

The effect of vitamin E supplementation on the libido and reproductive capacity of Large White boars

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Abstract

In this study the effect of dietary supplementation of vitamin E on libido, servicing capacity (SC), sperm quality and serum α -tocopherol of Large White boars was evaluated. Twenty four boars were divided into three groups of eight boars each. Groups were randomly allocated to treatment groups, i.e. 0, 40 or 70 IU of dl- α -tocopheryl acetate/kg of diet. Libido was defined as the time from intromission to ejaculation being recorded as the reaction time (RT) in minutes. Serving capacity (SC) was measured by number of mounts, combats, head-kicks, anogenital sniffs during a 30 min test period. Semen was collected by the use of an artificial vagina following the SC test, and afterwards analyzed for quantitative and qualitative parameters. The 70 IU supplementation of dietary vitamin E per kg diet to pigs resulted in the highest number of mounts, combats, head-kicks and anogenital sniffs with the shortest RT in comparison to the 40 and 0 IU vitamin E supplementation. The 70 IU vitamin E boar group produced semen with the highest semen volume, sperm cell motility, progressive movement, acrosomal normal apical ridge (NAR), percentage live sperm, sperm concentration per mL semen volume and total number of sperm per ejaculate and improved serum α -tocopherol concentrations ($5.1 \pm 0.5 \mu\text{g/mL}$). Results suggest that supplementing 70 IU per kg α -tocopheryl acetate in boar diets appears to be most beneficial in optimizing libido and reproductive capacity in breeding boars.

Keywords: Boars, dl- α -tocopheryl acetate, reaction time, servicing capacity, sperm viability

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Introduction

It has been suggested that vitamin E is an essential nutrient that should be included in pig diets (McDowell, 2002; Umesiobi, 2009) to enhance body immunity (Giguère *et al.*, 2002), metabolism (McDowell, 2002) and reproduction (Umesiobi, 2009). In addition vitamin E improves spermatogenesis and semen quality (Marin-Guzman *et al.*, 2000; Wallock *et al.*, 2001; Wilson *et al.*, 2001) and possibly the fertilization of oocytes in the female (Umesiobi, 2009).

However, the optimal level of vitamin E needed to improve the function of the reproductive system in boars seems to be highly variable, mostly because of several factors such as the composition of the diet, feed consumption (Umesiobi, 2009), growth rate (McDowell, 2002) and husbandry conditions or stress (Flowers, 2002) which exert some influence on conception rate and litter size. In this study, the effect of dietary supplementation of vitamin E on libido, as observed through reaction time (RT), servicing capacity (SC), sperm quality and serum α -tocopherol concentration in boars, was investigated.

Materials and Methods

Thirty Large White boars were randomly chosen and maintained for breeding experiments at a commercial pig unit at Tierpoort near Bloemfontein in the Free State Province. Tierpoort is situated at an altitude of 1351 m, 29°06' latitude South and 26°18' longitude East.

At three months of age at a live weight of approximately 30 kg, boars were divided into three groups. Groups were randomly allocated to the treatment groups. The treatments consisted of three levels of vitamin E supplementation, i.e. 0, 40 or 70 IU dl- α -tocopheryl acetate/kg of diet. The treatment diets were provided following the procedures of Marin-Guzman *et al.* (2000) and Umesiobi (2009). The composition of the diets used in the trial is presented in Table 1.

Table 1 The composition of diets fed to boars at different growth stages (BW = body weight)

Ingredients	30 - 130 kg BW ^a	≥ 130 kg BW ^b
Maize meal (%)	75.3	65.9
Soybean meal (45% CP)	20.0	25.0
Lard	-	4.5
Dicalcium phosphate	2.6	2.5
Limestone	0.75	0.75
Selenium premix	0.15	0.15
Trace minerals	0.50	0.50
Vitamin premix	0.20	0.20
Vitamin E premix ^c	+	+
Antibiotics	0.50	0.50

^aCalculated analysis: 165 g CP, 9.5 g lysine, 10 g Ca, 8 g P/kg diet.

^bCalculated analysis: 140 g CP, 6.5 g lysine, 10 g Ca, 8 g P/kg diet.

^cVitamin E premix contained 44000 IU dl- α -tocopheryl acetate/kg diet and was added at the appropriate level to supply: 40 or 70 IU dl- α -tocopheryl acetate/kg of the diet at the expense of maize meal.

Libido was recorded during a 30-min pen test as the time from intromission to ejaculation following a 30 min of sexual restraint (recorded time in minutes).

A total of 960 ejaculate samples were collected with the gloved hand method from 24 boars (32 ejaculates per boar) immediately after libido tests. Semen was tested for total volume, percentage of progressively motile sperm, normal acrosome, live sperm, sperm concentrations and spot examination of sperm motility at X400 magnification using clean pre-heated microscope slides. Motility was evaluated in two ways: (1) as a percentage of progressively moving sperm using phase-contrast microscopy and (2) by type of sperm movement, graded on a scale of 0 - 9. Acrosome integrity was assessed according to the guidelines described by Foote (2003) and rated as normal apical ridge (NAR), damaged apical ridge (DAR), missing apical ridge (MAR) or loose acrosomal cap (LAC).

Immediately after sexual capacity tests, all the boars (n = 24) were bled (8 mL/boar) by puncturing the jugular vein or the anterior vena cava (Giguère *et al.*, 2002). The blood was collected in a glass container once per week for 32 weeks to evaluate haematological, α -tocopherols and selenium (Se) concentrations. Aliquots of the blood samples (lymphocytes and neutrophils) were analyzed with the procedures of Marin-Guzman *et al.* (2000). The selenium level was determined with the method of Mahan (1994) using a spectrofluorometer.

Statistical analyses were performed using the General Linear Model procedure (McDonald, 2008). Differences between treatment means were tested for significance using the procedures of McDonald (2008).

Results and Discussion

Supplemental vitamin E levels affected ($P < 0.01$) boar libido as indicated by the reaction time (RT) and respective reproductive indices. Boars fed with 70 IU/kg of vitamin E supplemented diet attained faster reaction time, more mounts, combats, head-kicks and anogenital sniffing than boars in 0 and 40 IU/kg of vitamin E supplementation groups (Table 2). This result supports the hypothesis that higher levels of dietary vitamin E supplementation to boars stimulate their underlying sexual motivation, and provides a meaningful measure of mating competence in boars (Jacyno & Kawecka, 2002).

Table 2 Effects of various levels of dietary vitamin E supplementation to boars on (mean \pm SE) reproductive capacity tests exemplified by reaction time, agonistic behaviour and anogenital sniffs

Parameters	Levels of vitamin E supplementation (IU/kg diet)		
	0	40	70
Reaction time/30 min (min)	15.2 ^a \pm 5.1	7.5 ^b \pm 0.6	2.2 ^c \pm 0.8
Mounts (frequency)	4.9 ^a \pm 0.7	8.7 ^b \pm 3.1	10.4 ^c \pm 3.1
Combats (frequency)	2.7 ^a \pm 0.5	3.9 ^b \pm 0.1	6.8 ^c \pm 0.5
Head-kicks (frequency)	4.6 ^a \pm 3.4	6.2 ^b \pm 6.3	10.4 ^c \pm 7.1
Anogenital sniffs (bout frequency/30 min)	7.2 ^a \pm 1.9	9.5 ^b \pm 0.5	12.6 ^c \pm 0.8

^{a, b, c} Means within rows with different superscripts differ at $P < 0.01$.

The study indicated that vitamin E supplementation resulted in improved ($P < 0.05$) ejaculate volume (Table 3), mostly in boars fed with 70 IU/kg of vitamin E supplemented diet. These values are in agreement with the reports that the quantity of semen produced by male animals is not only dependent on the amount of sexual excitement but also upon a number of other factors, such as the dietary regimen (Wilson *et al.*, 2001; Umlesiobi 2009) and ejaculation frequency (Flowers, 2002).

Table 3 Effects of various levels of dietary Vitamin E supplementation to boars on (mean \pm SE) semen viability and acrosomal integrity

Parameters	Levels of vitamin E supplementation (IU/kg diet)		
	0	40	70
Ejaculate volume (mL)	133.3 ^a \pm 4.1	278.4 ^b \pm 2.7	340 ^c \pm 2.5
Sperm motility (%)	72.5 ^a \pm 0.4	80.7 ^b \pm 0.9	89.3 ^c \pm 0.3
Progressive movement (scoring 0- 9)	5.3 ^a \pm 0.9	6.4 ^b \pm 0.4	8.1 ^c \pm 0.5
Normal acrosomal apical ridge (%)	75.4 ^a \pm 0.5	81.2 ^b \pm 6.5	98.1 ^c \pm 7.3
Live sperm (%)	75.5 ^a \pm 0.2	79.3 ^b \pm 0.5	92.3 ^c \pm 0.8
Sperm concentration (X 10 ⁶ /mL)	411.9 ^a \pm 63.2	450.2 ^b \pm 60.1	585.8 ^c \pm 51.6
Total sperm count (X 10 ⁹)	50.8 ^a \pm 2.9	60.6 ^b \pm 2.2	86.6 ^c \pm 3.7

^{a, b, c} Means within rows with different superscripts differ at $P < 0.05$.

Supplementing boars' diet with vitamin E produced significant effects in semen viability and normal acrosome, with the highest values recorded in 70 IU/kg supplementation boar group. These results are in line with Marin-Guzman *et al.* (2000) who found that high levels of dietary vitamin E supplementation effectively prevented the sperm from changing in morphological structure and acrosomal defects, possibly because vitamin E acts as an intracellular antioxidant (McDowell, 2002). It also acts as a precursor to certain thromboxanes, prostaglandins, leukotrienes and immunoglobulins, which consequently promote spermatogenesis and acrosomal integrity (Umlesiobi, 2009).

The significant increases noticed in the serum α -tocopherol concentrations in boars with the body weight of 130 and 200 kg (at approximately 1 - 1.5 years of age) supports the reports by Tao *et al.* (2004) who indicated that concentrations of plasma α -tocopherol were higher in pigs with a prolonged feeding of vitamin E supplemented diets. The activity of the selenium in the serum of 30 kg (3 month-old) boars was very low despite the fact that the boars' feed had been supplemented with 0.15 mg selenium/kg. This record supports Marin-Guzman *et al.* (2000) who noted that due to the inherently low levels of selenium in the serum of younger pigs, the selenium status of younger boars might be more critical for their health than their vitamin E profile.

Conclusion

The results of this study indicate that feeding boars with diets supplemented with vitamin E is a practical method for optimising libido, servicing capacity and sperm viability in breeding sires. Boars receiving diets supplemented with 70 IU of vitamin E/kg feed had the shortest reaction time, highest number of mounts, combats, head-kicks, anogenital sniffs and optimum semen quality in comparison to boars receiving diets with 0 and 40 IU vitamin E/kg feed. It is recommended that routine checks be conducted to determine the Se levels in the serum of young pigs. More so, since vitamin E and selenium act synergistically, vitamin E supplementation does not completely eliminate the need for selenium in the diets of pigs.

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