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Effects Of Dietary Browse Plant Inclusion On Growth Performance, Carcass Characteristics, Organ Development And Economic Viability Of Rabbit

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Abstract

This study evaluated the nutritive value and economic potential of selected browse plant leaves as alternative feed resources for weaner rabbits. Forty weaner rabbits of about 800–1000 g were fed to five different feed. Treatment consisted of 20% inclusion levels of Blighia sapida (T1), Ficus thonningii (T2), Gmelina arborea (T3), and Gliricidia sepium (T4), while a browse-free diet served as the control (T5). The feeding trial lasted for 12 weeks, after which carcass characteristics, organ weights, and feed cost implications were assessed.

Proximate analysis revealed higher crude fibre contents in Blighia sapida (23.72%), Gmelina arborea (22.13%), and Ficus thonningii (20.27%) compared with Gliricidia sepium (16.67%). Ether extract values of the browse-based diets were generally comparable to those of the control diet. Carcass evaluation showed that head weight of rabbits fed Blighia sapida was comparable to those fed Gliricidia sepium and the control diet, while rib weight was similar to rabbits fed Gmelina arborea and Gliricidia sepium. Rabbits fed the Blighia sapida-based diet recorded significantly ($P < 0.05$) differences. Economic analysis indicated that the cost per kilogram of feed was lower for all browse-based diets compared with the control diet.

The results demonstrate that Blighia sapida, Ficus thonningii, Gmelina arborea, and Gliricidia sepium leaves can be effectively utilized as alternative feed ingredients in weaner rabbit diets, with the added advantage of reducing feed costs without adverse effects on carcass performance. Their inclusion in rabbit feeding systems may therefore contribute to more sustainable and cost-effective rabbit production.

Keywords: Browse plants, weaner rabbits, Blighia sapida, Ficus thonningii, Gmelina arborea, Gliricidia sepium, carcass characteristics, feed cost, alternative feed resources

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Introduction

Livestock are animals that are raised on farms for food, work, and other purposes (McClure et al., 2018). Rabbits are small domestic animal. The European rabbit, Oryctolagus cuniculus is the ancestor of the world's hundreds of breeds (McClure et al., 2018) of domestic rabbit. Their adaptability is one reason for their successful proliferation in many parts of the world, including regions where they have been introduced by humans. Rabbits are known for their prolific breeding habits, which have given rise to the phrase "breeding like rabbits." (Susan et al., 2021).

Weaner rabbits, typically aged between 4 to 8 weeks, are young rabbits that have recently been weaned from their mother's milk and transitioned to solid food (Parsons et al., 2018). Hay, particularly timothy hay, should constitute the bulk of their diet as it aids in digestive health and helps prevent issues like gastrointestinal stasis. Fresh vegetables provide necessary vitamins and minerals, but they should be introduced gradually to avoid digestive upsets. Pellets specifically designed for young rabbits ensure they receive adequate protein and nutrients to support rapid growth (Vella et al., 2021). This period is critical as it involves significant changes in their diet, environment, and physiology, making proper care essential for their growth and health. Nutritionally, weaner rabbits require a high-fiber diet to support their developing digestive systems. A mix of hay, fresh vegetables, and specially formulated pellets is recommended (Romanovsky et al., 2014). According to Johnson-Delaney et al. (2011), the term "browse plant" refers to plants that are primarily consumed by herbivorous animals, particularly browsers. Browsers are animals that feed on high-growing vegetation such as leaves, twigs, and fruits of shrubs and trees, as opposed to grazers that eat grass and low vegetation. In their natural habitats, animals typically feed on a diverse range of plants.

The carcass characteristics of weaner rabbits, typically those aged between 6 to 12 weeks, are crucial for assessing their meat quality and overall economic value in the rabbit meat industry (Benedek et al., 2021). These characteristics include factors like carcass weight, dressing percentage, organs, head, and loin. The carcass weight of weaner rabbits is a fundamental measure, directly influenced by factors such as genetics, diet, and overall health (Cooke et al., 2014). Weaner rabbits are generally smaller than mature rabbits, but the goal is to achieve a balance between growth rate and carcass quality.

Materials And Methods

Experimental site

The experiment was carried out at the Rabbitary unit of the teaching and research farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso.

Pre experimental preparation

The experimental pen were washed and disinfected with Lysol, DD force and detergent to get rid of insect and microorganism before getting the animals and was allow to dry for 2weeks.

Experimental animals and their management

Forty (40) weaner rabbits was used for the experiment weighing between 800g to 1000g which were fed to five (5) dietary treatments with four replicate which contains eight rabbit in each pen for 12 weeks. On arrival, the rabbit was acclimatized for 3 days under perfect condition. They were given anti-stress, feed and clean water. Before the arrival of the rabbit the hutches were washed and disinfected. The hutches were partitioned into cells. The rabbit was housed and separate feeders and drinkers was provided for each rabbit.

Procurement and preparation of test Ingredient

Browse plant (Blighia sapida, Fiscus thoningii, Gmelina arboreal, Gliricida sepium) were harvested and the formulated feed was done at a reputable feed mill in Ogbomoso. The harvested browse plant was air dried by spreading it under a shed to avoid direct contact with sunlight, it was constantly stirred to promote uniform dehydration until it reaches a constant weight after which it was grinded into a powdered form.

Table 1 : Experimental diet

The experimental diets used is as follows:

INGREDENT	DIET A%	DIET B%	DIET C%	DIET D%	DIET E%
DCP	20.08	20.08	20.08	20.08	30.10
W/O	20.08	20.08	20.08	20.08	20.08
S/M	10.04	10.04	10.04	10.04	8.02
GNC	9.04	9.04	9.04	9.04	10.04
R/B	10.04	10.04	10.04	10.04	15.06
PKC	10.04	10.04	10.04	10.04	16.06
Blighia sapida	20.08	0	0	0	0
Fiscus thoningii	0	20.08	0	0	0
GMELINA arboreal	0	0	20.08	0	0
GLIRICIDIA sepium	0	0	0	20.08	0
LYSINE	0.06	0.06	0.06	0.06	0.06
METH	0.06	0.06	0.06	0.06	0.06
PREMIX	0.06	0.06	0.06	0.06	0.06
SALT TOTAL	0.50 100	0.50 100	0.50 100	0.05 100	0.05 100

Diet A: 20% Blighia sapida were mixed with other feed ingredients.
Diet B: Contains 20% Ficus thonnigii and other feed ingredients.
Diet C: Contains 20% Gmelina arboreal and other feed ingredients.
Diet D: Contains 20% Gliricidia sepium and other feed ingredients.
Diet E: Contains 0% of browse plant with other feed ingredients
DCP= Dry cassava peel, W/O= Wheat offal, S/M= Soybean meal, GNC= Groundnut cake, R/B= Rice bran, PKC= Palm kernel cake,

Experimental design

The experiment was laid in a completely randomized design (CRD)

Procedure for pellet diets

The mixed ingredient was immediately transfer into the pellet mill and pelletized using an extrude of 200°C heater and a 4mm mesh size to produce pelleted diet. The pellet was allowed to cool down for 10 minute in order to solidify and air dried on a neat cemented surface for three days to reduce moisture content (≤ 7%), to minimize deterioration and prolong shelf life.

Data collection

Feed intake

The feeding trail lasted 12 weeks, and were determined by giving 3% body weight (DM) on daily basis to the experimental animals. The left ort in each trough was weighed between 07 08hrs the following day. Feed intake = quantity of feed offered (g) – quantity of feed leftover (g)

Weight change

The weight changes were determined by subtracting the initial weight from the final weight change.

Weight change = Final weight –Initial weight

Digestibility trial

Digestibility trial At the end of 12 weeks feeding trial, four (4) animals from each experimental diet were transferred into metabolic cages for digestibility study. The metabolic cages were designed in a way that eases collection of faeces. The animals were allowed an adaptation period of seven days in the metabolic cages followed by seven days digestibility study.

$$\text{Digestibility} = \frac{\text{Nutrient in feed intake (g) - Nutrient excreta output (g)}}{\text{Nutrient in feed intake}}$$

Carcass characteristics

At the end of the 12 weeks of feeding trial, four (4) animals from each treatment were randomly selected for carcass and organ evaluation. After slaughtering, the blood was allowed to completely drain. The viscera and other organs were removed to get the dressing weight. The carcass was dissect into a primal cut and weighed.

Laboratory Analysis

Sample of the test ingredients, experimental diets and feed samples were taken and oven dried at 105°C for 24 hours. The grinded sample (0.02mm) were taken to the lab for proximate analysis according to AOAC (2005), while the fiber fraction was carried out according to van soet (1991).

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) using SPSS 2020. The significance treatment was separated by Duncan multiple range test (DMRT) of the same package.

Results And Discussion

Results

Proximate composition of the test ingredient

The proximate composition of the test ingredient is presented in table 2 below. All the test ingredients differ significantly ($P<0.05$). The highest Dry matter content (89.70%)

was recorded at T1 while the lowest value (82.67%) was recorded for T3 (ingredient 3). The highest crude protein (19.67%) was recorded for T1 and statistically similar to T3 while the lowest value was recorded at T2 (17.42%). But crude fiber and ether extract (23.72 and 12.12%) were observed has the highest at T1 while their corresponding lowest value were recorded at T4 (16.67%), T2, T3, and T4 (10.00-10.17%). However, the highest ash content was recorded at T3 (12.42%) and statistically lower for T4 (10.12%) and T1 (10.23%). The highest NDF (31.62%), ADF (29.31%) and ADL (21.18%) were recorded at T1 while the lowest NDF, ADF and ADL were recorded at T4.

Table 2 : Proximate composition of the test ingredient

PROXIMATE ANALYSIS	T1	T2	T3	T4	SEM
DM	89.70a	87.60b	82.67d	86.77c	0.77
CRUDE PROTIEN	19.67a	17.42c	19.43ab	19.26b	0.79
CRUDE FIBRE	23.72a	20.27c	22.14b	16.67d	0.79
ETHER EXTRACT	12.12a	10.17b	10.10b	10.00b	0.27
ASH	10.23c	11.12b	12.42a	10.12c	0.28
NFE	34.26c	41.02b	35.91c	43.95a	3.65
NDF	31.62a	26.64c	29.20b	22.47d	1.02
ADF	29.31a	25.11c	27.18b	20.52d	0.98
ADL	21.18a	18.40c	19.65b	15.23d	0.66

[abcd] Mean different superscripts along the row are significantly different (P<0.05)

Proximate composition of the experimental diets

The proximate composition of the experimental diets is presented in table 3 below. All the experimental diets differ significantly (P<0.05). The highest Dry matter content (91.70%) was recorded at T1 and statistically similar to T3 (91.73%) and T5 (91.54%) while the lowest dry matter content (89.83%) was recorded at T4. The highest crude protein was recorded at T5 (18.24%) while the lowest value was recorded at T4 (16.19%). However, the highest crude fiber was recorded at T2 (14.11%) while the highest ether extract was recorded at T3 (6.07%). The lowest crude fiber (10.41%) was recorded at T5 and The lower ether extract (4.27%) were observed at T1, T2 and T5 (4.11- 4.27%) while the highest ash content (7.12%), NDF (28.46%), ADF (17.43%), and ADL (17.31%) were recorded for T2.

Table 3 : Proximate composition of the Experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
DM	91.70a	90.70b	91.73a	89.83c	91.54a	0.20
CRUDE PROTIEN	16.35b	17.45b	16.31b	16.19c	18.24a	0.16
CRUDE FIBRE	12.24b	14.11a	12.00d	12.11c	10.41e	0.31
ETHER EXTRACT	4.11c	4.11c	6.07a	4.51b	4.27c	0.20
Ash	5.30c	7.12a	6.11b	6.02c	6.11b	0.16
NDF	28.16b	28.46a	28.31b	28.45b	27.24c	0.16
ADF	15.13b	17.43a	14.64b	14.91b	12.27c	0.44
ADL	15.00b	17.31a	14.82b	14.62b	12.62c	0.40

abcde Mean different superscripts along the row are significantly different (P<0.05)

Cost analysis of the experimental diet

The cost analysis of the experimental diets is presented in table 4 below. The analysis reveals that experimental diets (T1-T4) with inclusion of browse plants have identical costs, while T5 with no inclusion has the highest cost.

Table 4: Cost analysis of the experimental diet

PARAMETERS	T1	T2	T3	T4	T5
Cost per ton	584,320	584,320	584,320	584,320	754,430
Cost/100kg	58,432	58,432	58,432	58,432	75,443
Cost/50kg	29,216	29,216	29,216	29,216	37,722
Cost/25kg	14,608	14,608	14,608	14,608	18,861
Cost/kg	584.32	584.32	584.32	584.32	754.43

Feed intake of weaner rabbits fed the experimental diets

The feed intake of weaner rabbits fed the experimental diets are depicted in table 5. The treatments differ significantly (P<0.05). The highest TFI (9258.6g) was recorded at T5, while the lowest value was recorded at T3. The highest AWFI (1061.5g) and ADFI (151.6g) was recorded at T2, while their lowest value was recorded at T5.

Table 5: Feed intake of weaner rabbits fed the experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
TFI (g)	12270.8b	12738.4b	11615.2c	11817.2b	9258.6a	218.2
AWFI(g)	1022.6ab	1061.5a	967.9b	984.9b	771.5c	18.2
ADFI(g)	146.1b	151.6a	138.3ab	139.9ab	110.2c	2.6
FCR	9.47	7.40	7.38	6.63	9.47	0.45

abc Mean different superscripts along the row are significantly different (P<0.05)

Weight change of weaner rabbits fed the experimental diets

The weight change of weaner rabbits fed the experimental diets is presented in Table 5. All the parameters do not differ significantly (P>0.05) except for the weight change. The highest weight change (18300.00g) was recorded at T4, while the lowest value was recorded at T5.

Table 6: Weight change of weaner rabbits fed the experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
Initial Weight	1428.4	1467.6	1418.4	1434.4	1440.0	52.93

Final Weight	2958.4	3225.6	3014.4	3264.4	2413.6	74.08
Weight Change	1530.00ab	1758.00b	1596.00c	1830.00a	973.60d	51.26
FCR	9.47	7.40	7.36	6.63	9.47	0.45

abcd Mean different superscripts along the row are significantly different (P<0.05)

Digestibility of weaner rabbit fed the experimental diets

The Digestibility of weaner rabbit fed the experimental diets is presented in table 6 below. Most of the Digestibility coefficients do not differ significantly (P>0.05). Except ASHD, ADFD and ADLD. The highest ASHD(30.76%) was recorded at T4, while the lowest value was recorded at T1. The highest NDFD (47.08%) and ADFD (60.53%) were recorded at T5, while their lowest value were recorded at T1.

Table 7 : Digestibility of weaner rabbit fed the experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
DMD	39.83	41.42	46.18	49.62	53.03	2.55
CPD	81.38	82.58	80.45	80.38	69.40	1.60
CFD	23.34	25.86	21.09	27.24	37.37	2.46
EED	91.89	91.35	93.86	91.23	86.35	0.88
AshD	9.65d	20.14b	20.90b	30.76a	29.03ab	1.90
NDFD	24.42c	33.47ab	29.67b	35.35ab	47.08a	2.52
ADFD	47.37c	54.47b	50.98b	56.13b	60.53a	1.80
ADLD	27.75	36.35	31.61	36.41	47.94	2.28

abcd Mean different superscripts along the row are significantly different (P<0.05)

Carcass characteristics of weaner rabbit fed the Experimental diets

The carcass characteristics of weaner rabbit fed the experimental diets do not differ significantly (P>0.05) except for the head and the rib weight. The highest head weight was recorded at T2 (287.20%), while the lowest value was recorded at T3. The highest rib weight was recorded at T2 (537.60%) and statistically similar to T1, T3 and T4 (468.00-472.40%) while the lowest value was recorded at T5.

Table 8: Carcass characteristics of weaner rabbit fed the Experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
FINAL WEIGHT	3291.20	3272.40	3663.60	3020.00	2834.40	64.38
BLED WEIGHT	3022.40	3189.97	3128.00	2946.00	2962.80	45.31
EVISERATED WEIGHT	2194.80	2395.20	2094.40	2116.00	2106.00	34.48
CARCASS WEIGHT	1718.80	2003.20	1975.20	1728.00	1691.20	32.35
HEAD WEIGHT	258.40ab	287.20a	231.20b	256.40ab	270.80ab	3.25
SHANK WEIGHT	96.80	116.00	89.20	105.60	111.60	1.99

FRONTLEG WEIGHT	271.20	224.00	264.00	302.00	250.80	4.16
THIGH WEIGHT	620.00	232.00	272.00	286.00	252.40	4.16
RIB WEIGHT	468.00ab	537.60a	476.40ab	472.40ab	417.20b	7.92
LOIN WEIGHT	453.20	458.40	489.20	414.00	454.40	9.91
DRESSING PERCENTAGE	54.13	61.22	54.85	56.77	61.35	1.66

[ab] Mean different superscripts along the row are significantly different (P<0.05)

Organ characteristics of weaner rabbit fed the Experimental diets

The organ characteristics of the weaner rabbit fed the experimental diets is presented in table 6 below. All the organ characteristics differs significantly (P<0.05). The highest kidney(20.00g) and liver (91.20g) was recorded at T1, while their lowest value was recorded at T2. The highest heart was recorded at T5 (11.20g), while the lowest value was at T3. The highest whole intestine (483.60g), lungs (17.76g) and abdominal fat (104.00g) were recorded at T4, while the lowest value for whole intestine, abdominal fat were recorded at T2 and the lowest lungs was recorded at T1.

Table 9: Organ characteristics of weaner rabbit fed the experimental diets

PARAMETERS	T1	T2	T3	T4	T5	SEM
KIDNEY(g)	20.00a	16.05c	19.81ab	16.61b	18.56b	0.26
LIVER(g)	91.20a	66.40c	71.60b	76.40b	80.40b	1.57
HEART(g)	10.61b	9.18b	7.81c	10.21b	11.20a	0.22
W/I(g)	447.20b	355.60c	416.40b	483.60a	408.00b	6.31
LUNGS(g)	13.52c	16.48b	14.40b	17.76a	13.92b	0.26
ABDOMINAL FAT(g)	89.20b	63.60c	92.40b	104.00a	88.00b	3.33

[abc] Mean different superscripts along the row are significantly different (P<0.05)

Discusssion

Browse plant can be nutritious feed supplement for rabbits, providing essential nutrients like fiber, vitamins and minerals (Adulleh et al.,2019). Studies have shown that feeding browse plants to rabbits can improve their gut health, antioxidants and support sustainable organic practices (Naanda et al.,2020). The choice of treatment would depend on the specific nutritional needs of the animals being fed.

The lower dry matter value obtained for T1 could probably be caused by poor soil structure, low pH, and nutrient deficiencies (Singh et al.,2020). Animal fed with plants with low dry matter could lead to lower energy density, affecting animal performance. It could also increase risk of nutrient deficiencies (Singh et al., 2020). Crude protein content for T1 was the highest in this study and compares favourably with the value obtained for T3. This indicates that both plants had comparable potentials as protein supplements in animal diets. However, it was generally observed that, other nutrients were comparable to the nutrients values of the plants especially CP and CF which were within the ranges of 19-25% which were against the CP and CF values of 12-22% obtained by (Aruwayo et al., 2021). The crude protein content of any given feed is responsible for muscle development and adequate growth so as other nutritional composition present (Van Soest, 1994). The ether extract obtained for T1 is high and will meet the fat requirement for animals. The ash content of any feed state the mineral availability of the feed. The ash content reported for T3 is high and could meet the mineral requirements of animals without any other supplementation. NDF,ADF and ADL help to determine the plants fiber content, affecting digestion and animal performance (Van Soest,1994). Imbalance fiber and nutrient intake could lead to digestive issues (McDonald et al.,2021).

Browse plants offer a cost effective alternative to traditional animal feeding programs. Farmers and livestock producers can reduce feed costs by incorporating browse plants into their feeding program (McDonald et al.,2021). Diets containing browse plants with high nutrient content can increase head and rib weight of animals (Tolera et al.,2018).The result obtained do not agreed with the findings of (Hoffman et al.,2010).Whereby animal with desirable head and rib characteristics command higher prices. However, The kidney and liver play important roles in the detoxification and excretion of most toxic materials from the body (Ani et al., 2020). Browse plants antioxidant properties reduce oxidative stress, promoting cardiac health (Tolera et al.,2020). The lower energy density allows for more efficient fat storage. The reduction in oxidative stress, promote intestinal health of animals (Sampaio et al.,2019).

Conclusion And Recommendation

Any of the test ingredients could be considered as an alternative feed source to reduce the cost of production whereby Blighia sapida could be recommended for high kidney, liver and abdominal fat compared to other treatment

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