

DZIMUMHORMONU KONCENTRĀCIJAS PAAUGSTINĀŠANAS IESPĒJAS ASINĪS VAISLAS KUIĻIEM

POSSIBILITIES OF RAISING THE CONCENTRATION OF SEXUAL HORMONES IN THE BLOOD OF BREEDING BOARS

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ABSTRACT

The aim of the study was to investigate the influence of feed components containing ω -fatty acids on the boars testosterone (T) and oestradiol-17 beta (E) concentration of blood in the sexual hormone activity reduced period (April- June) and the influence of one hour transportation on the boars' sexual hormones concentration of blood. The experiment was performed with 10 boars in the company of artificial insemination. In the identical dates of 2010 and 2011 serum samples were analyzed for: T, E, total cholesterol, HDLH and LDLH and quality of boars' ejaculate. There were positive effect of omega fatty acids on boars' serum T, E and HDLH concentration and negative influence on the total cholesterol and LDLH levels. One hour quiet transportation promotes for a short period a significant ($p < 0.05$) elevation of serum T and E for pen kept boars'.

KEY WORDS: boar, testosterone, transportation stress, ω -fatty acids.

INTRODUCTION

Testosterone (T) is a steroid hormone from the androgen group. In mammals, T is primarily secreted in the testicles of males, although small amounts are also secreted by the cortex of adrenal glands. It is the principal male sex hormone and an anabolic steroid. Androgen hormones play an important role in reproduction functions (development of male secondary sex characteristics), stress and inflammatory responses, behavior and some metabolic processes, e.g. activate DNA for protein synthesis in muscles (Zitzmann, Nieschlag, 2001).

The Leydig cells in the interstitial tissue of testis are synthesis T from cholesterol (mostly from the high density lipoprotein cholesterol - HDLH). Biologically, T is largely bound to plasma proteins, only 1 - 2 % being free, 40 - 50% being loosely bound to albumin, and 50-60% being specifically and strongly bound to the sex hormones-binding globulins (SHBG). Serum free T and albumin- bound testosterone represent the fractions readily available for biological action (Joshi, Parle, 2006).

Environmental and feeding factors are affecting T levels of boars. Seasonal variations affect levels of testicular steroids- T decreases when day length increases. T levels have been higher for higher range and heavier entire male pigs, too (Giersing et al., 2000; Zamaraskaia, 2004). Feeding low protein diets, especially when energy intake is also reduced, has been shown to significantly reduced boar interest in mounting a dummy sow. Breeding performance is reduced due to decreased level of the hormone oestradiol-17beta in blood (E) (Louis et al., 1994).

Comparing total serum T levels in omnivorous man and those on a vegetarian diet showed no differences, but in the latter group there were significantly higher levels of SHBG, leading to a decreased levels of bioavailable T. The kind of diet mostly influences the fraction

of bioavailable T, but not the total level of this hormone (160 - 165). T concentrations had a persistent positive association with HDLH ($t = 3.5$; $p < 0.001$) (Heller et al., 1983).

Omega-3 (polyunsaturated) fatty acids include linolenic, eicosapentaenoic (EPA), and docosahexaenoic (DHA) fatty acids. Pig spermatozoa contain large amount of DHA, suggesting that DHA is most likely an essential component for optimal boar fertility (Reese, 2003). The inclusion of omega-3 fatty acids via fish oil in the diet of boars for 6 - 12 weeks indicate that DHA concentration in spermatozoa can be increased with dietary fish oil supplementation (Paulenz et al., 1999; Rooke, Speake, 2001). Corn-soybean meal diets contain very little omega-3 fatty acids. Linseed and canola are excellent sources of linolenic acid, while fish oils are the only dietary sources of EPA and DHA (Reese, 2003).

Depending on the kind of stressors (positive or negative), the stress release can have an elevating or reducing effect on the androgen level in blood (Zitzmann, Nieschlag, 2001). Strength training for men can have an acute effect on endocrine functions. Measurements immediately and 5 minutes post-exercise show an age dependent increase in T levels (Kraemer et al., 1992). Studies have reported negative relationships of resting T levels and certain stress hormones (i.e., cortisol and prolactin) in humans - endurance-trained males (Key et al., 1990). But there is significantly ($p < 0.05$) elevated T and cortisol level at 30 minutes resting period after endurance-trained males (Daly et al., 2005).

Serum T levels are influenced by conditions which are partly due to control by the hormone itself, but are also affected by conditions which are beyond individual or hormonal control (Zitzmann, Nieschlag, 2001).

The aim of our study was to investigate: 1) the influence of food components containing ω -fatty acids on the boars T and E concentration of blood in the sexual hormone activity reduced period (April- June); 2) the influence of one hour transportation on the boars' T and E concentration of blood.

MATERIAL AND METHODS

The study was carried out in the company of artificial insemination in two parts: 1) in 2010 and 2011, nutrition of breeding boars was changed: there were included food components containing ω -fatty acids for the improvement of the boars breeding ability; 2) in May 2012, breeding boars were transported to the new facilities for 60 kilometers.

In the first part of experiment, 10 boars venous blood samples were obtained for detection of serum cholesterol fractions, T and E levels in identical periods of the year 2010 and 2011: at 8:30 a.m. on April 12, April 29, May 25 (one more time on 30.06.2010). Until 25.05.2010, boars received 3 kg barley meal, 220 g feed additives (50% protein), 100 g minerals and vitamins. At this time, a reduction tendency of boars ejaculate volume, concentration of spermatozoa, testosterone and oestradiol-17beta level ($p > 0.05$) were detected. Since 25.05.2010, 20 ml linseed oil and 250 g linseed cake had been added to the feed ration. In 2011, the boars ration all the time contained: 1.9 kg barley meal, 0.6 kg wheat meal, 0.1 kg corn meal, 0.3 kg soy cake, 20 ml fish oil, 60 g fish meal, 100 g minerals and vitamins. At this time boars' ejaculate volume, concentration and activity of spermatozoa was also analyzed.

In the second part of the study (in the year 2011) five boars venous blood samples were obtained three times for detection of cholesterol fractions, T and E beta concentration: first time - on May 2 (just before transportation); second time - on May 5 (3 days after transportation) and third time - on May 11 (9 days after transportation). All data were statistically analyzed by SPSS 11.5.

RESULTS AND DISCUSSION

In previous years studies were detected seasonal reduction of T and E levels in serum of breeding boars. In the period 21.03.2011 - 12.04.2011 T fell from 4.67 ± 1.83 ng/ml to 3.12 ± 1.37 ng/ml ($p < 0.05$). On 25.05.2010, for improvement breeding ability in feed ration of boars were included linseed oil and cake for 35 days. In result, an increase in the serum testosterone and estradiol-17beta concentration ($p = 0.07$) was recognized (Figure 1 and 2), and insignificant improvement of ejaculate volume and reduction of concentration of spermatozoa was also detected. It means that linseed cake and oil additives can improve levels of boars' sex hormones at seasonal depression of breeding ability.

In 2011, the nutrition of boars was altered with adding more ω -fatty acids containing feed components (fish oil and meal, corn meal and soy cake) which caused similar and more notable differences in T and E levels of boars compared to that of the year 2010, especially on April 12 and May 25, 2011, when differences were significant ($P < 0.05$) (Figure 1). T level was 1.83 ± 1.32 ng/ml and E was 85.7 ± 44.45 pg/ml on 12.04.2010. T was 3.12 ± 1.37 ng/ml and E was 131.0 ± 47.86 pg/ml on 12.04.2011. T concentration was 0.89 ± 0.56 ng/ml and E was 84.7 ± 23.94 pg/ml on 25.05.2010. T level was 2.95 ± 2.15 ng/ml and E was 165.5 ± 76.18 pg/ml on 25.05.2011. The reduction of mean T concentration on 29.04.2011 could be associated with restriction of high energetically nutrients in ration preparing boars for transportation to the new facilities on 02.05.2011. At the same time, the concentration of E did not fell.

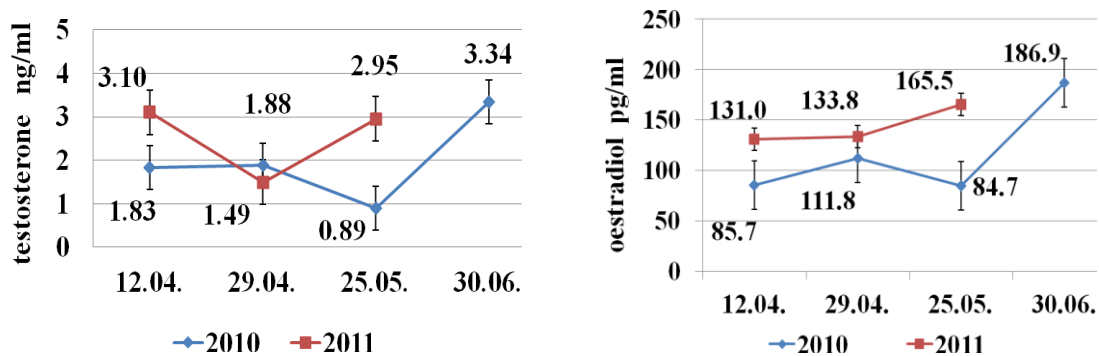


Figure 1. Dynamics of serum testosterone and oestradiol-17beta concentration of the breeding boars in 2010 and 2011.

In boars, fed like vegetarians, have not animal originating proteins. This could be a reason why all boars have the total cholesterol level below serum biochemical references range (2.1 - 3.5 mmol/l) (Cynthia, Scott, 2005). The total cholesterol concentration of serum in experimental boars range from 0.77 to 1.83 mmol/l. In 2011, levels of blood total cholesterol were insignificantly lower, but concentration of HDLH - insignificantly ($p > 0.05$) higher than in 2010. On 25.05.2011., was recognized significantly ($p < 0.001$) lower concentration of blood low density lipoprotein cholesterol (LDLH) than one year before, without feed additives of omega fatty acids in the ration of boars. There were established low positive correlation between HDLH and total testosterone concentration ($r = 0.31$; $p < 0.05$). It means that feeding fish oil and meal, corn meal and soy cake lowered the total cholesterol concentration and gave higher HDLH level than feeding linseed products alone. Synthesis of boars' sex hormones depends more on the concentration of HDLH not on the total cholesterol of serum. These results are similar with investigations of R.F. Heller (1983).

Three days after one hour quiet transportation of boars to the new facilities (on 05.05.2011) we established a significant ($p < 0.05$) elevation of serum T level (from $1.45 \pm$

0.70 ng/ml to 4.99 ± 3.70 ng/ml) and E concentration (from 120.6 ± 58.76 pg/ml to 254.8 ± 108.49 pg/ml), with a following a significant reduction ($p < 0.05$) one week later, respectively, T level was 2.83 ± 1.52 ng/ml and E concentration was 161.4 ± 92.52 pg/ml (Figure 2). The reason might be the influence of positive stressors to physiological processes of boars. They did not have possibilities to move out of the pen in the old pigsty. At the time of transportation they had moderate physical exercises which improved metabolism and synthesis of boars' sex hormones. After arrival, they did not have any more possibilities to take a walk, and the serum T level decreased again. Ration of boars was identical as in old facilities. It is essential to provide regular walking every day for support of boars breeding ability.

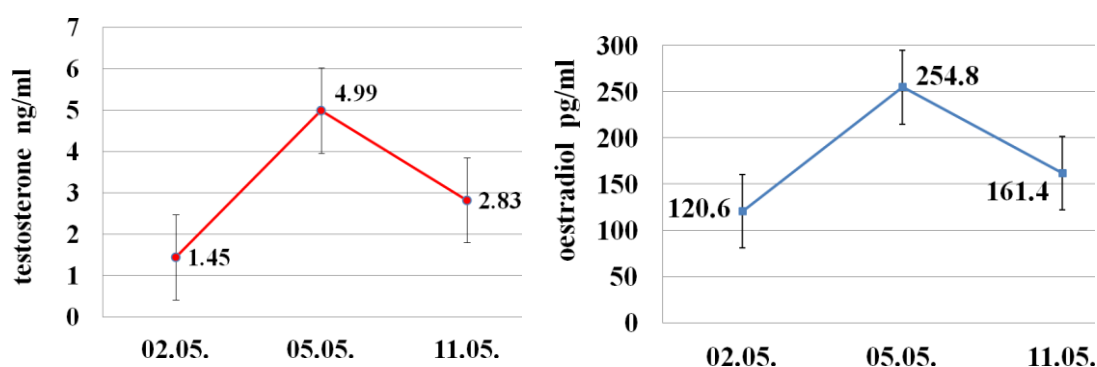


Figure 2. The transportation stress induced dynamics of serum testosterone and oestradiol-17beta concentration of the breeding boars in 02-11 May, 2011.

CONCLUSIONS

1. Feed additives containing omega fatty acids improve boars testosterone and oestradiol-17 beta levels of serum in the seasonal sexual hormone activity reduced period.
2. One hour transportation significantly ($p < 0.05$) elevates the serum testosterone and oestradiol-17beta levels of boars due to deficiency of regular physical exercises (like walking) in the previous pigsty.

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