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REPRODUCTIVE AND GROWTH PERFORMANCE OF FOUR GENOTYPES OF RABBITS FED WITH TOASTED CHRISTMAS BUSH FRUITS (*Alchornea cordifolia*) SEED MEAL

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ABSTRACT

The body weight and reproductive performance of four genotypes of rabbits fed with toasted *Alchornea cordifolia* seed meal were examined in the study, as well as the body weight performance of their first filial generation and their reciprocal crosses. Toasted *Alchornea cordifolia* seed meal (TASM) inclusion was to know the (%) level that will perform better. The mating ratio of 1 sire to 9 dams in combinations of Dutch black buck and New Zealand does (DTB X NZW), New Zealand buck and Dutch black does (NZW X DTB), and then their reciprocal crosses resulted in a total of 127 kittens (NZW X DTB). The treatment diets were formulated at different levels to meet the rabbit's nutritional requirements. Rabbits were kept in hutches inside rabbit's pens, and feed and water were provided *ad libitum.* Reproductive and body weight were recorded. Preliminary and phytochemical analysis of the TASM revealed that it has values of 20.00%, 90.30%, 14.50%, 12.00%, 1.05%, and 65.2% for crude protein, dry matter, Ether extract, crude fiber, Ash, and Nitrogen-free extract, and phytochemical contains 6.50mg/g and 86.05mg/g for phytic acid and tannins. From the experiment, it is revealed that the rabbit fed on 15% TASM (NZW X DTB) significantly ($p<0.05$) had a better body weight and reproductive performance than other groups. The findings of this study show that TASM can be incorporated into rabbits' diets up to 15% inclusion level for better weight gain and reproductive efficiency without having any negative impact on the animal.

Keywords: Alchornea cordifolia, Body weight, Genotype, Performance, Rabbit, Reproductive

INTRODUCTION

Worldwide, rural residents are gaining more interest in rabbit farming (Cullere and Dalle, 2018). Rabbit (*Oryctolagus cuniculus*) farming is growing more and more popular among rural inhabitants around the world, because of its high prolificacy rate, strong mothering competence, adaptability to a wide range of conditions, high sources of variation, high roughage use, and low cost of production (Vastolo *et al.*, 2022, Ade *et al.*, 2023). The key factor in determining the economic viability of a rabbitry is the reproductive success of the doe, which is influenced by the buck's fertility (Marco-Jiménez *et al*., 2020).

Bucks are unquestionably the foundation of a successful generation because farm income depends on both buck and female viability. Male fertility in rabbit breeding is an additional noteworthy trait because, collectively with the doe, it determines reproductive and productive success. Additionally, the male can affect the productivity of the does in addition to fertility and conception due to the semen's capacity to fertilize (Jimoh and Ewuola, 2018).

In subsistence agriculture, *Alchornea cordifolia* is advantageous since it is regularly used as foliage and fed to grazing animals or processed into leaf meals for non-ruminants (Irikefe-ekeke *et al.*, 2020). However, it produces a lot of raw fruits that have not been domesticated and attention has not been given throughout any stage of production, processing, or usage, (Emenalom *et al.*, 2011, Ahiwe *et al.*, 2015). According to the limited scientific literature (Huffman 2002), wild mammals and birds like gorillas and chimpanzees devour the fruits and pith of *A. cordifolia* and *A. floribunda* in the Republics of Guinea (Sebater, 1977), Equatorial Guinea, Africa (Sugiyama and Koman, 1992).

Some authors report that subsistence farmers utilize the leaves to feed their cattle and that ruminants treasure them (Emenalom *et al.*, 2015; Irikefe-ekeke *et al.*, 2020; KpunIteimoere *et al.*, 2023). Furthermore, observations of the yellowing of egg yolks and shanks in broiler and layer diets, respectively, are believed to be connected to the leaves' high xanthophyll content (Udedibie and Opara, 1998). Unfortunately, a lot of browsing plants produce seeds with a range of anti-nutritional elements that prevent them from being used as food for cattle and other livestock. Alchornea plants only contain the alkaloids acronine and acronidine (Huffman, 2002; Martnez *et al.*, 2017). Alchornea seeds are consumed as animal feed, although there is very little information in the literature concerning its potential harmful effects and utility as a source of energy for rabbits.

Evaluating the reproductive and body weight traits of two strains of rabbits and their reciprocal crosses fed toasted *A. cordifolia* seed meal is the aim of this present study.

MATERIALS AND METHODS.

Experimental Site: The experiment was concluded at the Dennis Osadebay University's Teaching and Research Farm, Anwai, Asaba, which is situated at latitude 06014' N and longitude 06049' E. It is in the tropical rainforest zone, which has an annual rainfall range of 1500 mm to 1849 mm and a rainy season that lasts seven months from April to October, interrupted by a brief break in August.

Seed Processing: Wild shrubs along the Kwale/Ughelli route in Delta State, Nigeria, were collected for their mature, ripe *A. cordifolia* fruits. The collected seeds were separated from the stem and pods, toasted in a frying pan for 15–25 minutes to minimize the content of the harmful water, and subsequently placed into a hammer mill and ground into meals (TASM).

Table 1: Proximate and phytochemical analysis of toasted *A. cordifolia* seed meals (TASM)

Composition	Raw seed meals	Toasted
Crude protein (%)	13.69	20.00
Dry matter (%)	89.75	90.30
Ether extract (%)	3.90	14.50
Crude fibre (%)	16 10	12 00
Ash (%)	4 80	1.05
NFE (%)	61.5	65.2
Phytic acid (mg/100g)	10. 00	6.50
Tannins (mg/100g)	100.02	86.05

Figure 1: *A. cordifolia* fruits

Experimental Diets:
The four experimental diets outlined below were compounded:
T1: Control group without TASM (0%)
T2: with TASM at (5%)
T3: with TASM at (10%)
T4: with TASM at (15%).

Table 2: Composition of the experimental diets

INGREDIENTS	0%	5%	10%	15%
Maize	35.50	35.50	35.50	35.50
BDG	15.80	15.80	15.80	15.80
Soybean meal	5.90	5.90	5.90	5.90
PKC	5.25	5.25	5.25	5.25
Wheat offal	35.80	30.80	25.80	20.80
TASM	0.00	5.00	10.00	15.00
Bone meal	0.60	0.60	0.60	0.60
Limestone	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Methionine	0.15	0.15	0.15	0.15
Lysine	0.30	0.30	0.30	0.30
Premix	0.26	0.26	0.26	0.26
TOTAL	100.00	100.00	100.00	100.00
Calculated:				
Crude protein (%)	16.35	16.37	16.60	16.89
Crude fiber (%)	9.04	9.19	9.35	9.30
Digestible energy (kcal/kg)	2468.7	2500	2532.4	2564.2

The animals were fed a ration that contained 16% CP, 2600 Kcal/kgME, and 8% CF, in line with the proximate analysis of the feed. Other management practices persisted up until the 14th and 21st days shortly after mating, and pregnancy was confirmed by careful abdomen palpation; if confirmed, nest boxes were provided for the preparation of kindling on the 28th day of pregnancy.

Experimental Rabbits and Design.

Forty (40) mature Dutch black and White New Zealand rabbits, including 18 Dutch black does, 18 White New Zealand does, 2 Dutch black bucks, and 2 White New Zealand bucks, were used for this investigation. The two Dutch black bucks were paired each with nine Dutch black does and nine New Zealand does.

One hundred and twenty-four (124) kittens produced through crossings between DTB x DTB, NZW x NZW, DTB x NZW, and NZW X DTB at the end of the breeding phase were used in the current study (Table 3). The rabbits were kept in four (4) hutches with dimensions of 170cm by 32cm and had ten sections within which comprised a 34cm by 30cm by 28cm, a sufficient space for one rabbit in each cell. Each rabbit was kept in a separate section that was labeled with identification, such as tags.

Table 3: Mating ratio and offspring produced

Genotype	NO. of sire	No. of dam	No. of offspring
DTB X DTB	1	9	31
NZW X NZW	1	9	30
DTB X NZW	1	9	31
NZW X DTB	1	9	35

Note: DTB =Dutch Black, NZW= New Zealand White

Collection of data and analysis.

The following variables were measured.

Gestation Period: Calculated as the interval of time between the most recent mating and the onset of kindling.

Litter Size at Birth: By counting all kittens as soon as it was born, including any stillbirths.

Litter Size at Weaning: At the time of weaning, each litter included the following number of young rabbits (6 weeks).

Birth Weight: Kitten weight was taken individually by weighing in a scale (Camry weighing scale) and precautions must be taken by wearing hand gloves. The kittens' weight was then divided by the total number of kittens in the litter.

Body weight at Weaning: The weight of each kitten when it is time to wean the kittens at six weeks of age (6).

Weekly Body Weight: Each kitten in a litter was weighed once a week to evaluate the weekly body weight.

The analysis of variance (ANOVA) was performed by making use of the General Linear Model (GLM) procedure of the Statistical Package for Social Sciences (SPSS) on the assessment of sire breed and dam breed on performance traits (gestation length, litter size at birth, birth weight, litter size at weaning, body weight at weaning, and weekly body weight). Using the Duncan New Multiple Range Test, significant means were separated, while performance traits (gestation length, litter size during birth, birth weight, litter size during weaning, body weight during weaning, and weekly body weight) were dependent variables, the model included genetic groups as fixed factors.

The linear model is as follows:

$$Y_{ij} = \mu + B_i + E_{ij}$$

Where:

Y_{ij} = measurement of traits

μ = Population means

B_i = Effect of ith genetic groups (i = DTB x DTB, NZW x NZW, DTB x NZW, and DTB x NZW)

E_{ij} = Random error effect

RESULTS AND DISCUSSION

The result in Table 1 showed a significant improvement in the crude protein and a drop in the ant-nutritional factor when the fruits were toasted compared to the raw fruit seed. The results of this research agree with the results reported by Ahiwe *et al*., (2015) who also reported that boiling *A. cordifolia* seed fruit has reduced the ant-nutritional value and improved crude protein.

The results in (Table 4) showed that genotype NZW X DTB significantly ($P< 0.05$) had the highest weight (154.33 g) at the end of the first week, followed by DTB X NZW (151.65 g), DTB X DTB (150.72 g) and NZW x NZW (149.70 g) which were statistically different (p<0.05). The genotype DTB X DTB had the lowest weight (137.83 g) at week two, NZW X DTB still had significantly ($P<0.05$) higher body weight (200.03 g) than other genetic groups that were statistically similar (P<0.05), including NZW X NZW

(188.6 g), DTB x NZW (142.60 g) and DTB X DTB (137.83 g).

Throughout the whole six weeks of the pre-weaning phase, this pattern was seen. The results of this research are consistent with those published by Ajayi *et al.,* *(*2018) and Fathi *et al.,* (2023), in their separate studies found considerable variations because of weight among several rabbit breeds influenced by genotype and size of litter in a tropical, humid environment and residual feed intake at a hot temperature, however, they find appreciable variations in the growth characteristics of various rabbit breeds when they conducted a comparative analysis.

The animals' bodies and other bodily measurements grew larger as they had previously shown that the genotype could be influenced by environmental factors, comprising nutrition, disease, hormones, and general management could lead to variation in growth rate or weight gain of rabbits within the same breed or among different breeds (Sam *et al.*, 2020). However, the animals' ability to grow in age indicates that they were in normal good physiological and health conditions. However, rabbits fed with toasted *A. cordifolia* seed meal may be the cause depending on genetic variations because of weight, because of the high protein content that was released through the toasting between the seeds, and the reduction of the ant-nutritional factors that were remarkably reduced.

Table 4: Mean (± S.E) Body weight (g) performance of two (2) rabbit breeds crosses.

Age (weeks)	DTB x DTB	NZW x NZW	DTB x NZW	NZW x DTB
1	150.72 ± 5.43^{b}	149.70 ± 4.39 ^{c}	151.65 ± 1.385^{b}	154.33 ± 4.49^{a}
2	137.83 ±3.09^{c}	188.62 ± 4.17^{b}	142.60 ± 3.46^{c}	200.03 ± 3.80^{a}
3	199.24 ±11.77 ^{c}	208.27 ± 6.45^{b}	185.60 ± 6.34^{c}	250.46 ±13.16^{a}
4	332.60 ±13.81^{b}	457.53 ± 14.19^{b}	285.50 ± 6.48^{c}	522.04±114.87^{a}
5	386.60 ± 15.87 ^{c}	474.88 ± 15.57^{b}	356.76 ± 6.06^{c}	590.23 ±22.18^{a}
6	510.34 ± 19.57 ^{c}	575.18 ± 24.16^{b}	392.04 ± 12.07^{c}	690.45±12.25^{a}

^{a,b,c} = The means in the same row with different superscripts differ significantly (*P< 0.05*).

Table 5 shows the results of the four genotypes' reproductive abilities, the results revealed that there were no effects (*P>0.05*) in litter size at birth across the groups (LSB). In litter size at weaning (LSW) there were significant (*P<0.05*) differences observed among groups. NZW X DTB crosses had considerably (*p<0.05*) better litter size at weaning (5.15 ± 0.54) than other genotypes that were statistically comparable, this agrees with Desouky (2021), who found that litter size can be influenced by genotype and productivity of rabbits is largely based on how many young kits make it through the pre-weaning stage. The effectiveness of the doe is influenced by her capacity to give birth to thrifty offspring and to nurse its offspring to weaning (Sorensen *et al.,* 2001). Thus, a large litter size at weaning is required to maintain production efficiency in rabbit farming.

The average birth weight (ABWT) was higher (*p<0.05*) in NZW X DTB which had (37.00 ± 0.54) as the size of the litter at weaning. Similarly, the NZW X DTB crosses had considerably (P<0.05) larger body weights at birth this may be attributed to the value increase in the protein content of toasted *A. cordifolia* seed meal and this agrees with the report of Emenalom *et al.*, 2011, Ahiwe *et al.*, 2015), in their study, reported that boiling *A. cordifolia* has a positive impact on the nutritive value, furthermore reduced the anti-nutritional factors, and there is a progressive increasing in weight of broiler both at the starter and the finisher stages.

The gestation length (shortest) of 29.40± 0.54 days was observed in crosses between DTB and NZW, which was slightly (*P<0.05*) different from other genotypes that had statistically similar gestation lengths of 31.62 ± 1.14, 31.46 ± 0.67, and 30.50 ± 0.67 for crosses between NZW and DTB and DTB and NZW, respectively. Apori *et al.*, (2015) had previously observed that breed differences could cause variations in the gestation length of rabbits.

The findings (Table 5) showed that the percentage mortality varied significantly (*p< 0.05*) compared to the genetic groups. The crossings DTB X NZW and NZW X DTB genetic groups had similar percentage mortality, 5.60 ± 7.95 and 4.20 ± 7.56, respectively. It became apparent the NZW X DTB genetic group had the lowest percentage of mortality (4.20 ± 7.56) followed by the DTB X NZW genetic group (5.60 ± 7.95). The ability of the does to produce enough fur in the nesting boxes for the naked kits at birth perhaps contributed a part to the low percentage of mortality shown in a crossed genetic group. It is probably also related to nutrition factors that could be influenced by the genotypes (Fadare and Fatoba, 2018).

Table 5: Mean (± s.e) of reproductive traits of two (2) breeds of rabbit and their offspring.

Parameters	DTB x DTB	NZW x NZW	DTB x NZW	NZW x DTB
LSB	5.13 ± 0.98	5.10 ± 0.34	4.20 ± 0.67	5.15 ± 0.67
LSW(g)	4.30 ± 0. 89[b]	3.07 ± 0.21 [b]	4.20 ± 0.52[b]	5.01 ± 0.54[a]
ABWT	32 .55 ± 0.02[b]	35 50 ± 0.01[b]	33. 05 ± 0.01[b]	37.00 ± 0.03[a]
GL (days)	31.00 ± 1.14[a]	31.00 ± 0.67[a]	30.00 ± 0.56[b]	30.00 ± 0.67[a]
AWWT(g)	437.8 ± 9.26[b]	522.9 ± 10.56[b]	410.4 ± 8.07[b]	604.5 ±11.18[a]
% MORT	6.10 ± 0.87[ab]	6.87 ± 0.78[a]	5.60 ± 7.95[b]	4.20 ± 8.56[c]

[a,b,c,] The means in the same row with different superscripts differ significantly (P< 0.05).
LSB = Litter size at birth, LSW= Litter Size at Weaning, ABWT= Body weight at Weaning, GL= Gestation periods, AWWT= Birth Weight, and MORT= Mortality

CONCLUSION

Per the results stipulated, including toasted *A. cordifolia* seed meal in rabbit diets had no negative effects on body weight during the pre-weaning stage or other assessments of reproductive characteristics. However, group 4 fed with a 15% inclusion level showed superior outcomes. The findings TASM can be used as a better feed resource in rabbit diets with a 15% inclusion level for reproductive performance without having any negative impacts. However, further research needs to be done on TASM on the blood profile, as well as semen characteristics, sperm concentration, and other reproductive traits of the male rabbit.

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