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The Detrimental Effect of Dietary Ginger Rhizome Powder Supplementation on Reproductive Performance of Pubertal Rabbit Bucks

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ABSTRACT: Thirty six crossbred rabbit bucks aged 6 months were used to study the detrimental effects of supplementing ginger rhizome powder (GRP) on reproductive performance of pubertal rabbits. The rabbit bucks were randomly divided into four experimental treatments A_1, B_1, C_1 and D_1 of nine animals and was further replicated three times with three animals per replicate in a Completely Randomized Design (CRD). The animals were fed commercial grower rabbit diet which was supplemented with GRP at the rate of 0g/kg, 5g/kg, 10g/kg and 15g/kg feed respectively for 10 weeks. Prior to the first six weeks of the study, a two week period of training was used to train the bucks to ejaculate artificially into artificial vagina. Semen was collected between 8.00 am and 9.00 am and taken the laboratory for analysis within 30 minutes of collection. Data collected were subjected to analysis of variance. Dietary supplementation with GRP revealed that live sperm cell (%), dead sperm cell (%) as well as live : dead sperm cell ratios differed significantly ($p<0.05$) among the groups. There were also significant ($p<0.05$) differences in sperm motility between rabbit bucks in group A_1 (68.48%) and those in group D_1 (53.34%). Libido scores were similar ($p>0.05$) among the treatment groups. The results of this study indicated that dietary inclusion of ginger rhizome powder supplementation at 15g per kg feed had deleterious effect on sperm motility and % live sperm cells of pubertal rabbit bucks.

KEYWORDS: Rabbits, ginger powder, supplementation, libido, semen.

1 INTRODUCTION

The Nigerian livestock industry has been faced with numerous challenges, such as high cost of conventional feed ingredients, diseases, poor quality forages as well as poor production environment. The association of these factors with reduced fertility rate in farm animals is increasingly a source of concern to livestock producers in Nigeria [1].

The use of synthetic fertility preparations and plant bioactive compounds has been found effective in solving this problem in developed countries [2]. In Nigeria, few studies have been conducted to enhance physiological parameters, especially reproductive traits in farm animals using commercial fertility drugs [1], [2], [3]. However, the variations in research findings, coupled with the high level of expertise needed in the preparation and administration of these drugs has limited their adoption, especially by the small holder livestock farmers in this region.

In view of these adoption constraints, there is the need to enhance the overall physiological well being and in particular the reproductive performance of livestock such as rabbit using cheap and readily available plants with antioxidant ability such as ginger, bitter kola and soy bean in their diet [4], [5], [6]. Generally, plants exhibiting antioxidant activity have been established to enhance physiological parameters, especially the reproductive traits of small laboratory animal models [7], [8], [9], [10].

Previous studies have documented the antioxidant and other physiological benefits of ginger [7], [11]. Most of these studies have been carried out using small laboratory animal models. Thus, most of the information generated, even though

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good, is of no direct use to livestock extension officers and resource poor small holder rabbit farmers. Therefore, there is the need to situate plant antioxidant research within the context of tropical animal production realities in order to generate adoptable and utilizable information.

To our knowledge there is lack of information that deal with the effect of dietary ginger rhizome powder supplementation on reproductive performance of rabbit bucks. Therefore, the objective of this study is to evaluate the detrimental effect of dietary ginger rhizome powder supplementation on reproductive performance of pubertal rabbit bucks.

2 MATERIALS AND METHODS

This study was conducted at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria. Geographically, Federal University of Technology, Owerri is located between latitude 4^{o} 4' and 6^{o}3' N and longitude 6^{o}15' and 8^{o}15'E.

Freshly harvested ginger rhizomes used for this study were obtained from National Root Crop Research Institute, Umudike, Nigeria. They were chopped into smaller bits and air dried under shade for 5 days. Thereafter, the dried ginger rhizome samples were milled using Laboratory mill (Arthur Thomas, USA).

Thirty - six healthy New Zealand white rabbit bucks aged 6 months with mean initial weight of 1.16 ± 0.28 kg were used for the study. The animals were randomly assigned into four treatment groups (A_1, B_1, C_1 and D_1) of nine each. Bucks in A_1, B_1, C_1 and D_1groups were assigned to commercial diets containing ginger rhizome powder at 0 g/kg, 5 g/kg, 10 g/kg and 15 g/kg feed respectively for 10 weeks in a completely randomized design experiment. The compositions and nutrient levels of the basal diet are presented in table 1.

Table 1. Composition and nutrient levels of basal diet (control).

Parameter	Percent (%)
Crude protein	18.00
Ether extract	6.00
Crude fibre	5.00
Salt	0.30
Calcium	1.00
Phosphorus	0.45
Lysine	0.75
Methionine	0.35
Metabolisable energy (Kcal / kg)	2900

The assessment of the buck for libido was based on the method described by [3]. A matured cycling doe (teaser) was introduced to the buck for 5 minutes weekly to monitor their sex drive. In this study, reaction time was considered as an indication of libido. Libido was scored in the scale of 5, 4, 3, 2 and 1 for high (groom, sniff and mount), normal (groom, sniff only), low (sniff only), very low (groom only) and no libido (does not pay attention to the female) respectively.

Prior to the first six weeks of the study, a two week period of training was used to train the bucks to ejaculate artificially into artificial vagina. Semen was collected between 8.00 am and 9.00 am. A matured cycling doe was used to tease the buck which made thrust in an attempt at intromission and semen was collected from the bucks using the artificial vagina as described by [12]. The semen was promptly evaluated for qualitative and quantitative parameters within 30 minutes of collection.

Semen colour was noted immediately after collection and the volume was measured using graduated collection tube. The pH was measured using a 507 Crison pH-metre. Sperm motility was done using methods described by [13]. Spermatozoa concentration was also evaluated using the improved Neubauer chamber method of counting. Live and dead percentages were determined using eosin-nigrosin staining method whereas live - dead sperm cell ratio was calculated.

Data generated were analyzed using one-way analysis of variance. Significance means were separated using LSD according to the methods of [14].

3 RESULTS

Table 2 presents the effects of ginger rhizome powder supplementations on libido and semen characteristics of pubertal rabbits. There were no significant ($p>0.05$) differences in the libido score among the treatment groups. Semen colour changed from cream - milky to milky with increasing supplementation level of ginger rhizome powder. Data on semen pH and volume ranged from 7.73 - 8.14 and 0.41 - 0.57 ml respectively. Semen pH and semen volume value were highest for rabbit bucks in A_1 group and lowest for those in D_1 group.

Table 2. Effect of ginger rhizome powder supplementation on libido and semen quality characteristics in pubertal rabbit bucks

Parameters	Treatment				S.E.M
	A_1	B_1	C_1	D_1	
Libido score (sec)	4.60	4.60	4.72	4.84	0.33
Semen colour	Cream - milky	Cream - milky	Milky	milky	-
Semen pH	8.14	8.11	7.83	7.73	0.16
Semen volume (ml)	0.57	0.50	0.44	0.41	0.04
Sperm conc. ($\times 10^9$ / ml)	0.86	0.80	0.70	0.72	0.03
TSC ($\times 10^9$ / ml)	0.49	0.40	0.31	0.30	0.04
Sperm motility (%)	68.48^a	60.12^{ab}	55.69^{ab}	53.34^b	1.50
Live sperm (%)	84.48^a	74.30^b	71.61^b	66.94^b	1.36
Dead sperm (%)	15.68^c	25.70^b	28.39^{ab}	33.06^a	1.13
Live / dead sperm ratio	5.38^a	2.89^b	2.52^b	2.02^b	0.45

^{a,b,c} Means within rows with different superscripts are significantly different ($p<0.05$); TSC – Total sperm concentration; S.E.M – Standard error of the mean.

The sperm concentration and total sperm concentration decreased with increasing supplementary level of ginger rhizome powder supplementation. Rabbit bucks on D_1 treatment recorded significantly ($p<0.05$) lower sperm motility from bucks in group A_1 but similar ($p>0.05$) to B_1 and C_1 bucks. Rabbit bucks in group A_1 recorded significantly ($p<0.05$) higher live : dead sperm cell ratio than all the other groups.

4 DISCUSSION

One of the methods of assessing reproductive efficiency of the male is through the measurement of semen quality. Every animal species has its capacity for sperm production, which is determined genetically but it has however, been clearly observed that other factors like nutrition, disease and stress influence the portion of the germinal epithelium that enters into spermatogenesis [15]. In the current study there were some variations in the semen quantity and quality characteristics of rabbit bucks fed diets supplemented with graded levels of ginger rhizome powder.

Results of this study clearly indicated that dietary supplementation with ginger rhizome powder resulted in semen colour change from cream – milky to milky. Gomez [16] reported that correlation exists between semen colour and sperm concentration. The semen pH obtained herein tends to maintain a downward trend as the levels of ginger rhizome powder was increased in the diets. According to [17], semen has a high buffering capacity, much higher than that of most other fluids in the body, but the buffering ability tends to decrease shortly after ejaculation as a result of loss of carbon dioxide by sperm cells. The comparable semen pH values in all treatment groups was an indication that ginger rhizome powder supplementation in buck's diet up 15g/kg feed did not affect the semen acid – alkaline equilibrium adversely.

Nutrition has long ago been established to affect the secretory functions of the accessory sex glands, the products of which constitute the seminal plasma [18]. The progressive decrease in semen volume as the supplementation level of ginger rhizome powder increases was in agreement with the findings of [18], that secretory functions of the accessory sex glands are very sensitive to dietary changes and that the slight changes in feed chemical composition goes a long way in influencing the semen volume.

Sperm concentration and total sperm concentrations are within the normal range reported by [19], but lower than that reported by [20] and [21]. Also, the lower sperm concentration and total sperm concentration values reported for B_1, C_1 and D_1 bucks were at variance [7] and [11] who reported improved sperm concentration in rats and cocks fed ginger rhizome powder - based diets. The observed increase in sperm concentration and total sperm concentration values in rats and cocks

fed ginger rhizome powder - based diets, and the lower values recorded for the same parameters in this study could be attributed to species differences.

Sperm motility is an important index in reproductive assessment because it demonstrates the ability of sperm to move and fertilize an ovum [22]. The significant decline in number of motile sperm cells in the ejaculates of D_1 bucks relative to control bucks is at variance with the observed higher motility recorded in cock fed ginger based diets by [11]. Again, the significant decrease in sperm motility of D_1 bucks is contrary to the reports of [7] and [23] that ginger powder - based diets improve spermatozoa motility in rats. The low sperm motility recorded on D_1 bucks could be attributed in part to the rapidity of sperm cell development in the seminiferous tubules, in the sense that spermatozoa may need a moderate but progressive development for them to have excellent motility.

The results of this present study also indicate that ginger rhizome powder influences percentage live spermatozoa of rabbit bucks negatively. The observed significant decrease in live sperm (%) of B_1, C_1 and D_1 bucks contrasts with the improved semen quality parameters of rats and breeder broiler birds fed ginger powder based diets [7], [11]. It however, agrees with the results of the depressive effects of medicinal plant leaves on spermatogenesis in animal species as reported by [4], [24], [25]. The significant decrease in percentage live sperm of B_1, C_1 and D_1 bucks is an indication that ginger rhizome powder based diets may impede the sperm energy metabolic pathway. This result also revealed significant increase in dead spermatozoa percent in B_1, C_1 and D_1 rabbit bucks when compared with those in control group. This indicates that ginger rhizome powder at these inclusion levels could accelerate the release of immature spermatozoa. The dead spermatozoa percent recorded herein agree with the results of similar study in cocks fed cotton seed meal diets by [26] and [27]).

In this study, reaction time was considered as an indicator of libido. Several factors have been reported to depress libido in farm animals, such as the temperature in rabbit building [28], [29] and / or consequence of feed deprivation [30]. The higher libido scores recorded for bucks in C_1 and D_1 groups could be attributed to ginger rhizome powder since that was the only varying factor in the feed. It is quite shocking to observe that inclusion of ginger rhizome powder in the diet of rabbit bucks increased libido at the same time reduced spermatozoa production. This could be that ginger bioactive principle improves the activities of 3β-hydroxysteroid dehydrogenase (3β-OHSD) and $\Delta^{5,4}$- isomerase; 17α-hydroxylase and 17, 20-lyase and 17β-hydroxysteroid dehydrogenase (17β-OHSD) in the testis which will likely enhance extra - gonadal testosterone production since maintenance of sex libido in males are attributed to testosterone.

5 CONCLUSION

It can be concluded that dietary ginger rhizome powder supplementation at 15g per kg feed had deleterious effect on sperm motility and % live sperm cells. Therefore, dietary ginger rhizome powder supplementation is not recommended in the diet of breeding rabbit bucks, as evidenced by reduced number of live sperm cells.

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