium Yeast for correction of productivity of pig's producing capacity, haematological, biochemical and antioxidant parameters of pigs in different periods of growth and development.

Material and Methods

Experimental design

In the conditions of JS Company "Zelve" (Lithuania) and Cooperative "Koptevka" of the Grodno region (Belarus), where selenium deficiency is up to 30-49 % (Antanaitis, 2004), there was conducted an experiment on studying the influence of organic selenium preparation on sows in the periods of farrows and lactation.

Young animals before wean off and on the pigs in the period of fattening were also the subject for the study. The quality of goods produced from these animals was assessed within the period from January till November 2006. It was the animals of hybrid breed that were studied: the sows were the hybrids of Norwegian Landrass and Norwegian Yorkshire (parts of blood 50/50). For the impregnation, pigs of pure Norwegian Durok breed were used. Two groups of three- to four-year-old sows in farrows having 10 heads each were formed. The animals were picked out taking into account their weight and the terms of impregnation. They were kept indoors and fed according to the feeding accepted in the farming. The feeding was balanced by energy exchange, the total amount of proteins and separate amino acids, macro- and microelements, vitamins. The sows of the first (control) group were treated with sodium selenite by 0.1 mg/kg once (25 days before farrow), the born piglets being treated twice (every 10 days) (Mahan, 2004). The animals of the second (experimental) group (the sows and piglets) were fed the preparation SELENIUM YEAST (of the firm CENZONE TECH INC, USA) at 250 g/t of concentrates that have yeast basis and contain 0.1 % of active substance, represented by selenomethionine. The preparation was assigned to the sows in the periods of pregnancy and rearing, and to the pigs from the 5th (the beginning of introducing the starting mixed fodder) to the 178th day (before slaughtering) (Table 1).

Table 1. Experimental design (n)

Groups	Farrowing sows	Milking sows	Piglets	Sows before slaughtering
Control	10	10	75	75
Experimental (SELENIUM YEAST)	10	10	75	75

After the sows' farrows, the total amount of piglets born alive and their weight were taken into account. The sow's milking capacity was defined by the weight of the litter on the 21st day of the farrow. The dynamics of the fattened pigs' weight was established at the age of 28 days (on wean off), 71 day, and before slaughtering (178 days). On the basis of the data of weighing, twenty-four-hour additional weight was calculated.

Haematological and biochemical analyses

Haematological and biochemical research of the sows was conducted at the beginning of the experiment and that of both sows and piglets was done 30 days later after the sows' farrows. In peripheral blood the content of haemoglobin, the amount of red blood cells (RBC), leucocytes (white blood cells (WBC)), and haematocrit was measured on the automatic haematological

analyser "MEDONIC CA 620" (Boule Medical AB, Sweden). In the serum the following parameters were measured: the content of protein, glucose, calcium, inorganic phosphorus, alanine (ALT) and aspartate aminotransferase (AspAT) by kinetic method, total bilirubin, iron on the bio chromatograph POINTE-180 and spectrometer "Fluorat-02-2M" (JSC "Lumex", Russia) according to the accompanying methods (Kamishnikov, 2000).

The level of lipid peroxidation is measured by the content of substrates reacting with thiobarbituric acid (TBARS) (Stocks and Dormandy, 1971) in whole blood in the period of sows' farrows and in piglets, at the end of fattening in blood, homogenates of liver and muscles. The functional state of the antioxidant system of the pigs' bodies was measured by the ability of resisting to TBARS growth when adding dissoluble analogue of hydrogen peroxide – tret-butyl hydroperoxide (*t*BHP) to the samples 1, 2, 3, 4, 5 or 6 mM. Moreover, the activity of one of the main antioxidant ferments – glutathione peroxide (GSHPx) – was studied (Martinez, 1979), using as substrates the reactions of *t*BHP and GSH and the level of reduced glutathione (GSH) (Ellman, 1959) with the reagent of Ellman, using the coefficient of extinction 13.6 mM^{-1} cm^{-1} (412 nm).

When slaughtering the animals of the both groups, the blood (from the heart), muscle (*Musculus longissimus dorsi*) and liver (from the right part) were taken for the research. In all the tissues, the state of lipid peroxidation (the level of TBARS) and antioxidant system (the activity of GSHPx and the level of GSH) were studied. Furthermore, the chemical composition and physical chemical properties of the meat were studied: pH, moisture binding ability, cooking loss, dry matter, protein, fat, ashes (Warris, 2000), the content of separate amino acids using the amino analyser AAA-881 (Savina et al., 1990).

Statistical analysis

All results are expressed as mean and standard error of the mean (SEM). The authenticity of the difference in variables between the groups was measured by the Student's criterion (Sakalauskas, 1998). Statistical differences between groups for different parameter concentrations were determined using ANOVA general linear model, GLM). P-values 0.05 and less were considered significant.

RESULTS AND DISCUSSION

Watching the sows didn't reveal any clinical deviations during the period of pregnancy and delivery in the experimental and control groups. All the animals gave birth on their own. We evaluated the influences of organic selenium supplementation on the some biochemical parameters of blood of

sows. When studying the biochemical variables of the sows' blood before injecting with the preparations no differences between the animals of both groups were revealed. All of them were in the state of physiological norm.

Animal technicians' parameters

Using the SELENIUM YEAST preparation in sows in farrows and piglets revealed a substantial increase in the productivity of the sows from the experimental group (Table 2).

Table 2. Reproduction parameters of sows

Parameters	Control group	Experimental group
The number of sows, units	10	10
Number of live-born piglets, units	10.40±0.48	11.2±0.60
Amount of alive born piglets, units	10.01±0.53	10.8±0.49
Mean body weight of newborn piglets, kg	1.03±0.02	1.06±0.05
Mean litter weight, kg	10.31±0.16	11.45±0.73*
Milking capacity of sows, kg	52.2±1.5	60.5±1.6**
Mean body weight of piglets at weaning, kg	7.34±0.17	7.83±0.24
Mean daily body weight gain of piglets, g	225±5	242±6
Percentage of survived piglets	91.6±1.7	92.4±1.8

Note: *P<0.05; **P<0.01

The mean litter weight on the day of the farrows was higher on 11.1 % (P<0.05) in the experimental group, although the foetuses higher body weight of the sows in the experimental group wasn't different from the control one (Table 2). The milking capacity of sows defined by the litter weight at the age of 21 days was higher in the experimental group than in the control one on 8.33 kg or on 16 % (P<0.001). The application of the SELENIUM YEAST preparation in the piglets' feeding exerted a positive influence on further growth and development of the piglets and also on their preservation.

As a result of the conducted research, it was revealed that the application of the SELENIUM YEAST preparation in feeding exerts a positive influence on the weight dynamics of the gilts and after wean off (Table 3).

Table 3. Daily body weight gain of piglets (n = 75)

Age of pigs (days)	Control group		Experimental group	
	Body weight, kg	Daily body weight gain, g	Body weight, kg	Daily body weight gain, g
28	7.34±0.17		7.83±0.24	
71	23.78±1.06	382±8.28	25.48±1.47	410±11.23*
178	98.96±2.56	703±7.35	102.95±3.12	724±8.57

Note: *P<0.05

The weight of the pigs from the experimental group was on 1.7 kg or 7.1 % higher body weight than that from the control one 43 days after wean off. Correspondingly the average weight per day was higher on 28 g or 7.3 % ($P<0.05$). So the SELENIUM YEAST preparation can lead to increase in the pigs average weight per day.

Haematological and biochemical analysis of blood

The application of the organic selenium preparation resulted in not changes of sows' haematological parameters (Table 4).

Table 4. Haematological parameters in sows (n = 10) receiving selenium yeast preparation

Group	RBC, 10^{12}/l	WBC, 10^{9}/l	Platelets, 10^{9}/l	Haemoglobin, g/l
Control	4.9±0.9	14.4±1.2	308.5±78.8	92.0±16.9
Experimental	5.0±0.8	13.6±1.1	282.5±61.8	95.7±20.4

A similar change of haematological parameters can be seen in the piglets that received organic selenium: the amount of erythrocytes increased 14.2 % ($P<0.05$) and platelets decreased – 8.4 % ($p > 0.05$) (Table 5).

Table 5. Haematological parameters in piglets (n=75) receiving selenium yeast preparation

Group	RBC, 10^{12}/l	WBC, 10^{9}/l	Platelets, 10^{9}/l	Haemoglobin, g/l
Control	5.7±1.0	12.03±2.5	501.9±172.5	104.4±20.9
Experimental	6.4±0.5*	11.5±3.0	434.8±135.7	105.7±33.6

Note: *P<0.05

The application of the SELENIUM YEAST preparation could afford to significantly increase the content of microelements in the blood serum of both sows – 65 % and piglets – 54 % (Table 6).

Table 6. Serum concentration of selenium in sows and piglets receiving selenium yeast preparation (μg/ml)

Sows (n=10)		Piglets (n=75)	
control	experimental	control	experimental
117±14	193±26*	118±16	182±10*

Note: *P<0.05

Considerable changes in biochemical blood parameters could be registered a one month later after selenium supplementation the sows and piglets with the preparation (Table 7). The content of total protein in the sows had risen largely due to globulins (16 %, $P<0.05$), and the concentration of glucose and cholesterol had increased, too. The concentration of Ca in the

piglets' blood increased by had risen. However the most noticeable shifts could be seen in hepatic nuclei. Organic selenium supplementation in comparison with selenium nitrite considerably decreased the activity of ALT and AspAT (11-71 %) and the level of bilirubin and its fractions (29-70 %) (P<0.05).

Table 7. Biochemical indices in blood of sows and piglets that received the Selenium Yeast preparation (250 g/t, 1 months inside with combined fodder)

Parameters	Sows (n=10)		Piglets (n=75)	
	control	experimental	control	experimental
Total protein, g/l	70.1±4.2	74.8±4.1	55.7±6.6	55.2±3.4
Albumins, g/l	34.7±3.1	36.8±3	36.2±3.5	35.7±3.3
Globulins, g/l	32.5±3.9	37.9±2.9*	19.5±7	19.3±4.4
Ca, µmol/l	3.12±1.12	3.14±1.24	3.02±0.54	5.27±2.43*
P, µmol/l	1.93±0.24	1.95±0.52	2.83±0.24	2.94±0.22
Ca/P	1.6±0.7	1.6±0.5	1.1±0.2	1.8±0.8*
Iron, µmol/l	19.4±5.2	17.1±2.2	26.0±5.2	16.8±5.3*
Glucose, mmol/l	3.78±0.51	4.27±0.52*	5.61±0.46	5.69±0.57
Cholesterol, mmol/l	2.19±0.62	2.48±0.51*	4.28±0.81	3.55±0.44*
AspAT, U/l	62.6±8.8	51.7±9.5*	66.6±0.9	15.2±1.8*
ALT, U/l	76.7±7.5	65.7±5.1*	80.4±19.5	71.3±8.4*
Total bilirubin, µmol/l	4.90±0.96	3.17±5.24*	24.4±2.5	13.9±2.2*
Conjugated bilirubin, µmol/l	3.68±0.74	2.64±4.34*	10.2±4.3	9.8±3.9
Unconjugated bilirubin, µmol/l	1.25±0.12	0.54±0.11*	14.2±3.4	4.11±1.10*

Note: *P<0.05

We compared the susceptibility of the blood components to the oxidative stress in the both groups of animals. While studying the processes of free radical oxidation, a marked inhibition in applying organic selenium was revealed. If the content of the reduced glutathione in the sows' whole blood are stable enough (Table 8), the initial and stimulated (expressing resistance to the products of oxidation) level of lipid peroxidation had decreased considerably. The concentration of TBARS with 0-6 mM being present *t*BHP made up 13.0-15.7 nM in the control group and 6.0-7.1 nM in the test one (Fig. 1).

Table 8. Changes of reduced glutathione level in blood of sows and piglets assessed one month after administration with selenium yeast preparation (µM).

Sows (n=10)		Piglets (n=75)	
control	experimental	control	experimental
4.8±0.1	4.4±0.13	4.1±0.09	2.1±0.02*

Note: *P<0.05

Statistically significant differences in the level of the reduced glutathione can be seen in the piglets' blood: it was by 48 % lower in the tested group than in the control one (Table 8).

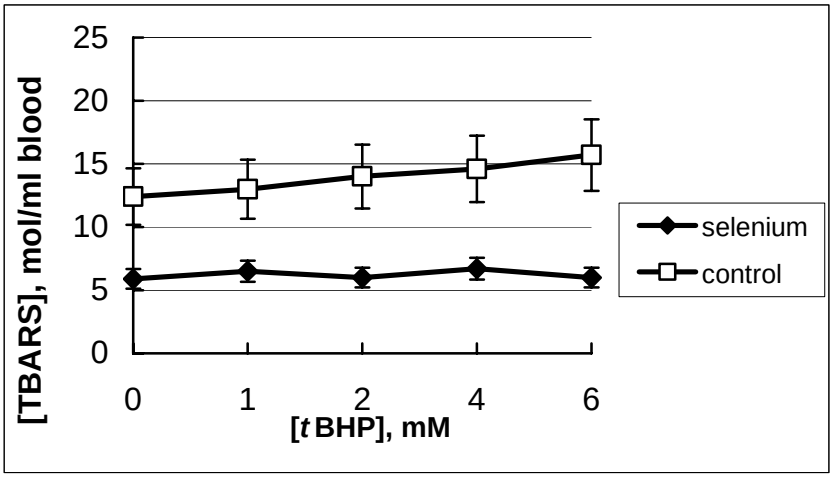

Figure 1. Relationships between TBARS and tBHP concentrations in blood of sows assessed one month after the delivery

Figure 2 represent the lipid peroxidation processes induced by known oxidative agent in the blood of piglets, treated with organic selenium preparation. The level of TBARS when adding up to 0-6 mM *t*BHP made up 12.0-15.5 nM in the control group and 4.4-8.6 nM in test one.

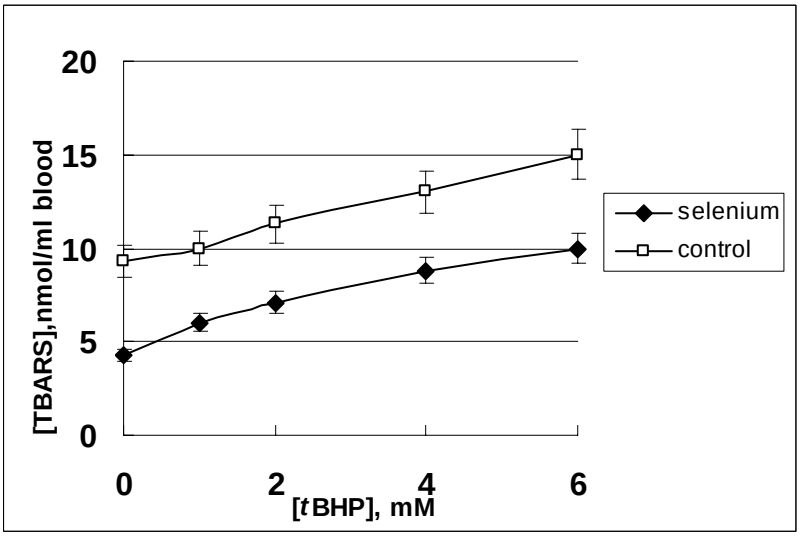

Figure 2. Relationships between TBARS and tBHP concentrations in the blood of the piglets at 30 days of age that received the Selenium Yeast preparation

Productive meat characteristics

The conducted analyses revealed a higher bioavailability of SELENIUM YEAST in comparison with sodium selenite not only for blood, but also for meat. The level of selenium content in the preparations for the longest back muscle of the animals from the experimental group made up 23.1±2.2 ng/kg and 18.2±1.0 ng/kg in those from the control one (P<0.05), after 178 days of experimental lasting.

The significant antioxidant characteristics of the preparation being studied are kept when prolonging the terms of observation. In the liver homogenate of the pigs that received organic selenium during 178 days, the level of TBA-products reduced 32 % with the simultaneous decrease in the concentration of the reduced glutathione 17 % (Table 9). The reduction in the content of substrates for GSHPx led to significant decrease in its activity in the experimental group 15 %.

Table 9. Changes in the antioxidant status of the tissues of the pigs that received the organic selenium preparation (250 g/t, daily, 178 days)

Parameters	Control	Experimental
Liver homogenate		
GSHPx, µmol GSH/min/mg protein	1.83±0.23	1.55±0.13*
TBA-products, nmol/mg protein	0.287±0.107	0.194±0.084*
GSH, nmol/mg protein	11.8±1.2	9.9±1.1*
Blood (whole)		
GSHPx, µmol GSH/min/mol Hb	57.3±12.6	50.9±16.9
TBA-products, nmol/mol Hb	1.56±0.86	1.24±0.64
Muscle homogenate		
GSHPx, nmol GSH/min/mg protein	58.65±11.4	39.65±7.67*
TBA-products, nmol/mg protein	52.40±15.76	26.91±5.73*
GSH nmol/mg protein	20.07±4.51	13.83±3.43*

Note: *P<0.05 in relation to control

Analogical significant changes were observed when investigating the muscle tissue (Table 9). The level of the TBA-products in the homogenate of the longest back muscle reduced by 49 % (P<0.01) during organic selenium treatment. The level of GSH decreased significantly (33 %, P<0.01), the activity of glutathione peroxidase reduced, too (34 %, P<0.01).

The investigation of peroxidation processes in the whole blood at slaughter we did not observe any significant changes in the parameters (Table 9).

The application of the organic selenium preparation exerted a conspicuous influence on physicochemical characteristics of meat. The level of selenium in meat enhanced significantly after organic selenium treated (Table 10).

Table 10. Physicochemical characteristic of meat of the pigs that received the organic selenium preparation (250 g/t, daily, 178 days)

Parameters	Control group	Experimental group
Dry matter, %	25.48±0.26	27.45±0.23**
Protein, %	22.90±0.23	23.00±0.20
Fat, %	1.42±0.06	1.55±0.12
Ash, %	1.15±0.01	1.15±0.04
pH	5.47±0.02	5.47±0.02
Selenium, mg/kg	0.018±0.001	0.023±0.001**
Water holding capacity, %	50.30±0.61	51.22±0.74
Cooking loss, %	29.10±0.60	25.67±0.54**
Amino acids composition, %		
Lysine	8.07±0.08	8.54±0.08**
Histidine	3.57±0.08	3.65±0.06
Arginine	6.31±0.09	6.40±0.11
Asparagine acid	10.01±0.09	10.04±0.08
Threonine	4.52±0.07	4.37±0.04
Serine	3.82±0.09	4.14±0.12
Glutamic acid	18.08±0.12	18.11±0.09
Proline	3.01±0.04	3.08±0.04
Glycine	4.19±0.06	4.26±0.06
Alanine	6.64±0.16	6.48±0.12
Cysteine	1.26±0.05	1.60±0.05**
Valine	6.94±0.44	5.83±0.55
Methionine	2.31±0.14	2.52±0.09
Isoleucine	4.47±0.08	4.45±0.09
Leucine	8.50±0.11	8.46±0.10
Tyrosine	4.19±0.08	4.10±0.06
Phenylalanine	4.02±0.05	3.87±0.05*

Note: *P<0.05, **P<0.001

In the meat of the pigs that received the preparation of SELENIUM YEAST, the amount of dry matters increases significantly and cooking loss was reduced by 1.97 % (P<0.001) and 3.43 % (P<0.001) respectively in comparison to controls (Table 10). Water holding capacity was increased by 0.92 % (P>0.05) in the experimental group. These parameters are the most important characteristics of meat, especially when cooking sausages. The higher water holding capacity is, the easier it is to cook a more valuable food product.

The amino acid composition of muscle was changed when administered the organic SELENIUM YEAST to the feed of pigs The amount of essential amino acid lysine and cysteine increases significantly by 0.47% and 0.34%, respectively, but the concentration of phenylalanine was reduced by 0.15% (P<0.05) (Table 10).

Selenium is an essential trace mineral because of seleno-proteins which are critical for antioxidant defense, fertility, thyroid hormone metabolism, immune responses, and muscle development and function. (Lymbury et al, 2010). It is only in the mid-1950s that the physiological significance of this trace element was correctly evaluated. Identification of pathologies related to selenium deficiencies demonstrated its essential nutrient function, first in livestock (Hatfield, 2001). The impact of selenium-containing feeding on the characteristics of meat is also confirmed by a whole range of research (Adams, 2004). The digestion of microelement from meat products makes up more than 90 % (Bügel et al., 2004), the nutritive value and the preservation of meat production rise (Roche, 2002).

Physiological loads, especially pregnancy and delivery, the primary period of body development, require not only the mobilization of all the body systems, but the increased requirement in nutrients and microelements. So selenium content in pregnant sow's blood reduces gradually during the whole period and increases extremely slowly after delivery (Yoon and McMillan, 2006). The application of selenium-containing yeast by the authors as it is in our experiment made it possible to increase the concentration of microelements not only in blood and hair, but also in colostrum and in milk (Yoon and McMillan, 2006; Sivertsen et al., 2007; Szczubiał and Kankofer, 2004). It leads to the growth of selenium level in pigs organisms.

The data about the balance of amino acids in different tissues are not as simple. The increase of lysine and cysteine only and the decrease of phenylalanine at the latter follow-up period shall be agreed with the other authors.

The plasma amino acid score was calculated from the free plasma amino acid levels in fed and fasted selenium-deficient and selenium-supplemented lambs and of rats. No significant difference either in the total or the total nonessential plasma amino acid score between supplemented and deficient lambs was observed at 1 - 14 days, but both scores were significantly higher for the supplemented lambs at 28 and 42 days of age. Of the essential amino acids, only the plasma amino acid score for methionine, threonine and lysine; and of the nonessential amino acids the scores for serine, proline, glutamate, aspartate, alanine, citrulline, glycine, ornithine, and two of the ninhydrin-positive compounds (taurine and α-amino butyrate) were significantly different supplemented and deficient lambs. The plasma amino acid score for all compounds, except aspartate, glutamate, proline and citrulline, were higher for deficient rats; however, only the scores for glycine, alanine, tyrosine and lysine were significantly higher (Whanger et al., 1972).

Alongside with the normalisation of the mineral balance, the vitamin balance of an organism improves, too. Selenium partially reduces the content

of ascorbic acid and tocopherol and is their synergist (Sivertsen et al., 2007). It can be the reason for the normalisation of protein synthesis and hemostimulating organism capacity after applying the preparation.

The received antioxidant characteristics of the preparation are confirmed by the prevention of oxidative stress caused by hydrogen peroxide (Demelash and Karlsson, 2004) or parakquat (Takizawa and Komori, 2007). Such effect of selenium-containing yeast causes both the increase in animal's resistance to illnesses and external effects, providing optimal pregnancy and delivery course, increasing the amount of piglets being born and their survival (Mahan and Peters, 2004; Machlin and Bendich, 1987).

A lack of selenium associated with several muscular diseases affecting both cardiac and skeletal muscles was described in both cattle and humans, defining a new syndrome called nutritional muscular dystrophy (Patterson et al., 1957). White muscle disease in cows, calves and sheep, or rigid/stiff lamb syndrome are myopathies characterized by the alteration of cardiac and skeletal muscle fibers with extensive calcification as an often-observed feature. Emergence of these diseases is strongly influenced by diet, and a direct link between the selenium content of the food and the incidence of the diseases could be established (Poston et al., 1976, Rederstorff et al., 2006). Finally, a good protection against white muscle disease emergence by selenium supplementation demonstrated the importance of this trace element.

Thus, the data obtained by our team about the microelement content increase in the muscles permit to positively solve the issue about the regulation of the structure and function of the tissue and testify to eventual possibility of the prophylaxis of severe cases.

CONCLUSIONS

It is advisable to use the organic selenium preparations when feeding pigs. The SELENIUM YEAST preparation raises the sow's reproductive performance, the amount and vitality of born piglets increases. Pigs live weight increase quickens while fattening. The investigated combination caused the normalisation of haematological and biochemical parameters of the sows and piglets blood and exerted a conspicuous antioxidant effect. Cooking and chemical characteristics of meat in the experimental group of animals improves, the content of selenium in blood and tissues rises.

So the organic selenium preparation can be successfully applied to raise the productivity of pig breeding, to receive more valuable food products and to supply shortage of microelements in nutrition.

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