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ORIGINAL RESEARCH ARTICLE

# Semen quality characteristics of post-pubertal rabbit bucks fed ginger rhizome meal based diets

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## ABSTRACT

***This study was conducted to determine the effect of ginger rhizome meal on libido and semen characteristics of post-pubertal rabbit bucks reared in Nigeria. Thirty - six crosbred rabbit bucks aged 10 - 12 months with mean body weight of 1470.70g were divided into 4 treatment groups of 9 each, which were further replicated thrice and fed diet supplemented with ginger rhizome meal at 0 g ($T_0$), 5g ($T_5$), 10 g ($T_{10}$) and 15g ($T_{15}$) per kg feed fed ad libitum 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. Sexual drive (libido) of the rabbit bucks was determined by introducing the female into the hutch containing the experimental rabbit bucks, and recording the reaction time (seconds) of the rabbit bucks with a stopwatch. Data collected were subjected to analysis of variance. Results revealed that semen colour changed from cream milky to milky. Similar ($p>0.05$) semen pH and sperm concentration values were obtained among the dietary groups. Bucks in $T_0$ (control) and $T_5$ treatment groups had significantly ($p<0.05$) higher semen volume than those bucks in $T_{10}$ and $T_{15}$ groups. Total spermatozoa concentration values of bucks on $T_0$ ($0.11 \times 10^9$/ml) and $T_5$ ($0.10 \times 10^9$/ml) treatments were significantly higher ($p<0.05$) than those bucks on $T_{10}$ ($0.07 \times 10^9$/ml) and $T_{15}$ ($0.07 \times 10^9$/ml) treatments. Sperm motility and live sperm cells (%) declined ($p<0.05$) progressively in a dose dependent manner. Percent dead sperm cells were significantly ($p<0.05$) lower for bucks in control group than those in $T_{10}$ and $T_{15}$ groups. Reaction time had a dose-dependent increase, though the observed difference was not significant ($p>0.05$). It was therefore, concluded that supplementation of bucks' diets with ginger rhizome meal at 10g/kg feed and 15g/kg feed for a period of 10 weeks decreased semen volume and total sperm concentration but increased the number of dead sperm cells in comparison to the control groups. It was also found sperm motility and number of live sperm cells decreased significantly in bucks that received ginger rhizome meal at 5g/kg feed, 10g/kg feed and 15g/kg feed in comparison to the control groups.***

**Keywords:** Rabbits, semen, libido, ginger rhizome, post-pubertal

## INTRODUCTION

The use of antibiotics in monogastric diets to promote growth, feed efficiency as well as reproductive performance in animal production has been reported (Cardozo *et al.*, 2004). Although high levels of production and efficient feed conversion are the needs of the modern animal industry which, to a certain extent, could be achieved in modern animal production industry by the use of antibiotics. However, the potential side effects of using antibiotics in animal diets as growth promoters has become a real public health concern globally (Ogbuewu *et al*., 2009; Ogbuewu *et al*., 2011) and have led to their prohibition in animal feeds in most western countries (Cardozo *et al*., 2004). In view of this, there is increased interest by Nigerian livestock farmers to search for unconventional growth promoters such as ginger rhizome (Odebunmi *et al*. 2007, 2010). Ginger which comes from the family *Zingiberanceae* and genus *Zingiber* is found throughout the tropics and sub-tropics. Ginger is a major crop grown primarily in China, India and Nigeria, and exported worldwide. It is a well known herb widely used as a spice all over the world (Bartley and Jacobs, 2000) and in medical treatment for certain ailments in traditional medicine. Proximate biochemical test revealed that ginger rhizome meal contained 10.36% crude fibre, 6.57% ash, 6.485 ether extract, 64.82% nitrogen free extract and 5.45% crude protein on analysis (Ogbuewu *et al*., 2014a). Ginger contains several phytochemical compounds which have strong antioxidant property and other pharmacological effects (Ogbuewu, *et al*., 2014a). In studies involving ginger rhizome meal for growing male rabbits, Ogbuewu *et al.* (2013) observed that reproductive performance of males was increased by the inclusion of high levels of the rhizome meals in the diets. Increased ovarian weight and sex hormone value of rabbit does administered ginger rhizome meal has been reported by Ogbuewu *et al*. (2014b). Several reports involving male animal species other than rabbits fed ginger indicate some positive effects on reproductive performance (Arash *et al*., 2009; Saeid *et al*., 2011). Enhanced reproductive performances have been observed in male rats and cocks administered ginger rhizome meal diets. Increased testicular weight of male rats and birds administered ginger rhizome meal has been reported (Arash *et al*., 2009; Saeid *et al*., 2011). There has been paucity of information on the effects of ginger rhizome meal on libido and semen quality characteristics of breeding rabbit bucks. The present study was designed to determine the effect of ginger rhizome meal based diets on libido and semen quality characteristics of crosbred rabbit bucks.

## MATERIALS AND METHODS

### Location of study

This study was carried out at the Rabbitry Unit of the Teaching and Research Farm, Department of Animal Science and Technology, Federal University of Technology, Owerri, Nigeria. Geographically, the University and the farm is located on an elevation of about 100m above sea level at latitude 4°4' and 6°3'N and longitude 6°15' and 8°15'E. Owerri falls within the rainforest zone of Nigeria which is characterized by hot and humid climate.

### Plant material

Fresh ginger rhizomes of the Indian cultivar *Himachel pradesh* were procured from the National Root Crops Research Institute, Umudike Abia State, Nigeria. The processing method described by Ogbuewu *et al.* (2013) was used. Milled ginger rhizome meal was collected and stored in a polyethene bag for use.

### Management of animals and diets

A total of 36 matured rabbit bucks were used for this study. The experimental rabbits were procured from Emii farm limited and the animals were stabilized for 2 weeks before introducing the experimental diets. The animals were randomly assigned to 4 dietary groups ($T_0$, $T_5$, $T_{10}$ and $T_{15}$ ) of 9 animals and replicated thrice in a completely randomized design. The experimental rabbits were assigned to diets containing ginger rhizome meal at 0g ($T_0$), 5g ($T_5$), 10g ($T_{10}$) and 15g ($T_{15}$) per kg feed. The nutrient composition of the treatment diet is presented in Table 1. Feed and water were offered *ad libitum* for 10 weeks and the study lasted for 12 weeks. Rabbit bucks in each dietary group were fed 50 g of Guinea grass (*Panicum maximum*) leaf meal containing 27.6% Crude fibre and 6.05% ash on dry matter basis occasionally as additional fibre sources.

**Table 1: Analysed nutrient compositions of the control diet**

| 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 |

### Libido assessment, semen collection and analysis

Semen was collected from the animals using an artificial vagina (AV) as described by Herbert and Adejumo (1995). The volume of semen collected was measured using calibrated collection tube and recorded in milliliters while semen colour was noted visually immediately after collection. Sperm concentration ($x10^6$/mL) was determined using the Neubauer haemocytometer and the calculations were made according to standard procedures; total sperm per ejaculate ($x10^6$), sperm motility (%), live sperm (%) and dead sperm (%) were as described by Zemjanis (1977). In this study, reaction time was considered as an indication of libido. Sexual drive (libido) of the rabbit bucks was determined by introducing the females into the hutch containing the experimental rabbit bucks, and recording the reaction time (seconds) of the rabbit bucks with a stopwatch.

### Statistical analysis

Quantitative data obtained in this study were subjected to analysis of variance in a completely randomized design according to the procedures of Steel and Torrie (1980). Difference between means were separated using the Duncan's Multiple Range Test

## RESULTS

The results of libido and semen quality characteristics observed in this study are shown in Table 2. Semen colour ranged from cream milky to milky. Semen from $T_0$ and $T_5$ bucks were cream milky in colour while those collected from $T_{10}$ and $T_{15}$ bucks were milky in colour. Semen pH and sperm concentration were similar ($p>0.05$) among the bucks in all the dietary groups. Total spermatozoa concentration and semen volumes recorded for the $T_0$ and $T_5$ groups were similar, but significantly higher ($p<0.05$) than those in $T_{10}$ and $T_{15}$ groups. Sperm motility and percent live sperm declined ($p<0.05$) progressively among the treatment groups. Percent dead sperm were significantly ($p<0.05$) lower in $T_0$ group than those in $T_{10}$ and $T_{15}$ groups. Reaction time recorded a dose-dependent increase, although not significant ($p>0.05$) different among the dietary groups.

## DISCUSSION

The depression in the reproductive performance of rabbit bucks observed in the current study as a result of feeding ginger rhizome meal have been reported for other animal species by Arash *et al.* (2009) and Saeid *et al.* (2011). Ogbuewu *et al.* (2013) has reported various effects of ginger rhizome meal on the reproductive characteristics of pubertal rabbit bucks. Similarly, Ogbuewu *et al.* (2014b) observed that ginger has depressive effects on reproductive in pubertal rabbit does. In this study, the semen volume was depressed by the feeds containing ginger rhizome meal. The observed reduction in semen volume in the order of $T_0$ (0.64 ml) > $T_5$ (0.60 ml) >

Table 2 Effects of diets containing different levels of ginger rhizome meal on semen quality and libido characteristics of adult post - pubertal rabbit bucks.

| Parameters | Inclusion level of ginger rhizome meal | | | | S.E.M |
|---|---|---|---|---|---|
| | $T_0$ | $T_5$ | $T_{10}$ | $T_{15}$ | |
| Semen colour | Cream milky | Cream milky | Milky | Milky | - |
| Semen volume (mL) | $0.64^a$ | $0.60^a$ | $0.44^b$ | $0.46^b$ | 0.04 |
| Semen pH | 8.04 | 8.04 | 8.03 | 8.04 | 0.01 |
| Sperm conc. ( $\times 10^6$/ ml) | 0.17 | 0.17 | 0.17 | 0.15 | 0.02 |
| TSC ( $\times 10^9$/ ml ) | $0.11^a$ | $0.10^a$ | $0.07^b$ | $0.07^b$ | 0.03 |
| Sperm motility (%) | $76.01^b$ | $70.09^a$ | $62.52^c$ | $58.21^c$ | 1.21 |
| Live sperm cells (%) | $89.35^a$ | $86.62^b$ | $84.03^b$ | $85.12^b$ | 1.10 |
| Dead sperm cells (%) | $10.65^a$ | $13.38^{ab}$ | $15.97^b$ | $14.88^b$ | 1.01 |
| Reaction time (Libido) | 4.02 | 4.10 | 4.11 | 4.13 | 0.02 |

[a,b,c] Means within rows with different superscripts are significantly different ($p<0.05$); $T_0$ = 0 g ginger rhizome meal per kilogram feed (control); $T_5$ = 5 g ginger rhizome meal per kilogram feed; $T_{10}$ = 10 g ginger rhizome meal per kilogram feed; $T_{15}$ = 15 g ginger rhizome meal per kilogram feed; TSC – Total spermatozoa concentration; S.E.M – Standard error of the mean.

$T_{15}$ (0.46 ml) > $T_{10}$ (0.44 ml) with increasing levels of ginger rhizome meal was at variance with the increased semen volume reported in male wistar rats and breeder broiler cocks fed ginger rhizome meal at 5g/kg feed, 10g/kg feed and 15 g/kgfeed by Arash *et al.* (2009) and Saeid *et al*. (2011) respectively. This is an indication that ginger rhizome powder supplementation is capable of reducing the seminal plasma of adult rabbits. These results also showed that bucks fed diet with 10 g of ginger rhizome powder had the least semen pH value, which compared favourably with those in $T_5$ and $T_{15}$ treatment groups. The comparable semen pH values in the entire treatment groups reflect the balance between the pH values of the different accessory gland secretions, mainly the alkaline seminal vesicular secretion and the acidic prostatic secretion. The results tend to show that ginger powder has no significant effect on semen buffering ability of post – pubertal bucks.

The observed dose related decline in total spermatozoa concentration and sperm motility of bucks on 5 - 15 g ginger rhizome meal is in agreement with Ogbuewu *et al*. (2013). The observed decline in total sperm concentration and sperm motility was at variance with Arash *et al.* (2009) and Saeid *et al*. (2011) whose observed higher total sperm concentration and sperm motility in male wistar rats and breeder broiler cocks fed ginger rhizome meal at the rates of 5 g/kgfeed, 10 g/kgfeed and 15 g/kg feed. Low concentration of spermatozoa is an indication of possible low fertility rate by the reason of the number of spermatozoa available at the time of copulation or insemination. Studies have shown that mammalian sperm produce energy by anaerobic glycolysis or by oxidation of pyruvate via the intra mitochondrial lactate dehydrogenase X (Peterson and Freund, 2002). This decline is an indication that saponins, the pre-dominant active principle detected in ginger rhizome meal (Ogbuewu *et al*., 2014a) may have suppressive effect on sperm intra mitochondrial lactate dehydrogenase X, a key enzyme in sperm energy metabolism (Peterson and Freund, 2002). The progressive decline in sperm motility also corroborate the earlier results of Gupta *et al*. (2004) that saponins from *Albizia lebbeck* (L) Benth bark and *Sesbania. sesban* seeds increased spermicidal activity in male rats. The depression in percentage live spermatozoa of rabbit bucks that received ginger rhizome meal based diets at 5 - 15g is at variance with the reports of Arash *et al.* (2009) and Saeid *et al.* (2011) in animals other than rabbits, but fell within the values reported by Ogbuewu *et al.* (2009; 2013) ) in rabbit bucks. This decline in live sperm percent suggests that ginger rhizome meal has a negative effect on livability of spermatozoa. This observation was also in agreement with the earlier reports of Ogbuewu *et al.* (2009, 2013) and Herbert *et al*. (2005) in rabbit bucks fed neem leaf, ginger rhizome meal and *Leucaena* - *Gliricidia* leaf meal based diets respectively. The dead sperm percent in the current study maintained an upward trend starting from $T_5$ bucks as the rate of ginger rhizome powder supplementation is increased. The mechanisms involved in the increase in percent dead sperm are poorly understood. However, it could be that ginger rhizome meal accelerated the release of immature spermatozoa and also inhibits the maturation of normal sperm cells by suppressing semen antioxidant systems that protect spermatozoa from oxidative stress caused by reactive oxygen species. However, the percentage of abnormal sperm cells in this study were below the upper limit of 20% recommended as the minimum for good reproductive potential and fertility in either normal mating or in artificial insemination (Oyeyemi and Okediran, 2007). Libido and quality semen are required year round to achieve the maximum productivity either through artificial insemination or natural mating. The comparable libido scores fell within the range reported by Ogbuewu *et al.* (2009) and Ogbuewu *et al.* (2013) in rabbit bucks fed neem leaf meal and ginger rhizome meal diets respectively. The dose dependent increases in libido score suggests that ginger rhizome powder may have aphrodisiac property in male rabbits.

## CONCLUSION

The supplementation of rabbit bucks' diets with ginger rhizome meal at 10g/kg feed and 15g/kg feed for a period of 10 weeks decreased semen volume and total sperm concentration. The addition of ginger rhizome meal at 5g/kg feed, 10g/kg feed and 15g/kg feed decreased significantly sperm motility and number of live sperm cells in comparison to the control group. It was found, that the number of dead sperm cells increased significantly in rabbit bucks fed diets containing ginger rhizome meal at 10g/kg feed and 15g/kg feed in comparison to the control groups that received ginger rhizome meal at 0g/kg feed and 5g/kg feed.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interests in this article.

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