INFLUENCE OF BIOTIN ON SEMEN AND TESTICULAR CHARACTERISTICS OF RABBIT BUCKS

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ABSTRACT

The effect of biotin on semen and testicular characteristics of rabbit bucks was studied using twelve healthy mixed breed rabbit bucks aged 8-10 months weighing between 1.60-2.08kg. The bucks were divided into two groups of six bucks represented as A and B. Group A was control and group B the treatment group. Bucks in the control group (A) were fed grass/legume forages with concentrates while those in the treatment group (B) were fed the same type of grass/legume forages with concentrates supplemented with biotin at the rate of 100µg/kg feed/day. The rabbits were fed for 56 days before data collection. Semen was collected twice a week between 8.00am-9.00am local time for three weeks. Semen quality and testicular characteristics were evaluated. Results of the study showed that with the exception of semen volume and sperm concentration which were not significantly different ($P>0.05$) between the two groups, the other semen characteristics between the control (A) and the treated group (B) were significantly different ($P<0.05$). The motility, live sperm cells and sperm with normal morphology of groups A and B (62.33 versus70.03 %, 64.03 versus 81. 83 % and 82.80 versus 85.40 %), respectively were significantly lower ($P<0.05$) in group A (control) than group B (treated). On the other hand, the abnormal sperm cells were significantly higher ($P<0.05$) in the group A (17.20 %) than group B (14.60 %). The testicular parameters of the B group showed significantly higher ($P<0.05$) values in left testis length and right epididymal length than the A group. These results show that biotin can be included as part of the ration of mature rabbit buck to enhance their reproductive performance of the male animal. This experiment revealed the possibility of improving the reproductive potentials of rabbit buck by supplementing the feed with biotin. Thus biotin could be included as part of normal diets of rabbit bucks.

Key words: Rabbit, Buck, Semen characteristics, Testicle, Biotin

INTRODUCTION

One of the characteristics of assessing reproductive efficiency of the male is through the semen quality. High fertility is associated with high semen quality. The production of meat, growth, reproduction and lactation require high levels of good quality nutrients. Since nutrition among other factors plays an important role in spermatogenesis, it is expected that whatever enhances the efficient utilization of nutrients by animals will also improve semen quality. Vitamins (to which biotin belongs) are complex organic compounds that are required in minute amounts essentially for normal growth, maintenance, production and reproduction (Ensminger and Olentine, 1978; Campbell et al., 1985; Coelho, 2000). Some vitamins such as vitamins E and selenium have been shown to improved sperm quality (Mason, 1954; Marin-Guzman et al., 1997). Also Brzezinska-Slebodzinska et al. (1995) observed that supplementation with vitamin E increased the concentration of spermatozoa in semen, an effect often linked to the antioxidant of this vitamin. In rats, using a deficiency model, Cooper et al. (1987) suggested that the effect of vitamin E occurs through intra-testicular factors that regulate steps in development of the germ cell of the rats. In rams, it was suggested that vitamins B_1, B_6 and B_{12} play key roles in thermoregulation of rectal and scrotal skin temperature during heat stress and maintain libido, semen quality, and fertility (El-darawany, 1999). Biotin commonly known as vitamin B_8 is the coenzyme required for the normal activity of four carboxylase enzymes (acetyl-CoA carboxylase, pyruvate carboxylase, propionyl-CoA carboxylase, and methylcrotonyl-CoA carboxylase) (McDonald et al., 1987). These enzymes

respectively play important roles in fatty acid synthesis, gluconeogenesis, amino acid, cholesterol, and fatty acid metabolism; leucine metabolism, and energy production (Coelho, 2000). Da Paz et al. (2006) reported that biotin has been used in combination with other nutrients to improve the seminal characteristics of Jaquars (Panthera onca). Recent advances indicate that biotin supplements play a role in glucokinase synthesis, gene expression both at the transcriptional and translational levels, and perhaps in DNA replication (Parks, 1998). Biotin is also known as the vitamin that enhances the growth and maintenance of blood cells, sebaceous glands, skin, hair, nails, nerve tissues, bone marrow and male sex glands (Parks, 1998; Coelho, 2000). Zimmerly and Weiss (2001) reported that biotin showed increased milk protein and milk yields in cow. There is paucity of information on the effect of biotin on the reproductive performance of animals. However, in rabbits, the effect of the micronutrient biotin on reproductive performance is not well documented. This study was aimed at investigating the effects of biotin on semen and testicular characteristics of rabbit bucks.

MATERIALS AND METHODS

Experimental location

The experiment was carried out in the Rabbitry Unit of the Teaching and Research Farm and Laboratory of the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia state. Geographically, Umudike is located on latitude 05, 29^{1} North and longitude 07, 33^{1} East of the equator. It is situated within the humid rain-forest zone of West Africa characterized by long duration of rainy season (March - October) and short period of dry season (November-February). The average rainfall is 2169.8 mm over a period of 149 - 155 rain days, average ambient temperature is 26^{0}C with maximum and minimum of 32^{0}C and 22^{0}C, respectively. Relative humidity is between 50% - 90%. This meteorological data were obtained from the Meteorological station of the National Root Crop Research Institute, Umudike during the period of the study.

Management of experimental animals

Twelve healthy mixed bred rabbit bucks aged 8-10 months weighing between 1.60-2.08 Kg were used in this study. The bucks were clinically examined and confirmed free from any obvious abnormalities of palpable reproductive organs as soon as they were brought into the University farm. They were also quarantined for a period of two weeks during which they were vaccinated with a multi-prophylactic vaccine. The experimental animals were provided with concentrate diet containing approximately 15.00 % crude protein, 2.5 % fat and 14.0 % crude fiber, 2.5 g premix composed of mineral and vitamins added to the concentrate ration to provide balanced nutrient requirement (Table 1).

Table 1. Composition of concentrate diets fed to the bucks

Ingredient	A	B
Maize offal (%)	57.00	57.00
Palm kernel cake (%)	30.00	30.00
Bone meal (%)	2.00	2.00
Soya bean meal (%)	10.00	10.00
Salt (%)	1.00	1.00
Biotin (µg)	00	100
Total	100	100

They received 150 g buck^{-1} day^{-1} of concentrate diet, 200 g of fresh forage *(Panicum maximum, Pennisetum purpuerum, Centrosema pubencens, Calapogonium mucunoides, and Aspillia africana*) and clean drinking water ad libitum during the course of the study. The feeders and drinkers were firmly held to the side of the hutches to avoid feed wastage and water spillage. The hutches and their surroundings were thoroughly cleaned daily.

Experimental Procedures

The rabbits were randomly assigned to two groups (A- control and B-experiment) of six bucks per group. Each buck was tagged and housed singly for ease of identification. Bucks in the control group (A), were fed grass/legume forages with concentrates. Bucks in the treatment group (B) were also fed grass/legume forages with concentrates supplemented with biotin at the rate of 100µg/of feed. The rabbit bucks were fed for 56 days before semen collection. Semen was collected between 8.00am to 9.00 am (local time) twice a week for three consecutive weeks. Collection of semen was done using an artificial vagina (AV) previously described by Herbert and Adejumo (1995). Semen evaluation was based on the following parameters: Semen volume, motility, sperm concentration, live/dead proportion of sperm cells, sperm morphology and testicular characteristics. Evaluation commenced immediately after collection and was determined using the microscope. This was done by placing a drop of the semen on a pre-warmed glass slide and covered with a cover slip, then viewed under a microscope and scored subjectively for mass progressive motility and recorded in percentages.

Statistical analysis

Means and standard error of difference (SED) were calculated from the data generated using T-test in accordance the methods of Steel and Torrie (1980)

RESULTS AND DISCUSSION

Semen characteristics

The result of the effect of biotin on semen characteristics are shown in Tables 2. With the exception of semen volume and sperm concentration which were not significantly different ($P>0.05$) the other semen characteristics were significantly different ($P<0.05$) between the control (A) and the treated group (B). The motility, live sperm cells and sperm with normal morphology of groups A and B (62.33 versus70.03 %, 64.03 versus 81. 83 % and 82.80 versus 85.40 %), respectively were significantly lower ($P<0.05$) in group A (control) than group B (treated). On the other hand, the abnormal sperm cells were significantly higher ($P<0.05$) in the group A (17.13 %) than group B (14.60 %).

Table 2: Effect of Biotin on Semen Characteristics

Parameters	Group A	Group B	SED
Semen volume(ml)	0.91	1.15	0.36
Progressive motility (%)	62.33	70.03	1.81*
Sperm concentration ($\times 10^6$/ml)	265.00	399.33	8.19
Live sperm cells (%)	64.03	81.83	2.23*
Dead sperm cells (%)	35.97	18.17	2.23*
Normal sperm cells (%)	82.80	85.40	0.87*
Abnormal sperm cells (%)	17.20	14.60	0.87*

* =significant ($P<0.05$) SED =Standard Error of difference

The significantly lower value of dead sperm cells obtained in the treatment group compared with the control group indicates that biotin reducing the production of dead sperm cells. The low incidence of abnormality observed in the treated group implies that biotin might be involved in the maintenance of higher functional integrity of the epididymis (Awojobi and Oyeyemi, 2001). The percentage of abnormality in the B group (14.60) was less than the upper limits of 20 % and 15 % recommended by Zemjanis, (1977) and Campbell et al, (1985), respectively, for male animals as the minimum for good reproductive potential and fertility in either normal mating or artificial insemination. The semen volume obtained in this study (Table 2) compares favourably with results of 0.27 to 0.93 ml (Kobal and Kosec, 1996) and 0.71 ml (Herbert et al., 2005). The motility of the groups corroborates the range reported by Herbert et al. (2005) and Oyeyemi and Okediran (2007) for rabbits. The significantly higher motility obtained in the B group of this study may be due to the effect of biotin in enhancing the metabolism of energy and protein from the feed. Sperm concentration in this study, although not significantly different between the two groups was numerically higher in the treated (B) group compared with the control (A) group (399.33 and 265.00 $\times 10^6$/ml, respectively). Sperm concentrations obtained in this study are in agreement with sperm concentration of 150 to 500 $\times 10^6$/ml reported by (Lebas, 1986). The increased sperm concentration in the treated group of this study indicates there is possibility of higher insemination rate by the reason of the number of spermatozoa available at the time of copulation or insemination. From results of this study, it is suggestive that biotin plays an obvious role in protein synthesis and availability, which in turn is directly involved in spermatogenesis and release of greater number of spermatozoa.

Testicular parameters

The left testicular length and the right epididymal length of the treated (B) were significantly higher ($P<0.05$) than those of the control (A). The rest of the testicular parameters showed no significant differences between the two experimental groups (Table 3).

Table 3: Testicular parameters of the experimental animals

Parameter	Group A	Group B	SED
Left Testis weight (g)	2.34	2.45	0.72
Right Testis weight (g)	2.25	2.17	0.72
Left Testis length (cm)	3.97	4.57	0.14*
Right Testis length (cm)	3.83	4.23	0.15
Left Vas deferens length (cm)	13.17	12.90	1.53
Right Vas deferens length (cm)	12.43	12.40	1.10
Left Testis circumference (cm)	3.77	3.57	0.37
Right Testis circumference	3.47	3.23	0.54
Right Epididymis weight (g)	0.77	1.3	0.23
Right Epididymis length (cm)	11.10	12.70	0.43*

* =significant ($P<0.05$)
SED =Standard Error of difference

CONCLUSION

The more the size of the testicular parameters, the higher the capacity of the testes to produce sperm cells (spermatogenesis). Also the fertility might be increased with the increase in percentage of motility, percentage livability and sperm concentration without increase in the abnormal sperm cells. Therefore this experiment revealed the possibility of improving the reproductive potentials of rabbit buck by supplementing the feed with biotin. Thus biotin could be included as part of normal diets of rabbit bucks without any adverse effects on their reproductive performance and seminal characteristics.

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