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Effects of Diminazene Aceturate and Ivermectin Administration on Semen and Serum Parameters of the Red Sokoto Buck

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ABSTRACT

Twenty seven red Sokoto bucks, at the age of 2 years and weighing between 32–34kg were used. After administration of the drugs, semen and sera samples were collected 1, 24, 72, and 192 hours for analysis. The parameters studied namely semen volume, percentage motility of sperm, sperm concentration, live sperm percentage, semen glucose level, serum testosterone and serum follicle stimulating hormone were found to decrease significantly ($P<0.05$) when compared with the pre treatment group throughout the collection period. However, the drugs did not affect the live sperm percentage and ivermectin did not affect semen glucose level. A relationship was established between spermatological characteristics and serum testosterone and follicle stimulating hormone levels. These findings indicate that the drugs investigated in this study decreased semen parameters and serum testosterone and follicle stimulating hormone. It was concluded that diminazene aceturate and ivermectin should be used cautiously in red Sokoto bucks meant for breeding due to the deleterious effects they were observed to have on fertility parameters.

Keywords: Red Sokoto buck, Diminazene aceturate, Ivermectin, Semen, Serum.

INTRODUCTION

Goats are among the most important domestic farm animals in the world as a source of meat, milk, skin and wool[1]. In Nigeria, it has been estimated that there are about 34.5 million goats. The goat population in Nigeria makes it the second most important livestock specie[2]. Three main varieties of goats are recognized in Nigeria, the Sahel, desert or West African long-legged goat, the red Sokoto goat and the West African dwarf goat[3]. The red Sokoto goat is found throughout the sub-humid and semi arid zones of Nigeria. It is a medium sized breed with reddish-brown coat colour with a mature average live weight of 30kg and is reared for its milk, meat and skin. Detailed descriptions of its herd size[4], production[5], lactation[6] and reproductive performance[2] have been documented.

Research findings have shown that drugs, both synthetic and natural products have considerable effects on the male reproductive system, especially the spermatozoa of domestic animals and man. The bark of *Corynanthe yohimbe* (*Yohimbe*) and *Pausinystalia johimbe* (*Rubiaceae*) are used to improve fertility, body building and performance in humans, and in captive breeding program of wild animals[7]. The toxicity of yohimbe causes stimulation of the mitotic activity of spermatogonia in mature male rats and increases spermatozoa counts[8] and

yohimbine increased the rate of copulation and reduces the intercopulatory interval in rats[9]. When administered in dogs yohimbe increased the spermatozoal output and prevented the decrease in volume of ejaculates[10]. A significant improvement in semen volume, sperm density, and sperm motility was noticed in men treated with Clomiphene citrate[11].

For several animal species the daily spermatozoal output is consistently lower than the daily spermatozoal production[12]. Several factors, including spermatozoal losses in the collection equipment, phagocytosis and epididymal absorption of spermatozoa, or overestimation of DSP which have been studied, failed to account for the quantitative differences between these indices[13].

In veterinary practice, several chemotherapeutic and other chemical agents, both synthetic and natural are administered to animals to treat infectious diseases and/or to achieve predetermined physiological modifications such as anesthesia or smooth muscle contraction amongst others[4]. These drugs may have beneficial or deleterious effects on the fertility of the animals. The aim of this research therefore is to investigate the effects of diminazene aceturate or ivermectin on some reproductive parameters of the red Sokoto buck.

MATERIALS AND METHODS

Twenty seven randomly sourced adult red Sokoto bucks, between the ages of 2- 2.5 years and weighing between 32 to 34Kg were selected for this study on the basis of their soundness for breeding purposes[14]. During the study, bucks were housed in brick pen houses made of concrete floors in the large animal unit of the Usmanu Danfodiyo University Veterinary Teaching Hospital (UDUVTH), Sokoto, in groups of nine bucks per group. They were fed with wheat bran and bean husks twice daily, allowed some level of free grazing and tap water provided *ad libitum*. In addition, permission for conduction of these experiments was obtained, from the relevant ethics committees of the Usmanu Danfodiyo University, Sokoto, Nigeria.

Bucks were randomly assigned in a block design to one of three groups comprising of one pre treatment and two treatment groups. Each of the three groups comprised of nine bucks each. The nine bucks in each group were further re grouped into two (one having 5 bucks and the other 4 bucks) from which semen and sera samples were collected simultaneously from the first five bucks in all the three groups but alternately (purposive sampling) for the remaining four bucks in the groups on the next sampling[15]. Samples were thus collected from the first 5 bucks of the pre treatment group and the two treatment groups concurrently and the same was done for the remaining 4 bucks of the control and the two treatment groups on the following collections.

The treatment groups comprised of diminazene aceturate treated and ivermectin treated group while bucks of the pre treatment group were not administered any of the drugs. The diminazene aceturate treated group was given an intramuscular injection of a solution of 188.8mg/ml of diminazene aceturate (Berenil®) (FARVET Bladel, Holland) at a dose of 3.5mg/kg body weight while the ivermectin treated group was given a subcutaneous injection of a 1% w/v solution of invermectin (V.M.D. Ltd, Arendonk, Belgium) at a dose of 0.2mg/kg body weight.

Semen and sera samples were collected from the pre treatment group, diminazene aceturate treated and ivermectin treated groups after 1, 24, 72 and 192 hours post drug administration. To obtain semen samples, bucks were restrained in a standing position and semen was collected by electro ejaculation as earlier described[16]. Immediately following collection of semen, evaluation for percentage motility of sperm was carried out. This was determined by the progressive and non-progressive movement of sperm observed under a compound microscope (Laborlux II, Leitz Germany)[17]. The sperm count was determined under a Neubauer haemocytometer (Superior Marienfeld, Germany)[18]. To evaluate for the dead and live sperm percentage the sperm suspension was stained with eosin negrosin, smears were made on slides, air dried and made permanent. The slides were examined by bright field[18].

Blood samples collected by jugular venipuncture were centrifuged at 3000rpm for 15 minutes and sera harvested for assessment of testosterone and follicle stimulating hormone concentration by radioimmunoassay using a testosterone and follicle-stimulating hormone EIA test kits respectively (Clinotech® Diagnostics and Pharmaceuticals, Inc., Canada). The determination of the semen glucose level was done by the glucose oxidase method which employed the use of a digital photo colorimeter.

Statistical Analysis

Statistical analysis of the data obtained before and after the drugs treatment was performed using the independent Student's t-test. All results are expressed as means ± standard deviation. Results were considered to be statistically significant at $P < 0.05$[19].

RESULTS

Effects of diminazene aceturate on semen and serum parameters

The overall mean values of semen and serum parameters of the pre treatment group and the diminazene aceturate treated group at 1, 24, 72 and 192 hours are presented in Table 1. When compared with the values of the pre treatment group, significant differences ($P<0.05$) were observed in the values of semen volume, percentage motility, sperm concentration per ml and semen glucose levels throughout the collection period. Serum testosterone and follicle stimulating hormone levels also differ significantly ($P<0.05$) throughout the collection period after administration of diminazene aceturate (Table 1).

Table 1: Mean (±SD) semen and serum parameters in bucks before and after diminazene aceturate treatment

Parameters	Control	1hr	24hrs	72hrs	192hrs
Volume of semen (ml)	0.36±0.06	0.28±0.16*	0.27±0.18*	0.27±0.11*	0.28±0.11*
Percentage motility	70±0.0	32±11.35*	33±21.33*	34±31.21*	34±21.31*
Concentration/ml (millions)	332.27±133.59	50.10±17.58*	66.30±11.3*	76.10±23.1*	79.00±23.61
Live sperm %	85.90±5.39	88.50±3.37	85.91±2.10	86.00±2.30	85.60±2.22
Semen glucose mmol/litre	3.5±0.23	2.24±0.40*	2.31±0.31*	3.40±0.26	3.50±0.31
Serum Testosterone (ng/ml)	9.10±0.42	1.75±1.77*	1.77±1.61*	2.13±0.60*	3.31±0.719*
Serum FSH (mIU/ml)	367.35±23.96	6.25±1.77*	9.31±1.89*	12.21±3.10*	12.13±3.36*

** Significant difference at P<0.05 compared to value obtained before treatment*

Effects of ivermectin on semen and serum parameters

The overall mean values of semen and serum parameters of the pre treatment group and the ivermectin treated group at 1, 24, 72 and 192 hours are presented in Table 2. When compared with the values of the pre treatment group, significant differences ($P<0.05$) were observed in the values of semen volume, percentage motility, and sperm concentration per ml throughout the collection period. Serum testosterone and follicle stimulating hormone levels also differ significantly throughout the collection period after administration of ivermectin (Table 2).

Table 2: Mean (±SD) semen and serum parameters in bucks before and after ivermectin treatment

Parameters	Control	1hr	24hrs	72hrs	192hrs
Volume of semen (ml)	0.36±0.06	0.23±0.07*	0.24±0.06*	0.27±0.03*	0.35±0.07*
Percentage motility	70±0.0	60±10.54*	63±9.32*	691±1.35	69±1.66
Concentration/ ml (millions)	332.27±133.59	250.40±84.08*	252.60±73.03*	255.30±62.03*	257.40±61.3
Live sperm %	85.90±5.39	87.50±3.69	86.317±2.41	85.56±3.26	85.71±3.11
Semen glucose mmol/litre	3.5±0.23	3.38±0.24	3.43±0.13	3.47±0.22	3.49±0.11
Serum testosterone ng/ml)	9.10±0.42	3.80±1.13*	3.71±2.11*	3.77±1.01*	3.88±0.11*
SerumFSH (mIU/ml)	367.35±23.96	22.50±20.51*	337.315±21.21	39.32±30.13*	41.30±33.12

** Significant difference at P<0.05 compared to value obtained before treatment*

DISCUSSION

The significant ($p<0.05$) decrease in volume of semen observed in the diminazene aceturate treated group is in agreement with a similar study on rams which reported that diminazene aceturate caused significant decrease in semen volume compared to the pre treatment group[20]. A decrease in volume was also observed in the ivermectin treated group; this is in disagreement with findings of a similar study using ivermectin on rams where the levels of semen volume increased significantly ($p<0.01$) in comparison with the pre treatment group[21]. The discrepancy may be attributed to the species or breed variation of animals used and also the dosage of drugs administered. Climatic variations may also be a factor responsible for the differences in findings.

Decreased percentage motility was also observed in the diminazene aceturate and ivermectin treated groups of the present study. The results obtained in these treatment groups are in agreement with similar studies using diminazene aceturate on ram[17] and ivermectin in sheep[21]. A decrease in sperm concentration was observed in the diminazene aceturate and ivermectin treated groups; this may be attributed to the corresponding decrease in serum testosterone and follicle stimulating hormone levels caused by these drugs. Follicle stimulating hormone is necessary to increase the level of the androgen binding protein production by sertoli cells and to develop the blood-testis barrier and other functions of the cells. Once the sertoli function is developed, testosterone alone will maintain spermatogenesis. The yield of spermatozoa, however, is increased if follicle-stimulating hormone is present.

Follicle stimulating hormone is known to increase the yield of spermatogonia by preventing atrasia of differentiating type spermatogonia. Therefore, the decreased sperm concentration noted in the present study, may be attributed to the corresponding decrease in the levels of follicle stimulating hormone and testosterone noted. The results of this study is in agreement with the findings of a similar study where a positive correlation between testosterone concentration, and total sperm count and sperm motility in buffalo-bulls treated with clomiphene citrate, indicating that low levels of testosterone was always associated with low values of semen characteristics[22].

In a similar study with ivermectin in sheep, the values of sperm concentration were established to decrease highly significantly ($P<0.001$) when compared with the pre treatment group[20]. This is in agreement with the results obtained in the present study. Also in agreement with our study are the findings of a similar study where

diminazene aceturate administered to ram caused a significant (P<0.01) decrease in sperm concentration, volume and motility compared to the pre treatment group[20].

CONCLUSION AND RECOMMENDATION

In conclusion, the drugs diminazene aceturate and ivermectin investigated in this study should be used cautiously in red Sokoto bucks meant for breeding purposes; this is because these drugs have been found in this study, to decrease ejaculate volume and semen glucose level, sperm motility and concentration, serum testosterone and follicle-stimulating hormone levels in the red Sokoto buck. These parameters are indices of fertility in the male animal; there is therefore a tendency to decrease fertility when these drugs are administered to bucks meant for breeding purposes. Compliance with withdrawal time is recommendable where use of any of these drugs is unavoidably administered to bucks meant for breeding.

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