International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 9, Number 5
Pages 1-12 (March, 2022)
www.arcnjournals.org

Performance and Apparent Digestibility of Rabbits Fed Oven Dried *Gmelina Arborea* Fruit as Replacement for Maize

Wariboko, O.N., Fidelis, E. E. and David, E.U.
Department of Agriculture, Faculty of Vocational and Technical Education, Ignatius Ajuru University of Education Rumuolumeni, Port Harcourt, Nigeria

Abstract: *Performance and apparent digestibility of rabbits fed oven-dried gmelina arborea fruit as a replacement for maize as an energy source were investigated for sixteen (16) weeks. A total of thirty-two (32) healthy young New Zealand White rabbits (mixed sexes) were fed with four diets: Diet 1 (0% replacement level of ground Gmelina fruit (GMF), diet 2 (5% replacement level of GMF), diet 3 (10% replacement level of GMF) and diet 4 (15% replacement level of GMF), respectively. Data on performance and apparent digestibility parameters were collected during this period and subjected to analysis using Analysis of Variance (ANOVA). From the results of this study, it is concluded that feeding rabbits with oven dried Gmelina fruits (Gmelina arborea) at varying levels of inclusion (0, 5, 10, and 15%) affected the growth performance parameters. Treatment 1, which has 0% inclusion of Gmelina fruits (Gmelina arborea), had the best final weight, dressed weight, and dressing percentage, although there was no significant difference (p 0.05) from Treatment 4. Furthermore, total digestible nutrients were relatively higher in Treatment 1, which is the control. The study therefore recommended that Gmelina arborea fruits be oven dried before feeding to rabbits to reduce the content of anti-nutritional factors, replace soya bean meal up to 15%, and subsequently increase feed intake, digestibility, and performance of rabbits.*

Keywords: Performance, Apparent Digestibility, Oven Dried *Gmelina Arborea* Fruit

. INTRODUCTION

According to Nworgu (2017), the growth rate of the Nigerian agricultural sector is below the potential of natural and human resources due to the high cost of agricultural inputs, poor funding of agriculture, inadequate functional infrastructural facilities, inconsistencies of government agricultural policies, inadequate private sector participation, poor mechanized farming, and little or no adoption of some simple agricultural technologies developed by scientists. In Nigeria, consumption of animal protein remains low at about 6.0–8.4 g/head/day, which is far below the 13.5g per day prescribed by the World Health Organization (WHO) (Egbunike, 2017). This is also true of the rabbit. Rabbit farming in Nigeria seems to be one aspect of livestock farming that has caught the interest of many Nigerians.

Adoption of rabbit farming as a modern farm practice and a form of mini livestock production is a sure way of attaining high agricultural productivity, an increase in sales and income, and an improvement in the living standards of farmers, as well as providing a basis for more scientific discovery and technological advancement. They are corrective measures for animal protein supplementation and increased meat sources to augment the family feed budget and sustain families in the most extreme economic situations. In the past, a series of works on rabbit farming have been carried out by many authors in line with the prevailing and changing technologies. Also, many researchers have made some attempts to show the reasons for and against the adoption of rabbit farming practices.

Gmelina (*Gmelina arborea*) fruit has been identified as a novel feed ingredient with the potential to reduce the cost of livestock production because the fruits are locally available and regarded as waste, not used as food by man and constituting an environmental hazard (Annongu & Folorunso, 2013). The most important and expensive feed item constituting a large portion of the cost of livestock feed is energy concentrates, especially for grains like maize, (Agunbiade *et al.*, 2001). Maize and its by-products of processing have been playing key roles as sources of energy in concentrated diets for rabbits. However, maize is also a major staple food in most developing countries including Nigeria, a raw material for industries, and an emerging bio-ethanol stock as the world energy crisis deepens (Akinola & Oruwari, 2007; Cotula *et al.* 2008; Spore, 2008). Therefore, the competition among men, industries, and livestock for the use of maize for food, raw materials, and feed, respectively, has heightened the cost of maize, often beyond the reach of livestock farmers. To compound the problem, maize is seasonally available (Omoikhoje *et al.*, 2008). Also, low-income countries, reflecting geographical and climatic zones, are projected to lose 5–10% of overall cereal production to climate change, while 1-3 billion people in poor and food-unsecured countries are facing losses of 10–20% of cereal production under climate change. To put it another way, the use of maize for livestock feed in this uncertain situation when people's direct needs have not been met makes economic and moral sense (Iyayi & Losel, 2001).

There is, therefore, a need for the exploitation of other energy sources as alternatives to maize in rabbit diets if the rabbit enterprise in the country is to be sustained. To become a substitute, the feed ingredient, as a matter of necessity, must be cheap, easily accessible and locally available, widely distributed, non-edible by man and, therefore, not competed for as food by man. In this vein, the use of fruit pulps as non-conventional, cheap, and alternative energy sources for maize has been advocated by Annongu and Folorunso, 2003; Oke *et al.*, (2007). According to Aduku and Olukosi (1990), the rabbit occupies a niche mid-way between ruminant and non-ruminant animals because of its simple and non-compartmentalized stomach, enlarged caecum, and colon. As posited by Wariboko, *et al.,* (2019), rhizophora mangle pith (rhizopith) which is a red mangrove plant is a very useful source of animal feed production. The findings of their study justified this by showing that rabbits fed diets with 10 and 15 % rhizopith gained weight faster than those fed the control diet. Further, feed efficiency increased with levels of rhizopith in the diets with rabbits on 15% rhizopith being most efficient. The animal, therefore, has the ability to thrive on forages and crop by-products, and this would certainly help to reduce the cost of rabbit production.

Gmelina fruit has been suggested as a possible energy source in livestock diets by Annongu and Folorunso (2003). Although most fruit pulps and husks are regarded as low-energy, low-protein, and high-fiber feedstuffs, Adejinmi *et al.*, (2007); Oluremi *et al.*, (2007); Ripe Gmelina Fruit Pulp (RGFP) has a better level of crude protein and energy releasing components than most fruit pulps, and is therefore regarded as a carbohydrate source by Annongu and Folorunso, (2003). Consequently, feed formulations exist, for combining ripe gmelina fruit pulp meal (RGFPM) with maize in rabbit feed with the aim of reducing the cost of feeding concentrates to rabbits and maintaining productivity within acceptable limits (Ingweye & Lamidi, 2017).

A review of the literature shows that little has been done on the use of heat-treated gmelina fruit as a feed ingredient for livestock, especially in rabbit diets. It is, therefore, important to generate data to provide another option for farmers in their bid to reduce the cost of rabbit nutrition. Using this fruit to feed livestock will not only benefit livestock owners but will also help to mitigate climate change. Work has been done on the chemical composition of oven dried gmelina fruit as well as the nutritive value. Ingweye and Akpan, (2015); Ingweye and Okon, (2012). However, feeding oven-dried gmelina fruit to rabbits in order to ascertain the digestibility of the nutrients as well as the effect on other performance characteristics is scarce. Therefore, this study was carried out to determine the performance, carcass, organ and apparent digestibility of rabbits fed diets of oven-dried *gmelina arborea* fruit (ODGF) with maize.

Purpose of the Study

The purpose of this study was to investigate the Performance and apparent digestibility of rabbits fed diets of oven dried *gmelina arborea* fruit. Specifically, the study seeks to:

i. Ascertain the extent to which the nutritional composition of oven dried gmelina fruit at replacement levels with maize in diets can enhance the performance of rabbits.
ii. Examine the apparent digestibility coefficient of rabbits fed oven dried gmelina fruit at replacement levels with maize in diets of rabbits.

Research Questions

The following research questions were raised to guide the study.

i. To what extent can the nutritional composition of oven dried gmelina fruit at replacement levels with maize in diets enhance the performance of rabbits?
ii. What is the apparent digestibility coefficient of rabbits fed oven dried gmelina fruit at replacement levels with maize in the diets of rabbits?

II. MATERIALS AND METHODS

Measurement of Performance Parameters in Rabbits

The measurements of the performance parameters of the rabbits lasted for sixteen (16) weeks. The animals were individually weighed at the start of the trial to obtain their initial body weights and thereafter every seven days (weekly) to obtain weight gains. Feed intake, body weight gain, feed conversion ratio (FCR), water intake, and water-to-feed ratio were measured and or calculated. The animals were fed daily. Water and experimental diets were provided twice, with one half provided in the morning (at 07:30 hours) and the other half in

the evening (at 16.00 hours). The leftover feed at the end of each day was subtracted from the feed supplied the previous day to obtain the daily feed intake. The feed conversion ratio was calculated by dividing the mean feed intake per treatment by the mean body weight gain at a point in time. Daily feed intake and weekly body weight gains were taken before serving fresh feed and water in the morning. On the last day of the experiment (the end of the growth trial – 16 weeks) the final weight was taken. Weekly weight gain in grams was calculated by subtracting the current week's weight from the preceding week's weight. The daily water intake for each rabbit was calculated by subtracting the amount of water that was left over from the amount that was given the day before and taking into account the amount that evaporated. Shoremi *et al.* (2001) explained how to do this.

Apparent Nutrient Digestibility Trials of Rabbits.

At the end of the growth phase (16 weeks), three (3) rabbits placed in individual pens of similar weight per treatment were selected for the determination of apparent digestibility. This trial lasted for fifteen days (5 days for adjustment and 10 days for data collection). During this period, the experimental rabbits were fed a ration allowance of 60g of the growing diets per day without forage supplementation. Faecal collections of individual rabbits were done on a 24-hour basis before fresh feed was served in the morning throughout the ten-day trial period. The fresh faeces from each animal were weighed and then reweighed after oven drying at 80^{o}C for 24 hours. Similarly, the daily feed intake per replicate was also recorded during the period. The feces were bulked, mixed, and milled before being analyzed for their proximate constituents. In addition, proximate analyses of the diets were carried out. All proximate analyses were carried out as recommended by the methods of AOAC (1995). The analyzed proximate components include crude protein (CP), crude fiber (CF), ether extract (EE), ash, nitrogen free extract (NFE), and calorific value. The apparent digestibility coefficients were calculated using the formula prescribed by Obun and Ayanwale (2006):

$$\text{Apparent digestibility coefficient} = \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times \frac{100}{1}$$

III. RESULTS

Performance of Rabbits Fed Diets of Maize and Oven Dried Gmelina Fruit

The performance characteristics of rabbits fed oven dried gmelina fruit is shown in Table 1. The feed intake, weight gain, final body weights, feed conversion ratio and the feed to water intake of rabbits fed the experimental diets were significantly ($p < 0.05$) different. However, the initial body weights and the water intakes of the experimental animals were not significantly ($p > 0.05$) different.

Table 4.1: Performance of Rabbits Fed Diets of Maize and Oven Dried Gmelina Fruit at Various Replacement Levels

Parameters	Treatment 1 (Control- 0%)	Treatment 2 (5%)	Treatment 3 (10%)	Treatment 4 (15%)
Initial weight (g)	1130.00±0.06 ^{ns}	1230.00±0.07 ^{ns}	1140.00±0.06 ^{ns}	1150.00±0.09 ^{ns}
Feed Intake (g)	1430±0.31^{c}	1830±0.24^{a}	1580±0.28^{b}	1380±0.32^{d}
Weight gain (g)	379.00±0.02^{a}	262.00±0.23^{c}	224.00±0.26^{d}	323.00±0.24 ^{b}
Final weight (g)	1509.67±0.16^{ns}	1492.33±0.17^{ns}	1364.00±0.20^{ns}	1473.00±0.17^{ns}
FCR (Feed Intake/Gain)	3.77±1.33^{b}	6.98± 1.78^{a}	7.05± 6.09^{a}	4.27±4.67^{b}
Water Intake (ml/day)	310.55±0.16 ^{ns}	300.56±0.17 ^{ns}	330.05±0.15 ^{ns}	325.08±0.17 ^{ns}
FWR	1: 4.60±0.31^{c}	1: 6.10±0.24^{a}	1: 4.78±0.28^{b}	1: 4.25±0.32^{d}
Mortality	0.0	0.0	0.0	0.0

$^{a, b, c, d}$: Mean on the same row different superscripts are significantly differently ($p< 0.05$); ^{ns} - Not significant, FCR (Feed Conversion Ratio), FWR (Feed Water Ratio)

The feed intake (FI) of rabbits in the study was significantly ($p < 0.05$) different. Treatment 2 had the highest feed intake of 1830±0.24g. This was followed by Treatment 3 (1580±0.28g), Treatment 1 (1430±0.31g) and the least value was observed in Treatment 4 (1380±0.32g). However, Pius *et al*. (2019) in their work on the effect of rations with fresh leaves of *Gmelina arborea* on the growth performance and organ weights of rabbit bucks reported significant but lower values of feed intake than those reported in this study. Similar values of feed intake, though not significant, were reported by Fanimo *et al*. (2003) when they worked on growth performance, nutrient digestibility, and carcass characteristics of growing rabbits fed cashew apple waste. Other authors and the feed intake they reported include Ikyume *et al*. (2019), who recorded feed intake between 36.11 and 50.54, Ozung *et al*. (2017), who recorded feed intake between 52.98 and 66.94, and Hadiza (2019), who recorded feed intake values between 83.99 and 84.48. There was a decrease in feed intake with increasing fibre content in the diets as revealed by the rabbits in Treatment 4 with an intake of 1380±0.32g and fibre content of 28.34±16.19 in this study. This trend was also applicable to Treatment 3 with an intake of 1580±0.28g and fibre content of 15.84±2.67. This is in agreement with the findings of Etchu, Ngu, Yongabi, and Woogeng (2014), who explained that feed consumption in rabbits tends to decrease with increasing fibre levels in feed. Furthermore, other factors that would have affected feed intake as observed in this study could also be feed availability, the quality of the feed in terms of its nutrient content, and palatability.

The final body weights of rabbits were significantly ($p < 0.05$) different. Results revealed that rabbits in Treatment 1 (control group) exhibited the highest body weight gains and final body weights (1509.67±0.16g) as opposed to the Gmelina fruit incorporated feeds in decreasing

order of Treatments 4 (1473.00±0.17g), Treatment 2 (1492.33±0.17g) and Treatment 3 (1364.00±0.20g) respectively. Treatment 1 had the highest final body weight. This implied that the final body weights of the rabbits decreased with *Gmelina arborea* addition, though not significantly ($p<0.05$). Pius *et al*. (2019) reported a similar final weight of rabbit that ranged between 1178 and 1672g. Higher values were reported by Hadiza (2019), who reported a final weight of rabbit between 1819 and 1979g. Using bitter cola, Ebenebe et al. (2016) measured final body weights ranging from 1407 to 1614.Ozung *et al*. (2017) also gave values between 1266 and 1650.Ingweye and Okon (2015) reported final body weights of between 1605 and 1900. Furthermore, the variation in final body weights of rabbits across the treatments recorded in this study could be attributed to variations in the crude protein (CP) contents and the metabolizable energy (ME) of the different feeds. This follows the findings reported by the Scientific Committee on Animal Health and Animal Welfare (2000) that diets of high energy and protein content promote fast growth.

The weight gains and final body weights of rabbits were significantly ($p < 0.05$) different. Results revealed that rabbits in Treatment 1 (control group) exhibited the highest weight gains and final body weights (379.00±0.02g; 1509.67±0.16g) as opposed to the Gmelina fruit incorporated feeds in decreasing order of Treatments 4 (323.00±0.24g ; 1473.00±0.17g) Treatment 2 (262.00±0.23; 1492.33±0.17g) and Treatments 3 (224.00±0.26 ; 1364.00±0.20g) respectively. The trend in the values of the weight gains and the final body weights among the rabbits is in agreement with the findings of Etchu *et al*. (2014), who stated that rabbits performed better on a low-fiber diet than on a high-fiber diet.

The feed conversion ratios (FCR) of rabbits were significantly ($p < 0.05$) different. Results revealed that rabbits in Treatment 3 exhibited the highest FCR (7.05± 6.09), followed by Treatment 2 (6.98± 1.78), Treatment 4 (4.27±4.67) and Treatment 1 (3.77±1.33) respectively. The varying fibre content of the diets used in this study contributed to the variation in the feed conversion ratios. The values in this study were lower than those reported by other authors. For instance, Pius *et al*. (2019) reported significant feed conversion ratio values that were between 7.88 and 17.01. Ramchurn *et al*. (2000) recorded feed conversion ratios between 4.8 and 7.8 when they worked on the digestibility and growth of domestic rabbits using multi-nutrient blocks as a feed supplement. Furthermore, Fanimo *et al*. (2003), Ikyume *et al*. (2019), Ozung *et al*. (2017), and Hadiza (2019) reported similar feed conversion ratios. According to Maertens and Gidenne (2016), feed accounts for the largest part of the production costs in animal production. Therefore, the efficient use of feed by farm animals, mostly expressed as feed conversion ratio (FCR), is a key indicator to judge the performance and profitability of a farming system. Similarly, it is an index of the efficiency of converting unit feed into unit weight gain (feed/gain) (Etchu *et al*., 2014). As a result, the Gmelina fruit was incorporated into the experimental diets: Treatments 3, 2, and 4 with higher fibre contents revealed higher FCR values. This increase is in agreement with the findings of Pote*et al*. (1980). Similarly, Alawa and Amadi (1991) observed that rabbits consume more high-fiber diets to compensate for the low energy content of such diets.

The water intake of rabbits was not significantly ($p > 0.05$) different. However, numerical results revealed that rabbits in Treatment 3 exhibited the highest water consumption (330.05±0.15ml/day), followed by Treatment 4 (325.08±0.17ml/day), Treatment 1

(310.55±0.16ml/day) and Treatment 2 (300.56±0.17ml/day) respectively. The results revealed that water intake was higher for the drier feeds (i.e., feeds with lower moisture and higher dry matter content). Therefore, from the study, the Gmelina fruit incorporated diets Treatment 3 and Treatment 4 with lower moisture contents of 4.73±0.37% and 5.36±0.11% respectively, were presumed to be drier, so the rabbits in that group tended to consume more water. The results of this study are in agreement with the findings of Etchu *et al*. (2014), who explained that water intake (WI) is a function of the nature of the diet, the age of the animal and ambient temperature, and that the drier the diet, the greater the quantity of water consumed. Consequently, the quantity of water consumed by the rabbits in this study was within the normal range (100 – 600ml/day) of water intake recommended for healthy rabbits.

The feed to water intake ratios of rabbits by the experimental groups were significantly ($p < 0.05$) different. The results revealed that rabbits in Treatment 2 portrayed the highest feed to water consumption (1: 6.10±0.24), followed by Treatment 3 (1: 4.78±0.28), Treatment 1 (1: 4.60±0.31), and Treatment 4 (1: 4.25±0.32) respectively. The result revealed that rabbits with the highest feed intake exhibited a higher feed-to-water intake ratio.

No mortality (death) was recorded in all the experimental groups: (zero Gmelina fruit inclusion) and Gmelina incorporated diets: Treatment 2 (5% Gmelina fruit inclusion), Treatment 3 (10% Gmelina fruit inclusion) and Treatment (15% Gmelina fruit inclusion). This result is in agreement with the findings of Ahemen, Shaahu, and Kwaghve (2016), who concluded that growing rabbits could be fed a diet containing up to 15% *Gmelina arborea* leaf meal without any harmful effects on growth performance, genital tract dimensions, visceral organ weights, or haematological parameters of rabbits.

Apparent Digestibility Coefficient of Rabbits Fed Oven Dried Gmelina Fruit

Table 4.6: Apparent Digestibility Coefficient of Rabbits Fed Varying Inclusion Rates of Oven Dried Gmelina Fruit

Parameters (g)	Treatment 1 (Control - 0%)	Treatment 2 (5%)	Treatment 3 (10%)	Treatment 4 (15%)
Crude protein	94.65 ^{ns}	90.86 ^{ns}	93.65 ^{ns}	93.5 ^{ns}
Ash	45.45 ^{ns}	47.09 ^{ns}	35.27 ^{ns}	47.66 ^{ns}
Gross energy	78.95 ^{ns}	59.47 ^{ns}	59.27 ^{ns}	61.05 ^{ns}
NFE	15.84^{c}	17.29^{b}	3.52^{d}	17.42^{a}
Ether Extract	95.04 ^{ns}	94.01 ^{ns}	94.76 ^{ns}	93.77 ^{ns}
Crude fibre	91.10 ^{ns}	89.40 ^{ns}	86.95 ^{ns}	85.09 ^{ns}

$^{a, b, c, d,}$ means within same row with different superscripts are significantly different ($p<0.05$).

Table 4.6 reveals the apparent digestibility coefficient of rabbits fed oven-dried Gmelina fruit. The highest apparent digestibility coefficient for protein was observed in Treatment 1

(94.65%) and the least was observed in Treatment 2 (90.86%). For ash, the highest value was recorded at Treatment 4 (47.66%) and the least at Treatment 3 (35.27%). Furthermore, the highest apparent digestibility coefficient for gross energy was observed in Treatment 1 (78.95%) and the least in Treatment 3 (59.27%). Treatment 1 (95.04%) had the highest apparent digestibility coefficient for ether extract, while the least was in Treatment 4 (93.77%). Furthermore, the highest apparent digestibility coefficient for fibre was observed in Treatment 1 (91.10%) and the least in Treatment 4 (85.09%).

The results of the apparent digestibility in the study indicated good utilization of the test ingredients by the rabbits, which is expressed by the high values observed in most of the parameters assessed in the study. Values for protein digestibility in comparison with those of other authors are relative. Meineri and Peiretti (2007) reported a range of 71–73%), whereas Ronke *et al*. (2014), Ingweye and Lamidi (2017), and Ikyume *et al*. (2019) in the latter research had 79, 85, and 76%, respectively. However, all compared reports are lower than the findings of this work, which recorded an average of 93.17%. Ozung *et al*. (2017) reported a range of 75-78% although the animals were fed with cocoa pods. It was, however, reported by Pier *et al.* (2014), that most of the nutrients, including protein, were more in the rabbit faeces than was observed in the test feed material. The values for ash are similar to those reported by Ingweye and Lamidi (2017) and Ozung *et al.* (2017). Non-significant values of lipid/ether extract have been reported by Rumchurn *et al.* (2020). The values reported in this study fell within the range of values reported by Ebenebe *et al*. (2016) and Ozung *et al*. (2017).

Variation in the digestibility of fibre has been reported by other authors. While Fanimo *et al.* (2003) reported significant variations in fibre digestibility in rabbits, Ingweye and Lamidi (2017) and Ikyume *et al*. (2019) reported non-significant variations. The values reported by these authors are, however, within those reported in this study. In their work on the performance and nutrient digestibility of young pigs fed dietary raw and processed *Gmelina arborea fruits,* Annongu *et al.* (2006) observed significant differences in digestibility of dry matter, protein, and fibre. They also observed that dietary *Gmelina arborea fruits* also influenced metabolizable energy as well as daily energy absorbed and retained. Values for these parameters decreased with an increasing level of raw *Gmelina arborea fruit* meal in diets. Conversely, there was improvement in the digestibility of these nutrients following *Gmelina arborea fruit* treatments or when a low level of raw *Gmelina arborea fruits* was fed for incorporation at a low level. They also revealed that treatment of high-fibre feedstuffs with alkali could assist in breaking ligno-cellulose complex walls, releasing nutrients and enhancing digestibility. Their results on nitrogen balance followed a trend similar to the other nutrients discussed. High nitrogen utilization on the 30% treated and 10% raw *Gmelina arborea fruit* meals suggested improved or better nutritional value of the test feedstuff treated or included at low levels.

Ingweye and Lamidi (2017) evaluated the nutrient digestibility and reproductive performance of rabbits fed ripe gmelina fruit pulp (RGFP)-based diets. Ripe gmelina fruit pulp replaced maize at 0, 25, 50, 75, and 100% for diets I, II, III, IV, and V, respectively. Grower/gestation diets had 17% crude protein and 2500 kcal (ME)/kg, while lactation diets had 18% crude protein and 2600 kcal (ME)/kg. At age 16 weeks, one buck and two does per group were

selected for a seven-day digestibility trial. Rabbits were fed 60 g of the grower diets per day without forage. Daily feed intake and feces collections were recorded. Three healthy does and a buck with well-developed testicles per group with similar body weights were selected for mating at 20 weeks old, at one buck to three does. They observed that the digestibility of NFE, ash, EE, CP, and CF values ranged from 53.21-53.19, 92.21-92.19, 91.34-91.20, 85.61–85.29, and 94.04–94.02, respectively. Replacement of maize with ripe gmelina fruit pulp did not affect ($p > 0.05$) the nutrient digestibility of the diets. Replacing maize with ripe gmelina fruit pulp reduced litter size at weaning, mean survival rate, litter weight at 21 days, litter weight at weaning, milk yield, and weight gain, but had no effect on litter weight at birth, number of matings per conception ($p > 0.05$), or abortion/still birth. For good reproduction, they recommended that ripe gmelina fruit pulp not replace maize in rabbit diets at more than 25%.

IV. CONCLUSION

From the results of this study, it is concluded that feeding rabbits with oven dried Gmelina fruits (*Gmelina arborea*) at varying levels of inclusion (0, 5, 10, and 15 %) affected the growth performance parameters. Treatment 1 which is 0% inclusion of Gmelina fruits (*Gmelina arborea*) had the best final weight, dressed weight and dressing percentage. Furthermore, total digestible nutrient was relatively higher in Treatment 1 which is the control. The response of the rabbits fed oven dry Gmelina fruits (*Gmelina arborea*) could be as a result of the treatment which likely may have had reduced phytochemical components and the fibre content of the Gmelina fruits. The duration of the research could be a reason as well. However, results for the apparent digestibility were positive which suggest that the drying released more nutrients inside the rabbits that could be assimilated that made the concentration of the nutrients in the feces higher.

V. RECOMMENDATIONS

The following recommendations are therefore made from the results of this study:

1. *Gmelina arborea* fruits should be oven dried before they are fed to rabbits to reduce the content of anti-nutritional factors and subsequently increase feed intake, digestibility and performance of rabbits
2. Treatment 2 (5%) oven dry Gmelina fruits (*Gmelina arborea*) gave the mean best performance in terms of live weight, weight gain, dressed weight and dressing percentage and haematological parameters of rabbits and it is therefore recommended for feeding rabbits.
3. A general sensitization of the use of oven dry Gmelina fruits (*Gmelina arborea*) should be carried out to promote its use among rabbit farmers.

REFERENCES

Adejinmi, O.O., Hamzat, R.A. & Fapohunda, J.B. (2007). Performance and nutrient digestibility of rabbits fed fermented and unfermented cocoa pod husk. *Nigerian Journal of Animal Production,* 34 (1), 63–68.

Aduku, A.O. & Olukosi, J.O. (1990). *Rabbit Management in the Tropics: Production, Processing, Utilization, Marketing, Economics, Practical Training, Research and Future Prospects*. Abuja: Nigeria Living Books series, G. U. Publications.

Agunbiade, J.A., Akeula, I.O. & Awojobi, H.A. (2001). An assessment of pig production systems: a case study of Lagos and Ogun States, Nigeria. *The Ogun Journal of Agricultural Sciences*, 1, 108-120.

Ahemen, T., Shaahu, D.T & Kwaghve, N.N. (2016). Growth Performance, Genital Organ Dimensions, Visceral Organ Weights and Haematology of Male Rabbits Fed Graded Levels of Gmelina Arborea Leaf Meal. *IOSR Journal of Pharmacy and Biological Sciences*, 11(3), 28 – 32.

Akinola, L.A.F. & Oruwari, B.M. (2007). Response of laying hens to total dietary replacement of maize with cassava, *Nigerian Journal of Animal Production,* 3(2), 196-202.

Alawa, J.P. & Amadi, C. (1991). Voluntary intake and digestibility of diets containing corn cobs, brewers dried grains and wheat bran by rabbits. *Journal of Animal Production Research*, 11 (1): 9 – 19.

Annongu, A. A., Liebert, F., Olawuyi, E. I. O., & Joseph, J. K. (2006). Performance and nutrients digestibility of young pigs fed dietary raw and processed *Gmelina arborea* fruits, JORMAR 3(1), 21 – 28, ISSN: 1597-3204

Annongu, A.A & Folorunso, A.S. (2003). Biochemical evaluation of *Gmelina arborea*fruit meal as a swine feed stuff. *Biokemistri,* 15(1), 1-6.

Cotula, L., Dyer, N. & Vermeulen, S. (2008). *Fueling Exclusion? The Biofuels Boom and Poor People's Access to Land*. Rome: Food and Agriculture Organization /International Institute Environment and Development.72 pp.

Ebenebe, C.I., Nwankwor, A.O., Izukanne, R.O & Ufele, A.N. (2016). Performance and Haematological Parameters of Rabbits fed graded levels of Bitter kola (*Garcinia kola*). *International Journal of Livestock Production*, 7(12), 128- 133.

Egbunike, G.N. (2017). What is animal science and how can Nigerians get out of nourishment? Livestock products. Proc. 2nd Ann. Conf. Anim. Sci. Assoc. of Nig. (ASAP). Sept. 16-17th 1997. Ikeja Lagos. 1-2.

Etchu, K.A., Ngu, G.T., Yongabi, K.A. & Woogeng, I.N. (2014). Effect of varying level of Groundnut (*Arachis hypogea*) haulms on the growth performance of weaner rabbits *(Oryctalaguscunninculus*). *International Journal of Livestock Production*, 5(5), 81 – 87.

Fanimo, A.O., Oduguwa, O. O., Alade, A. A., Ogunnaike, T. O. & Adesehinwa, A. K. (2003). Growth performance, nutrient digestibility and carcass characteristic of growing rabbits fed cashew apple waste, *Livestock Research for Rural Development* 15 (8), 1-7.

Hadiza, I. (2019). Growth performance and nutrient digestibility of growing rabbits (*Oryctolagus cuniculus*) fed with mixtures of brewers dried grains and sorghum brewers dried grains diets. *Food Science and Technology*, 20(1), 163 – 170.

Ikyume, T.T., Ogu, I.E., Okwori, I.A. & Shaahu, D.T. (2019) Growth Performance and Apparent Nutrient Digestibility of Grower Rabbits Fed Combinations of Concentrate with Grass and/or Legume Forage. *Journal of Multidisciplinary Research Review*, 1 (1), 41-45.

Ingweye, J. N. & Lamidi, A.A. (2017). Apparent Nutrient Digestibility and Reproductive

Performance of Rabbits Fed Ripe Gmelina (*Gmelina arborea*) Fruit Pulp Meal. *Science and Agriculture*, 17 (1), 22-27

Ingweye, J.N. and Okon, B.I. (2013). Growth performance and organ characteristics of rats fed gmelina (*Gmelina arborea*) fruit pulp, *African Journal of Livestock Extension*, 11,1 -5

Iyayi, A.E. & Losel, D.M. (2001). Protein enrichment of cassava by-products through solid state fermentation by fungi. *The Journal of Food Technology in Africa*, *6* (4), 166-118.

Maertens L. & Gidenne T. (2016). Feed efficiency in rabbit production: nutritional, technico-economic and environmental aspects, 11th World Rabbit Congress-June 15-18, 2016-Qingdao-China. pp 337 -351.

McMichael, A.J., Powles, J.W., Butler, C.D. & Uauy, R. (2007). *Food, livestock production, energy, climate change and health*. Energy and Health Paper 5, National Centre for Epidemiology and Population, the Australian National University, Canberra, Australia, 55–65. Retrieved October 20, 2021 from http://www.thelancet.com.

Nworgu, F.C. (2017). Economic importance and growth rate of broiler chicken served fluted pumpkin (*Telfariaoccidentalis*). *African Journal of Biotechnology*, 2(6) 34-39.

Obun, C.O. & Ayanwale, B. (2006). Utilization potential of *Afzeliaafricana* seed meal in the diet of starter broiler chicks. *Tropical Journal of Animal Science*, *9* (1), 55–61.

Oke, D.B., Adeyemi O.A., Oke, M.O. & Akinpelu M.I. (2007). Utilization of citrus wastes in broiler diets. In E. A. Agiang, L, N. Agwunobi and O. O Olawoyin (eds), *Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production held at University of Calabar, Calabar,* March 18–20. pp 20-34.

Oluremi, O.I.A., Andrew, I.A & Ngi, J. (2007). Evaluation of the nutritive potential of the peels of some citrus fruit varieties as feed stuffs in livestock production. *Pakistan Journal of Nutrition,* 6 (6), 653-656.

Omoikhoje, S.O., Bamgbose, A.M. & Aruna, M.B. (2008). Replacement value of unpeeled cassava root meal (UCRM) for maize in weaner rabbits. *Nigerian Journal of Animal Production*, 35 (1), 63–68.

Ozung,P. O., Kennedy,O. O.,Oko, E. A. Agiang, P. O. Eburu, E. I. & Evans, C. E. (2017). Growth Performance and Apparent Nutrient Digestibility Coefficients of Weaned Rabbits Fed Diets Containing Different Forms of Cocoa Pod Husk Meal, *Agriculture and Food Sciences Research*, 4(1), 8-19.

Pius, O., Ahemen, T. & Addass, P.A. (2019). Effect of rations with fresh leaves of *Gmelina arborea* on growth performance and organ weights of rabbit bucks, *Agricultural Science and Technology*, 11 (4), 317-322.

Pote, L.M., Cheeke, P.R. & Patton, N.M. (1980). Utilization of diets high in Alfalfa meal by weaning rabbits. *Journal of Applied Rabbit Research*, 3 (4), 5 – 10.

Ramchurn, R., Raggoo, J. & Ruggoo, A. (2000). Digestibility and growth in the domestic rabbit using multi-nutrient blocks as a feed supplement, *Livestock Research for Rural Development* 12 (1), 1-8 http://www.cipav.org.co/lrrd/lrrd12/1/ram121b.htmcyanide content of cassava (*Manihot esculenta*) and cassava products. *Journal*

Ronke Yemisi Aderinboye, Olaysinka T.O., & Adeyemi M.B. (2014). Performance of weaner rabbits fed a concentrate diet supplement with paw-paw leaves. Tropical Anin Health and production 47, 323-329 (2015).

Shoremi, O.I.A., Akor, J.A., Igoche, L.E. & Onaa, S.O. (2001). Effect of graded levels of sweet potato (*Ipomea batatas*) forage on growth and carcass characteristics of weaner rabbits fed concentrate mash. *Discovery and Innovation*, 13, 35-38.

Wariboko, O.N., Onunkwo, D.N., Tambari, N.A, Kornom, B.C. Nnadi, P.N & Okonkwo, J.C. (2019). Growth response and apparent nutrient digestibility of rabbits fed RHIZO (Rhizophora mangle) PITH. *International Journal of Veterinary Science,* 8(3), 192-194.