THE EFFECT OF VARIOUS FORMS (ORGANIC, INORGANIC - HIGH 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 0.6 mg Se/kg of feed mixture in organic form, and 0.6 mg Se/kg of feed mixture in inorganic form. The experiment lasted 20 weeks.

The group of boars receiving the inorganic selenium supplement of 0.6 mg/kg of feed mixture had a lower sperm concentration ($P < 0.05$); however ejaculate volume increase ($P < 0.05$) occurred at the same time. In our experiment the groups of boars receiving the selenium supplement of 0.6 mg/kg of feed mixture in both organic and inorganic form had the most equal values of the total count of sperm produced. Selenium in organic form (higher dose) may improve semen quality in breeding boars.

Key Words: selenium, ejaculate, , organic, boar

Selenium is an essential element for reproduction of boars Kryštofová et al (2010), in spite of the fact that selenium has been considered as a substance causing toxicity in livestock for many years. The necessity of selenium was discovered in 1957. Selenium plays an important role in the correct sequence of physiological functions, especially in farm animals. Selenium is a component of the enzyme glutathione peroxidase, which is one of the most important antioxidants in animals and marker of oxidative stress (Pavlata et al, 2011).Imbalance between reactive oxygen species and total antioxidant capacity can cause male infertility (Drevet et al. 2012). Selenium as a component of glutathione peroxidase protects spermatozoa, spermatogonia and sperm cells themselves against the free oxygen radicals (Noblanc et al, 2011). In addition, it plays crucial role during the process of spermatogenesis (Horký et al, 2012). Therefore, it is not surprising that selenium is essential for the sperm cells, because it provides their viability, motility and generally total fertility of males. Selenium itself influences not only the quality of ejaculate of boars, but participates in the reproduction processes of gilts Selenium deficiency in the diet leads to the decline of ejaculate quality, which causes deteriorated fertilizing ability (Camejo et al, 2011).

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, which were divided into four 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 four groups of animals. The first group (Se1) of boars (n = 9) were fed 0.6 mg Se/kg FM in organic form. The second group (Se2) of animals (n = 9) were fed 0.6 mg Se/kg FM in inorganic form. Yeast supplemented with selenium was used for complementing of selenium in organic form.

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. Table 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.

Throughout the entire experimental period there were no significant changes in sperm concentration in the Se1 group of boars (organic form of selenium – 0.6 mg/kg FM); at the end of the experiment the decrease was only 0.8 %. With the last, fourth Se2 group of experimental animals (inorganic form of selenium – 0.6 mg/kg FM) a gradual decrease in sperm concentration in the ejaculate occurred; in the fourth period this decrease amounted to 9.5 % ($P < 0.05$) and in the fifth period to 14.4 % ($P < 0.05$). Simultaneously with the decreasing sperm concentration the ejaculate volume increased; in the fourth and fifth period we measured an increase by 20.7 % ($P < 0.05$) and 17.3 % ($P < 0.01$) respectively. The volume of ejaculate in the Se1 group of boars did not reach any changes. We recorded no significant difference with the S1 group of animals either; in the last period there was 5.1 % increase. The Se1 and Se2 groups of boars had the most equal total count of sperm produced throughout the experiment with no significant differences.

The last indicator of ejaculate quality to be evaluated was the per cent of pathological sperm. Se1 and Se2 groups of boars no significant difference in the per cent of pathological sperm was discovered.

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

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 (0.6 mg Se/kg FM organic form) and Se2 (0.6 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.	2.4	92.0 ± 17.0	71.2 ± 2.6	208.4 ± 51.4	460.4 ± 116.9	10.9 ± 6.2
	II.	3.1	104.5 ± 17.0	71.7 ± 73.2	205.1 ± 45.3	515.7 ± 88.7	7.6 ± 4.1
	III.	3.2	91.6 ± 13,5	70.1 ± 9.1	203.7 ± 63.9	483.3 ± 140.2	10.5 ± 5.6
	IV.	3.5	99.5 ± 27.3	70.1 ± 9.1	217.5 ± 60.7	477.1 ± 125.6	11.5 ± 6.2
	V.	3.6	95.7 ± 28.9	68.3 ± 12.9	219.1 ± 55.9	456.5 ± 153.4	10.7 ± 7.9
Se2	I.	2.1	95.7 ± 33.4	70.9 ± 1.9	229.8 ± 67.0	440.7 ± 152.6	5.7 ± 3.9
	II.	3.3	97.1 ± 28.6	71.5 ± 2.7	250.7 ± 44.1	401.0 ± 144.7	7.1 ± 5.1
	III.	3.3	104.1 ± 42.9	69.8 ± 3.1	223.9 ± 49.0	477.9 ± 188.6	9.5 ± 5.7
	IV.	3.2	102.4 ± 31.0	70.6 ± 4.0	277.4 ± 76.5 ^{x}	399.0 ± 162.2 ^{x}	11.5 ± 7.9
	V.	3.4	95.8 ± 34.2	69.7 ± 7.3	269.6 ± 67.5 ^{xx}	377.4 ± 175.9 ^{x}	10.1 ± 9.9

^{x} - Symbol expressing statistically significant changes (as against period I, i.e. the start of the experiment) $P < 0.05$ ^{x}; $P < 0.01$ ^{xx}

Discussion

A similar experiment to ours was carried out by López *et al.* (2010). Group of boars A received the supplement of 0.4 mg Se/kg FM (inorganic form) in their feed ration. Group of boars B were supplemented with selenium in the amount of 0.4 mg Se/kg (organic form). Group of animals B had significantly higher sperm concentrations ($P < 0.05$) as against group A. We did not succeed in corroborating this result; with both groups of animals supplemented with the organic form of selenium no increase in sperm concentration was observed. The evaluation of the sperm motility by the above collective of authors showed a lower sperm motility with boars of group B, albeit without statistical significance. From our monitoring these conclusions are not quite evident; in the Se1 and Se3 groups of boars we observed an decrease in sperm motility by 2.9 % resp. 1.2. In the research by Jacyno *et al.* (2002) three groups of boars were supplemented with selenium in the amounts of 0.2 mg/kg FM in inorganic form (group I), and 0.2 and 0.4 mg Se/kg FM in organic form (groups II and III). In their evaluation of the ejaculate volume the researchers observed an increase ($P < 0.01$) in both groups supplemented with the organic form of selenium. Also in our experiment the ejaculate volume increased ($P < 0.01$), yet the increase was found in the group of boars receiving selenium in inorganic form (0.6 mg/kg FM). Furthermore, this collective of authors recorded no differences in sperm motility; the values ascertained by them between the experimental groups (72.1 – 73.3%) come close to our results, in which the motility between the groups was from 68.3 to 72.7%. The results of Jacyno *et al*. (2005) suggest an increase in sperm concentration and a decrease in per cent of pathological sperm in the groups of boars II ($P < 0.01$) and III ($P < 0.05$) as against group I. After their 13-week experiment Fernandez *et al.* (2008) came to the conclusion that supplementation with organic selenium at the rate of 0.5 mg/kg FM significantly increased motility and concentration of sperm in comparison with the group of boars that were receiving only 0.025 mg Se/kg FM from native sources. After the completion of their experiment two boars from each group were castrated and their testicles microscopically assessed. The group of animals receiving selenium in their diet had more developed seminiferous tubules than the group of boars without selenium supplementation.

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 group of boars receiving the inorganic selenium supplement of 0.6 mg/kg of feed mixture had a lower sperm concentration ($P < 0.05$); however ejaculate volume increase ($P < 0.01$) occurred at the same time. In our experiment the groups of boars receiving the selenium supplement of 0.6 mg/kg of feed mixture in both organic and inorganic form had equal values of the total count of sperm produced.

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