

## Reproductive characteristics of adult rabbit bucks fed diets containing *Dialium guineense* leaf meal

Iwuji, T. C\*, Uzor, V. C., Kadurumba, O. E., Okere, P. C. and Egenuka, F. C.

Department of Animal Science and Technology, Federal University of Technology, P. M. B. 1526, Owerri, Imo State, Nigeria.

\*Corresponding Author: [tiwuji@gmail.com](mailto:tiwuji@gmail.com); Phone Number: +2348033429540

Target audience: Rabbit farmers, Researchers, Agronomists

### Abstract

The utilization of leaf meals in diets of livestock species is not only explored for use in replacing expensive feed materials, but also for some other potential benefits which include reproductive performance. This study evaluated the effect of *Dialium guineense* leaf meal on semen parameters and libido of adult New Zealand White (NZW) rabbit bucks. The experiment lasted for 28 days and was carried out in Completely Randomized Design (CRD). It was made up of three treatment diets T1, T2 and T3, containing 0.0, 30.0 and 60.0 % inclusion levels of *Dialium guineense* leaf meal, respectively. The result of the experiment recorded significantly ( $p < 0.05$ ) higher total spermatozoa count per ejaculate, spermatozoa concentration, reaction time and libido score in T2 rabbits than in T1 rabbits, while percentage motile spermatozoa, active motile spermatozoa and abnormal spermatozoa were significantly ( $p < 0.05$ ) higher in T1 rabbits than in T2 rabbits. Data were not collected from rabbit bucks on T3 because they were not sexually responsive. This experiment demonstrates that *Dialium guineense* leaf meal may be included in diets of breeder rabbit bucks at 30% level for enhanced total spermatozoa count per ejaculate, spermatozoa concentration, libido score and reduction in percentage abnormal spermatozoa.

**Keywords:** Semen; Spermatozoa; Libido score; Reaction time; Reproduction.

### Description of Problem

Rabbits are pseudo-ruminants and capable of digesting forages, occasioned by the presence of an enlarged caecum in their digestive system [1]. Although rabbits can be fed concentrate feed or combination of concentrate and forages [2], local rabbit farmers usually feed their rabbits with forage which include *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum* and *Gomphrena spp.* [3]. Unfortunately, during the dry season, observation has shown that these farmers face the problem of scarcity of the conventional forages used in feeding their animals, and when seen, they are not usually fresh and their nutritive value, reduced [4]. However, during this season of scarcity and low nutritive value

of the conventional forages used in rabbit feeding, the leaves of *Dialium guineense* are seen flourishing in the bushes around these local rabbit farms.

In recent times, the use of plants of various potential benefits has gradually acquired more research attention to play the role of replacing synthetic materials used in livestock production. This is occasioned by the ban on antibiotic use in livestock production due to increased incidence of drug resistance to those materials [5]. In Africa, particularly in Nigeria, several plants have been identified for their beneficial potentials which include reproductive, medicinal and nutritional; and have been used in form of leaf meal or extracts [6]. Some plants have been reported to improve libido, sexual behavior, mating

performance and spermatogenesis, and balance the level of hormones, such as testosterone, luteinizing hormone and follicle stimulating hormone [7].

*Dialium guineense* is a genus of a legume belonging to the family of Fabaceae and sub-family of caesalpiniodeae; and has been reported to possess unique medicinal properties commonly used in West Africa [8]. It is a tree of an average height of 30m tall and grows in dense savannah forest and gallery forest. It is naturally found on moist soils, sometimes blackish soils with mean annual rainfall of less than 2100 – 2600 mm [9]. Different parts of *Dialium guineense* have been used in herbal medicine for treatment of various ailments [10]. The leaves are used as remedy for fever, pre-natal pains, diarrhea [11]. The pulp is a good source of protein and minerals [12]. The fruit of *Dialium guineense* plants are chewed among women to check lactation and genital infection [9]. The leaves and bark are used in controlling fertility, jaundice, bronchitis and wound [13].

Unlike many other plants like neem, moringa, *Garcinia kola*, *Alcornoeca cordifolia*, *Aspilia africana*, etc, *Dialium guineense* has

not been widely explored for use in livestock production, including rabbits. Rabbit production has been tagged emergent and has been adjudged to have the potential to fill the niche in animal protein need of developing countries like Nigeria [14, 15]. Therefore, this study is designed to evaluate the reproductive characteristics of adult New Zealand White (NZW) rabbit bucks fed diets containing *Dialium guineense* leaf meal.

### Materials and Methods

This study lasted for 28 days and was carried out at the Teaching and Research Farm of Federal University of Technology, Owerri, Imo State. A total of 18 matured NZW rabbit bucks were used. Prior to the arrival of the rabbits, the house and the hutches were properly washed and disinfected. The drinkers and feeders were also washed and feeds made available. The rabbits were allocated on weight equalization basis to three experimental groups of six rabbits per group and replicated thrice to contain two rabbits per replicate. Three treatments, T1, T2, and T3 were randomly allocated to the groups.

**Table 1: Composition of diets fed the experimental rabbit bucks**

Ingredients	T1	T2	T3
Maize	10.00	10.00	10.00
Soyabean meal	15.00	15.00	15.00
Palm kernel cake	10.50	10.50	10.50
Wheat offal	60.00	30.00	0.00
<i>Dalium guineense</i>	0.00	30.00	60.00
Fish meal	1.00	1.00	1.00
Bone ash	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00
Salt	0.25	0.25	0.25
Vit/Min premix*	0.25	0.25	0.25
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

\*To provide the following per kg of diet; Vit A, 10,000 IU; Vit D, 1,500 IU; Vit E, 3 IU; Vit K, 2 mg; Riboflavin, 3 mg; Vit B<sub>12</sub>, 0.8 mg; Folic acid, 4 mg; Mn, 8 mg; Zn, 0.5 mg; Iodine, 1.0 mg; Co, 1.2 mg; Cu, 10 mg; Fe, 20 mg.

The animals were housed individually in cages measuring 0.61m x 0.61m x 0.61m, with a wire mesh floor and wooden frames. They were fed standard rabbit diet according to [16] for 2 weeks to stabilize before administering the treatments. The experimental diets (Table 1) and water were freely offered to the animals while other standard management practices were carried out throughout the experiment.

Fresh *Dialium guineense* leaves were harvested from the bushes within Federal University of Technology Owerri, Imo State. The leaves were removed from the stem and

spread under shade to dry for 10-15 days while still retaining its green colour. The dried leaves were milled using an electric grinder to produce leaf meal, which was used to formulate the treatment diets (Table 1). The experiment was carried out in Completely Randomized Design (CRD). The animals were divided into three (3) treatment groups, T1, T2 and T3, containing 0.0, 30.0 and 60.0% *Dialium guineense* leaf meal. Each treatment contained six rabbits replicated thrice to contain two rabbits per replicate.

**Table 2 Semen parameters and libido of adult rabbit bucks fed diets containing *Dialium guineense* leaf meal.**

Parameters	T1	T2	p - Value
Semen volume (ml)	0.95±0.05	1.05±0.03	0.8131
Total sperm count (x 10 <sup>6</sup> )	20.71±0.25 <sup>b</sup>	34.47±0.35 <sup>a</sup>	0.0478
Sperm concentration (x 10 <sup>6</sup> /ml)	21.80±0.43 <sup>b</sup>	32.83±0.54 <sup>a</sup>	0.0333
Total motile sperm (%)	65.00±0.78 <sup>a</sup>	62.50±0.33 <sup>b</sup>	0.0481
Active motile sperm (%)	57.47±0.36 <sup>a</sup>	52.26±0.34 <sup>b</sup>	0.0498
Sluggish motile sperm (%)	7.37±0.14	10.20±0.37	0.0732
Abnormal sperm (%)	3.48±0.07 <sup>a</sup>	3.03±0.41 <sup>b</sup>	0.0334
Reaction time (sec)	8.47±0.34 <sup>b</sup>	9.38±0.44 <sup>a</sup>	0.0421
Libido score (mounts/minute)	6.21±0.44 <sup>b</sup>	9.28±0.34 <sup>a</sup>	0.0398

<sup>ab</sup>: Means within a row with different superscripts are significantly (p<0.05) different.

**Table 3 Percentage gain in reproductive parameters of adult rabbit bucks fed diets containing 30% *Dialium guineense* leaf meal.**

Parameters	T2	Remarks
Semen volume	10.53	NS (See Table 2)
Total sperm count	66.44	
Sperm concentration	50.60	
Total motile sperm	- 2.50	
Active motile sperm	- 5.21	
Sluggish motile sperm	2.83	NS (See Table 2)
Abnormal sperm	0.45	
Reaction time (sec)	- 10.74	
Libido score (mounts/minute)	49.99	

NS = Not significant (p>0.05)

Semen was collected using an artificial vagina (AV) as described by [17] and modified by [18]. A mature rabbit doe was used as teaser.

The semen volume was read immediately after collection from the collection tube while determination of other parameters like sperm

motility, total sperm per ejaculate, sperm concentration, percentage live sperm and abnormal sperm were carried out as described by [19]. To monitor their sexual drive (libido), a mature doe was introduced to the rabbit bucks to monitor their sexual drive (libido). The time, in seconds, it takes the rabbit bucks to sniff, groom and mount the female was recorded with a stop clock and regarded as the reaction time [20]. Rabbit bucks that do not react after 10 minutes were termed sexually unresponsive. Libido score was determined by counting the number of times the buck tries to mount the doe in one minute (mounts/minute) as described by [20]. Percentage gain of the reproductive parameters of the *Dialium guineense* treated adult rabbit bucks were calculated by finding the percentage difference of the reproductive parameters between the control (T1) and the treated rabbits (T2 and T3, respectively).

The data collected from the experiment were subjected to Student's T-test.

### Results and Discussion

Results of the semen analysis and reproductive evaluation of the experimental rabbits are presented in Tables 2 and 3. No data was collected for adult rabbit bucks on T3 (60% inclusion level of *Dialium guineense* leaf meal) because they were not sexually responsive, inhibiting semen collection and libido evaluation. The inclusion of 60% *Dialium guineense* leaf meal in the diet of adult NZW rabbit bucks could be said to adversely affect their libido. This is evident in the inability of the rabbit bucks on T3 (60% inclusion level of *Dialium guineense* leaf meal) to sexually respond to introduction of a female rabbit in their hutches; thereby making it impossible for semen collection and libido assessment to be carried out. This phenomenon could be because the optimum level of *Dialium guineense* leaf meal was exceeded, which diminished the benefits recorded in T2 (30%

inclusion level of *Dialium guineense* leaf meal) rabbits. Semen volume and percentage sluggish motile spermatozoa were similar ( $p>0.05$ ) between T1 (control; 0.0% inclusion level of *Dialium guineense* leaf meal) and T2 (30% inclusion level of *Dialium guineense* leaf meal). Total spermatozoa count and spermatozoa concentration of T2 ( $34.47\pm 0.61 \times 10^6$  and  $(32.83\pm 0.54 \times 10^6/\text{ml})$ ) rabbits were significantly ( $p<0.05$ ) higher than those of rabbits on T1 ( $20.71\pm 0.44 \times 10^6$  and  $21.80\pm 0.43 \times 10^6/\text{ml}$ ). Also, reaction time and libido score were significantly ( $p<0.05$ ) higher in T2 ( $9.38\pm 0.44$  sec and  $9.28\pm 0.34$  mounts/minute) than in T1 ( $8.47\pm 0.34$  sec. and  $6.21\pm 0.44$  mounts/minute) rabbits. Percentage total motile spermatozoa, active motile spermatozoa and abnormal spermatozoa were significantly ( $p<0.05$ ) higher in T1 ( $65.00\pm 0.78$ ,  $57.47\pm 0.36$  and  $3.48\pm 0.07$ , respectively) than in T2 ( $62.50\pm 0.33$ ,  $52.26\pm 0.34$  and  $3.03\pm 0.41$ , respectively) rabbits.

The reproductive benefit of *Dialium guineense* leaf meal in the experimental rabbit bucks is evident in both the significant ( $p<0.05$ ) increases recorded in total spermatozoa count, spermatozoa concentration, libido score and significantly ( $p<0.05$ ) lower percentage of abnormal spermatozoa recorded in this experiment as these parameters indicate better reproductive potentials of T2 rabbits than T1 rabbits [1]. These benefits may be attributed to the antioxidant property of *Dialium guineense* leaves [21], which has been reported to enhance male reproductive potentials [22, 23]. The significantly ( $p<0.05$ ) lower percentage of total motile spermatozoa recorded in T2 rabbits may be attributed to the increased spermatozoa concentration, leading to competition for space and probably resulting to death or loss of motility of more spermatozoa in rabbit bucks fed the diets containing 30% *Dialium guineense* leaf meal. However, the

number and percentage of actively motile spermatozoa recorded in T2 are well above required number of spermatozoa and percentage motility for fertility [24, 25], and therefore do not compromise fertility in the T2 rabbits. Reaction time represents the time it took the rabbit bucks to sexually respond to the introduction of a female rabbit in their hutches [26]. The male hormone, testosterone, is responsible for male secondary sexual characteristics, which include sexual drive [1]. Since libido score was significantly ( $p < 0.05$ ) higher in T2 rabbits, implying a role in testosterone increase by *Dialium guineense* leaf meal. The significantly ( $p < 0.05$ ) higher reaction time recorded in T2 rabbits could be attributed to an unknown cause, interacting with the leaf meal effect on the rabbits to influence the pulsatile release of testosterone to cause minor delay in the release of the hormone or its precursors. But once the hormone is released, probably in significantly higher volumes than in T1 rabbits, and sexual response initiated; sexual drive (libido) of the T2 rabbits became significantly higher, leading to the significantly ( $p < 0.05$ ) higher libido score recorded in them. The result of this study is in agreement with those obtained with *Azadirachta indica* [27], *Moringa oleifera* [28, 29, 30] and *Ficus carica* [31], which have been reported to enhance male reproductive potentials of rabbits and mice.

Percentages of the benefits recorded in the reproductive parameters evaluated in this study are presented in Table 3. This aims to explain in clear understandable terms, especially to the local rabbit farmers, the reproductive gains achieved through incorporation of 30% *Dialium guineense* leaf meal in the diet of adult rabbit bucks. Although T2 recorded 10.53% gain in semen volume, it was not significant ( $p > 0.05$ ) based on the result in Table 2, and may not be regarded as a gain at this level. Likewise, percentage of sluggish motile spermatozoa (higher in T2), will not be

considered as a negative attribute, since it was not significant ( $p > 0.05$ ). However, the rabbits on T2 made gains in total sperm count (66.44%), sperm concentration (50.60%) and libido score (49.99%), with little but significant ( $p < 0.05$ ) gain recorded in sperm morphology (0.45%). Percentages of total motile sperm and active motile sperm lost 2.50% and 5.21%, respectively in T2, but may not negatively affect fertility of the rabbits due to the very high percentage gain in their total sperm count and sperm concentration, coupled with the fact that the recorded percentages of total motile sperm and active motile sperm of T2 rabbits were well above minimum requirements, below which fertility will be negatively affected [24, 25]. Significant ( $p < 0.05$ ) reaction time of 10.74% was lost in T2, but this was significantly ( $p < 0.05$ ) countered by the gain in their libido score (49.99%).

### Conclusions and Applications

1. Inclusion of 30% *Dialium guineense* leaf meal in diets adult New Zealand White (NZW) rabbit bucks increased their total spermatozoa count, spermatozoa concentration, libido score and reduced their percentage of abnormal spermatozoa.
2. Inclusion of 60 % *Dialium guineense* leaf meal in diets of adult NZW rabbit bucks did not facilitate collection of data from the animals in same way for other treatments.
3. *Dialium guineense* leaves could serve as a veritable option for rabbit feeding during periods of scarcity of the conventional forage plants, and as a reproductive performance enhancer for breeder NZW rabbit bucks.

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