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THE EFFECT OF DIFFERENT LEVELS OF ORGANIC SELENIUM ON BODY MASS, BODYWEIGHT GAIN, FEED CONVERSION AND SELENIUM CONCENTRATION IN SOME GILTS TISSUES

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Thirty-nine gilts, 82 days old, divided into 3 groups, were fed the main diet supplemented by 0; 0.3 and 0.6 mg Se/kg in the form of Se-enriched yeast during 99 days. Selenium levels of 0.3 and 0.6 mg/kg diet led to no significant bodyweight gain nor increase in body mass in any of the studied periods. However, gilts fed a diet supplemented with selenium (0.3 and 0.6 mg/kg) during the whole research period had somewhat higher body mass (1.17 and 3.36%, respectively) and higher average daily bodyweight gain (1.07 and 4.30%, respectively). Selenium supplemented diet influenced also more efficient feed conversion for 3.11 and 2.18%, respectively.

The highest content of selenium was observed in the kidneys, then in liver and heart, whilst the lowest selenium content was observed in the leg and neck musculature. Selenium concentration in kidneys ranged from 1.23 mg/kg to 1.38 mg/kg and no statistically significant differences were established among studied groups. Selenium concentration in the liver was 3-4 times lower, and in the heart muscle even up to 6 times lower in comparison with the kidneys. Among the studied groups statistically significant differences were established ($P<0.01$) for selenium levels in liver and heart muscle. The highest levels were observed in the group fed 0.6 mg Se/kg diet, that is, in the liver 0.511 mg/kg and in the heart 0.313 mg/kg. Selenium concentration in the leg and neck muscle was twice, i.e., three times higher in gilts fed 0.3 mg Se/kg and 0.6 mg Se/kg diet in relation to animals fed no supplemented selenium diets ($P<0.01$).

Key words: gilts, Se-enriched yeast, body mass, bodyweight gain, feed conversion, selenium tissue concentration

INTRODUCTION

Selenium is a nutrient indispensable for physiological functions and for improving productive characteristics. Recently the use of organic selenium has had an advantage over inorganic selenium due to its more efficient activity on the organism and its considerably lesser toxicity (Todorović, 1997). Mahan and Kim

(1996) and Mahan *et al*. (1999) confirmed that addition of 0.1, 0.2 and 0.3 mg Se/kg in the form of Se-enriched yeast into porcine diets led to no difference in body mass in examined animals. The addition of 0.3, 3 and 7 mg Se/kg diet in the form of Se-enriched yeast had a significant influence on bodyweight gain and feed consumption which increased with selenium supplementation (Kim and Mahan, 2001). Gunter *et al*. (2003) in their trial on cattle stated that there was no difference in body mass between animals fed with or without addition of organic selenium.

Selenium depots in tissues are considerably higher when animals are fed diets supplemented by organic selenium in relation to inorganic selenium (Dorrnenbal, 1975; Young *et al*., 1977; Kurkela and Kääntee, 1984). Selenium is being rapidly stored in the liver, because it is the site where selenoprotein P is being synthetized, by means of which it is most probably transported from liver to other tissues, (Hostetler and Kincaid, 2004). Tissues display various affinity towards selenium. The highest selenium concentration is found in the kidney cortex, kidney core, liver, pancreas, heart and skeletal muscles. Such an arrangement of tissues in relation to selenium concentrations is similar in all species of domestic animals. The greatest quantity is stored in the kidneys because it is the major organ responsible for selenium secretion (Shariff *et al*., 1984). Many authors believe that addition of selenium has no great significance in increasing body mass but that it has a great capacity for making depots in some tissues.

In our research we have studied the effects of different levels of organic selenium in the form of Se-enriched yeast (0.3 and 0.6 mg) on body mass, bodyweight gain, feed conversion and tissue concentration in gilts in the period from 82 to 181 days of age.

MATERIAL AND METHOD

Thirty-nine gilts 82 days old, divided into 3 groups were fed a diet supplemented with 0, 0.3 and 0.6 mg Se/kg (I, II and III group, respectively) in the form of Se-enriched yeast, during 99 days. In the first period (from 82 - 124 days) gilts were fed *ad libitum* and in the second period (from 125 - 181 days) in installments. During the trial we have monitored liveweight gain by measuring animals at the end of the first and second period, namely at 42 and 99 day of trial. In the same period we also measured feed conversion. Live weight gain and feed conversion for 1 kg of liveweight gain were calculated for the first, for the second and for the entire period of trial. At the end of the trial (on 99th day) 3 animals from each group were slaughtered, and tissue samples were taken (kidneys, liver, heart, leg and neck muscle) in order to determine selenium concentration by the method of atomic absorption spectrophotometry – by the hydrating procedure.

RESULTS

The effects of different selenium levels in gilts' diet on body mass, average daily weight gain and feed conversion are shown in Table 1.

Table 1. Effects of different selenium levels on production results of gilts

Parameter	Group		
	I	II	III
	Supplemented Se, mg/kg		
	0.0	0.3	0.6
Body mass, kg			
– at the beginning of the experiment	26.75	27.15	27.00
– at the end of the first period	50.20	51.30	52.07
– at the end of the second period	91.23	92.30	94.30
Index, %	100.00	101.17	103.36
Daily liveweight gain, g			
– in the first period	0.558	0.575	0.596
– in the second period	0.719	0.719	0.740
– whole period	0.651	0.658	0.679
Index, %	100.00	101.07	104.30
Feed consumption/kg liveweight gain, kg			
– in the first period	2.78	2.86	2.76
– in the second period	3.46	3.28	3.38
– whole period	3.22	3.12	3.15
Index, %	100.00	96.89	97.82

Different selenium levels had no significant influence on body mass in any of the examined periods. A control group which received no addition of selenium in the diet had approximately the same body mass at the end of second period (91.23 kg), as did the groups fed selenium supplemented diet (92.30 and 94.30 kg respectively). Also, there were no significant differences ($P>0.05$) in average weight gain between the trial groups in any of the studied periods. Average daily weight gain during a whole period of research ranged from 0.651 to 0.679 g. However, there was a slight trend of increase in gilts weight gain in all studied periods as a result of increased selenium concentration in the diets.

Supplemented selenium resulted in more efficient feed consumption. The control group had greatest feed consumption/kg liveweight gain during the whole trial (3.22 kg), whereas groups fed 0.3 and 0.6 mg Se/kg diet had less feed consumption/kg liveweight gain (3.12 and 3.15 kg, respectively).

The effects of different dietary levels of organic selenium on its concentration in some tissues are shown in Table 2.

The highest selenium concentration in all studied tissues was observed in the kidneys. However, the established differences among groups were not statistically significant. As regards the liver, higher selenium levels in proportion to its increase in the diet, were observed and these differences were statistically significant ($P<0.01$). The lowest value was established in group I (0.337 mg/kg), and the highest in group III (0.511 mg/kg). In the heart muscle an increased level

of selenium was also observed and it was in proportion to its diet supplementation. The lowest content was observed in group I (0.180 mg/kg), and highest in group III (0.313 mg/kg). A substantially lower concentration of selenium was established in the leg and neck muscle. The lowest concentration in the leg and neck musculature was confirmed in gilts fed no additional selenium (0.093 and 0.090 mg/kg), and was the highest in animals fed 0.6 mg Se/kg diet (0.260 and 0.216 mg/kg, respectively).

Table 2. Effects of different dietary levels of selenium on its concentration in some tissues, mg/kg

Tissues	Group					
	I		II		III	
	mg/kg	%	mg/kg	%	mg/kg	%
Kidney	1.23	100	1.26	102	1.38	112
Liver	0.337[a]	100	0.424[ac]	125	0.511[c]	151
Heart	0.180[a]	100	0.224[ac]	124	0.313[c]	173
Leg musculature	0.093[a]	100	0.191[ac]	206	0.260[c]	279
Neck musculature	0.090[a]	100	0.164[ac]	182	0.216[c]	290

Differences between a and c statistically highly significant ($P<0.01$)

DISCUSSION

In our experiment it was established that selenium levels of 0.3 and 0.6 mg/kg diet had no significant influence ($P>0.05$) on body mass or daily average liveweight gain in any period studied, although we have observed somewhat higher body mass (1.17-3.36%) and higher liveweight gain (1.07-4.30%) in relation to animals fed no added selenium. Similar to our results, Mahan and Kim (1996) and Mahan *et al*. (1999) stated that supplementation with 0.1, 0.2 and 0.3 mg Se/kg in the form of Se-enriched yeast led to no increase in porcine liveweight gain. Also, Ku *et al*. (1973), Wilkinson *et al*. (1977) and Mahan and Parrett (1996) obtained similar results in their research. In a trial on calves and cows fed additional inorganic selenium, or Se-enriched yeast, Bruce (1997) and Gunter *et al*. (2002) established no significant differences in body mass in relation to animals whose diet contained no added selenium. On the contrary, Kim and Mahan (2001) stated that fortification 0.3, 3.0 and 7.0 mg/kg organic or inorganic selenium in gilts' diet led to a significant increase in bodyweight gain along with the increase of selenium dietary levels. This could be explained by very high selenium contents in diet which were even ten times higher in comparison with concentrations used in our research.

The efficiency of feed conversion during the whole period of our trial was similar in all groups. However, the highest feed conversion was in animals fed 0.3 mg Se/kg, whereas the lowest feed conversion was in animals fed no selenium

supplemented diets. In our trial, by increasing selenium dietary levels we have established no improvement in feed conversion. Similar results were obtained in a trial on pigs by Ku *et al*. (1973) and by Li and Wang (2004) in their trial on layers.

The content of selenium in internal organs and muscle tissue increased linearly with the increase of selenium dietary level. The greatest selenium content was established in kidneys, followed by liver and heart, whilst the lowest selenium content was observed in the leg and neck muscles. Selenium is stored primarily in kidneys since most of it is eliminated from the organism by urine. In animals fed diets containing 0, 0.3 and 0.6 mg Se/kg diet, selenium content in kidneys ranged from 1.23 to 1.38 mg/kg with no significant differences. The fact that the largest depots of selenium is in the kidneys is confirmed also by the results of Ku *et al*. (1973), Zachara *et al*. (1993), Mahan *et al*. (1999) and Pavlata *et al*. (2001). Selenium concentration in the liver was 3-4 times lower (0,337-0,511 mg/kg), and in the heart muscle even up to 6 times lower (0.180-0.313 mg/kg) in comparison with the kidneys. Among the examined groups a statistically significant difference ($P<0.01$) regarding the content of selenium in the liver and heart musle was established. In contrast to the kidneys, in the liver and heart musculature there is an increase of selenium level proportional with its concentration in the feed. Similar results were stated also by Ortman and Pehrson (1997), Knowles (1999) and Pavlata *et al*. (2001) in a trial on calves. Somewhat higher selenium concentrations were established in the liver of gilts (Mahan and Kim, 1996) and layers (Li and Wang, 2004). However, similar to our research results, certain authors suggest a significant increase in selenium level in the liver along with increasing dietary selenium.

Selenium concentration in the leg and neck muscle tissue was twice, and three times higher in gilts fed 0.3 and 0.6 mg Se/kg diet, in relation to animals receiving no additional selenium. A significant increase of selenium in the muscle tissue was established by Ku *et al*. (1973); Mahan and Kim, (1996) and Mahan *et al*. (1999) in pigs, and by Yaroshenko *et al*. (2005) in chicks. The results of Yaroshenko *et al*. (2004) suggest that adding 0.6 and 0.8 mg/kg organic selenium in the diet leads to a significant increase of its concentration in the breast (from 85.2 to 284.3 ng/g) and leg muscles (from 72.2 to 274.2 ng/g), in comparison with animals fed 0.1-0.2 mg Se/kg diet in the form of selenite.

Seko *et al*. (1989) and Spalholz (1994) established that inorganic selenium could have a harmful effect on muscle tissue. However, by the addition of organic selenium, seleno-aminoacids are being built into muscle proteins with no harmful effects on the quality of meat.

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UTICAJ RAZLIČITIH NIVOA ORGANSKOG SELENA NA TELESNU MASU, PRIRAST, ISKORIŠĆAVANJE HRANE I KONCENTRACIJU SELENA U POJEDINIM TKIVIMA KOD SVINJA

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SADRŽAJ

Trideset i devet nazimica starih 82. dana, podeljenih u 3 grupe, hranjeno je osnovnim obrokom dopunjenim sa 0, 0,3 i 0,6 mg Se/kg u obliku seleniziranog kvasca u toku 99 dana. Nivoi selena od 0,3 i 0,6 mg/kg hrane nisu doveli do značajnog povećanja prirasta i telesne mase ni u jednom ispitivanom periodu. Međutim, nazimice hranjene obrocima sa dodatkom selena (0,3 i 0,6 mg/kg) u toku celog perioda ispitivanja imale su nešto veću telesnu masu (1,17 i 3,36%, redom) i prosečan dnevni prirast (1,07 i 4,30%, redom). Dodati selen u hranu je uticao i na efikasnije iskorišćavanje hrane za 3,11 i 2,18%, redom.

Najveći sadržaj selena ustanovljen je u bubrezima, a zatim u jetri i srcu, a najmanji u butnoj i vratnoj muskulaturi. Koncentracija selena u bubrezima kretala se od 1,23 do 1,38 mg/kg i nisu ustanovljene statistički značajne razlike između ispitivanih grupa. U jetri, koncentracija selena je bila 3-4 puta niža, a u srčanoj muskulaturi čak i do 6 puta niža nego u bubrezima. Između ispitivanih grupa ustanovljene su statistički značajne razlike ($P<0,01$) u nivou selena u jetri i srčanoj muskulaturi. Najviši nivo ustanovljen je u grupi hranjene sa 0,6 mg Se/kg hrane i to u jetri 0,511, a u srcu 0,313 mg/kg. Koncentracija selena u butnoj i vratnoj muskulaturi bila je dva, odnosno tri puta veća kod nazimica hranjenih sa 0,3 i 0,6 mg Se/kg hrane u odnosu na grla koja nisu dobijala dodatak selena ($P<0,01$).