THE EFFECT OF VARIOUS FORMS (ORGANIC, INORGANIC - STANDARDIZED DOSE) OF SELENIUM ON THE LABORATORY VALUES OF THE EJACULATE OF BREEDING BOARS (BREED DUROC)

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Abstract

The experiment was based on feeding the organic and inorganic forms of selenium and the assessment of their effects on the laboratory values of the ejaculate (total count of sperm, sperm motility, ejaculate volume, sperm concentration and per cent of pathological sperm) in breeding boars. The experiment involved 18 boars breed Duroc divided into two equal groups. The individual groups received feed mixtures with the supplement of 0.3 Se/kg of feed mixture in organic form, and 0.3 Se/kg of feed mixture in inorganic form. The experiment lasted 20 weeks.

The selenium supplement significantly decreased the sperm concentration in boars supplemented by 0.3 mg Se/kg of feed mixture ($P < 0.05$) in inorganic form; this group of boars also had a lower total count of sperm produced ($P < 0.05$). Boars with an income of 0.3 mg Se/kg of feed mixture in an organic form had improved semen quality compared to inorganic forms

Key Words: Ejaculate, selenium, organic, inorganic, standardized dose, boar

Selenium is an essential element for pigs in reproduction. For many years selenium was regarded as a substance with toxic effects in livestock. Essentiality of selenium was discovered in 1957. This element plays an important role in the correct sequence of physiological functions, especially in high-production animals (Underwood and Suttle, 1999). Selenium occurs in all cells and body tissues; its content in an organism varies according to the amount of the element in the feed ration (Kim and Mahan, 2001). Selenium is a component of glutathione peroxidase enzyme, which counts among the most important antioxidants in animal bodies (Smith, 1979; Koller *et al.*, 1984). Shortage of selenium in the diet can cause sperm deformities and infertility in males (Wu, 1979). For the present, modern genotypes of breeding boars the recommended rate of selenium is 0.3 mg/kg feed mixture (NRC, 1998).

The objective of this experiment was a comparison of various forms of selenium and their effects on the laboratory values of the ejaculate of breeding boars.

Material and Methods

The experiment proper was conducted at the boar insemination station (BIS) in Velké Meziříčí (Czech Republic) and involved 18 boars (breed Duroc), which were divided into two equal groups according to age. The age of the boars varied from 1 to 3 years. The experimental animals were housed individually (2.5 x 2.5 m) and had ad-libitum access to water. All the animals were fed 3.3 kg of the basic feed mixture (Table 1 and 2) containing 0.02 mg Se/kg of feed mixture (FM). Energy content FM was 12.6 MJ/kg. The experiment involved two groups of animals. The first group (Se1) of boars (n = 9) were fed 0.3 mg Se/kg FM in organic form. The second group (Se2) of animals (n = 9) were fed 0.3 mg Se/kg FM in inorganic form. Sodium selenite was fed as inorganic source of selenium.

Table 1. The composition of the feed mixture for boars

Component	% in feed mixture
Barley grain	36.00
Wheat grain	20.36
Oat grain	20.00
SBM (soybean meal)	14.50
EKPO T	3.00
BergaFat	2.10
Calcium carbonate	1.50
Monodicalciumphosphate	1.20
Mineral vitamin premix for boars 0.5%	0.50
Sodium chloride	0.40
Magnesium oxide	0.15
L-Lysine HCl	0.14
L- Threonine	0.09
Methionine DL	0.06

Bergafat (Berg + Schmidt, Germany) – palm oil; EKPO T ((Delika – Pet, Czech Republic) – biscuit meal

To demonstrate spermatogenesis (ca 42 days) the experiment was established to last 20 weeks. The experiment was divided into five periods lasting 19, 31, 30, 31 and 31 days, respectively. Samples of boars' sperm were taken 4 times a month. The ejaculate was collected from the boars by means of a phantom. The veterinarian monitored the health condition of the animals.

Macroscopic and microscopic evaluation of the ejaculate was performed in the laboratory of the insemination station. The ejaculate volume was assessed using a graduated cylinder. Sperm motility was determined microscopically within 15 minutes of sampling using sperm that had been gently stirred; straight-line forward motion after the head was evaluated. Sperm concentration was determined by photometry using the Spekol 11 instrument. The per cent of pathological sperm was determined microscopically from the first sampling in the month. The results were evaluated statistically using the Statistika programme and the differences between the mean values were evaluated by the Student's t – test.

Results

In the course of the experiment we assessed the effect of supplementation of various forms of selenium (organic and inorganic) on the laboratory values of the ejaculate of breeding boars. During the experiment we collected data from laboratory evaluations of the boars' sperm. Tab. 3 show the average values of the monitored parameters, their statistical deviations and statistical correlations. From the table it is evident that statistical significance in sperm motility was not found in any of the monitored groups of animals. With the Se1 group of boars (organic form of selenium – 0.3 mg/kg FM) a slight decrease in sperm concentration by 10.0 % was observed at the end of the fifth period of the experiment. In the animals of the Se2 experimental group (inorganic form of selenium – 0.3 mg/ kg FM) a gradual decrease in sperm concentration was seen from the fourth period, by as many as 13.9 % ($P < 0.05$) at the end of the fifth period.

The volume of ejaculate in the Se1 group of boars did not reach any changes; the ejaculate volume in these animals was practically at the same level throughout the duration of the experiment. The second Se2 group of boars did not show significant changes, at the end of the experiment the increase was only 6.7 %. We recorded no significant difference with the S3 group of animals either; in the last period there was 5.1 % increase.

The total count of sperm in the boars of the S1 group decreased by 14.2 % (but no significant). A gradual decrease in the total count of sperm was seen in the S2 group of animals; in the fifth period the decrease amounted to 10.6 % ($P < 0.05$)..

The last indicator of ejaculate quality to be evaluated was the per cent of pathological sperm. In the first S1 group of boars an increasing trend was observed during the experiment, at its end the total increase by 25.3 % occurred. In the Se2 groups of boars no significant difference in the per cent of pathological sperm was discovered.

Table 2.The composition of premix for boars (0.5%)

Parameter	Unit	Quantity
Vit.A	U.I.	3.000.000
Vit.D3	U.I.	400.000
Alpha-Tocopherol	mg	20.020
Vit.B1	mg	500
Vit.B2	mg	1.200
Vit.B6	mg	800
Vit.B12	mg	6
Vit.K3	mg	600
Vit.C	mg	16.000
Biotine	mg	70
Folic acid	mg	200
Niacinamide	mg	8.000
Calcium pantothenate	mg	4.000
Choline chloride	mg	55.200
Betaine	mg	26.500
Lysine in the form of L-Lysine monohydrochloride	g	225.79
Butylhydroxi-toluene	mg	400
Ethoxyquin	mg	179.82
Cu - in the form of copper sulfate pentahydrate	mg	2.882.82
Zn – in the form of zinc oxide	mg	19 976
Mn – in the form of manganese oxide	mg	19 759
Fe – in the form of iron carbonate	mg	23.624
Co – in the form of cobalt sulphate heptahydrate	mg	91.35
I – in the form of potassium iodide (KI)	mg	229.20
Carrier ad. – wheat meal, calcium carbonate	Kg	1

Table 3. Representation of changes in the laboratory values of the ejaculate in boars of the groups Se1 (0.3 mg Se/kg FM organic form) and Se2 (0.3 mg Se/kg FM inorganic form)

Group	Period	Average number of samplings per one boar		Ejaculate indicators			
			Total count of sperm (bill.)	Sperm motility (%)	Ejaculate volume (ml)	Sperm concentration (ths/mm^3)	Pathological sperm (%)
Se1	I.	2.3	104.6 ± 38.1	72.3 ± 3.9	255.8 ± 79.3	426.9 ± 141.7	7.9 ± 3.0
	II.	3.2	118.9 ± 32.2	71.7 ± 3.6	246.6 ± 66.8	504.6 ± 169.5	7.7 ± 4.9
	III.	3.5	108.6 ± 27.0	69.7 ± 2.9	253.8 ± 85.5	462.4 ± 157.2	8.2 ± 5.0
	IV.	3.3	90.3 ± 23.8	69.2 ± 8.1	252.7 ± 88.9	402.7 ± 160.3	7.1 ± 6.2
	V.	3.4	89.7 ± 32.4	71.6 ± 3.5	259.3 ± 92.0	384.2 ± 163.3	9.9 ± 5.2
Se2	I.	2.2	98.2 ± 31.2	72.7 ± 3.6	247.3 ± 73.5	402.6 ± 124.9	9.0 ± 5.9
	II.	3.2	101.9 ± 27.9	71.4 ± 5.0	232.5 ± 47.4	451.4 ± 138.0	7.2 ± 3.0
	III.	3.0	95.9 ± 22.3	69.7 ± 10.3	249.5 ± 81.7	414.1 ± 137.4	8.1 ± 4.9
	IV.	3.1	94.1 ± 21.6	72.7 ± 2.4	250.8 ± 66.3	388.9 ± 176.8	8.1 ± 5.7
	V.	3.7	87.8 ± 18.0 ^{x}	69.5 ± 10.8	263.9 ± 70.3	346.7 ± 114.4 ^{x}	9.9 ± 6.5

Discussion

Marin-Guzman *et al*. (1997) conducted an experiment with 192 adult cross-bred boars ([Landrace x Yorkshire] x Duroc) divided into two groups for 16 weeks. The first group of animals served as control group without selenium supplement, the second, experimental group had selenium supplemented in the feed ration in the amount of 0.5 mg/kg FM in organic form (yeasts fortified with selenium). The authors recorded an increase in ejaculate volume by 25.7 % ($P < 0.05$), sperm concentration by 14.7% and sperm motility by 31.3% ($P < 0.01$) as against the control group of boars. Three years later also Marin-Guzman *et al.* (2000) carried out a similar experiment, in which they compared a group supplemented with 0.5 mg Se/kg FM (in organic form) with the control group of boars receiving no selenium supplement. Selenium was fed as early as of the 28th day of age of the animals. The objective of the researchers was to find out what would be the impact of this feed intervention on the spermatogenesis in the individual life periods of the boars. During the experiment the boars were killed and their reproductive systems properly analysed. In boars receiving selenium supplement in their diet the sperm concentration was significantly increased in the 9th month ($P < 0.05$) and the 18th month ($P < 0.01$). In the 5th and 6th months of the boars' age there was no significant difference between the groups. Kolodziej *et al*. (2005) also arrived at the conclusions that the 0.5 mg Se/kg FM supplement (in organic form) caused a significant rise in the sperm concentration by 29.7% ($P < 0.05$) and a decrease in the per cent of pathological sperm by 46.7% ($P < 0.05$) as compared to the control group, in the feed ration of which selenium was only contained from native sources (0.2 mg/kg FM). On supplementing organically bound selenium in the amount of 0.5 mg/kg FM Groenewegen *et al.* (2006) ascertained an increase in sperm concentration by 11.1% in relation to a higher production of insemination rations (by 9.7%). No significant differences in the motility and ejaculate volume were found by this collective of authors. As our experiment did not involve a group of boars receiving no selenium supplement, the differences in the motility and concentration of sperm were not as significant.

Conclusion

In the experiment involving 18 boars we compared the effect of organic and inorganic forms of selenium on the changes in the laboratory values of the ejaculate of breeding boars (breed Duroc).

The selenium supplement significantly decreased the sperm concentration in boars supplemented by 0.3 mg Se/kg of feed mixture ($P < 0.01$) in inorganic form; this group of boars also had a lower total count of sperm produced ($P < 0.01$). Boars with an income of 0.3 mg Se/kg of feed mixture in an organic form had improved semen quality compared to inorganic forms.

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