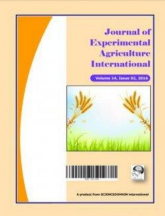

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Performance and Carcass Characteristics of Rabbits Fed Diets with Total or Partial Replacement of *Tridax procumbens* by Bamboo (*Bambusa arundinancea*) Leaves

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Authors' contributions

This work was carried out in collaboration between all authors. Author OFA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors VA and AJ managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The evaluation of performance parameters and carcass characteristics of rabbits fed diets with various ratios of bamboo (*Bambusa arundinacea*) and *Tridax procumbens* leaves.
Study Design: A completely randomized design was applied.
Place and Duration of Study: The experiment was carried out at the rabbitry unit, Department of Animal and Environmental Biology, Adekunle Ajasin University between May and August 2016 and lasted for a period of 70-days.
Methodology: 36 weaned mixed sex rabbits with an average weight of 1075g were randomly assigned to six dietary treatments of 6 rabbits (3 does and 3 bucks) per treatment. Apart from the concentrate feed (50%), freshly harvested *B. arundinancea* and *T. procumbens* leaves were offered

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to the animals at 2% of their live weight at the ratio of 0:0 (T1), 100:0 (T2), 75:25 (T3), 50:50 (T4), 25:75 (T5) and 0:100 (T6). Proximate analysis of the experimental leaves and concentrate diets were carried out at the end of the trial. Performance parameters (final live weight (g), weight gain (g/d) and feed conversion efficiency (gain/intake)), dry matter intake of experimental leaves and of concentrate diets were also recorded.

Results: The use of leaves in the rabbits' diets had no significant effect (P>.05) on final live weight, total dry matter intake and Feed Conversion Efficiency (FCE). Significant effect (P<.05) was observed in total and average weight gain of rabbits fed with the forage diets. Non-significant effect (P>0.05) was observed in slaughter weight and dressing percentage between control (T1) and T2 (100% bamboo leaves) group of rabbits. Liver, kidney and heart weights were not significantly different (P>0.05) between T2 and T6 groups. Addition of leaves in the diet of rabbits did not have a significant effect on the offal (head, blood and pelt) of rabbits.

Conclusion: It can be concluded from this study that bamboo leaves, when combined with tridax leaves, up to 50% inclusion levels could be utilized as forages for feeding grower rabbits.

Keywords: Rabbits; bamboo; tridax; carcass; performance; forage leaves.

1. INTRODUCTION

The nutritional level of the Nigerian population is characterized by inadequate intake of protein both in quality and quantity [1]. Animal protein consumption is very essential for covering protein requirement of the organism. The average daily protein intake is still far less than the value of 35 g per adult per day recommended by FAO [2]. Therefore, efforts are directed towards the evaluation of all reasonable options that cover the recommended level at an affordable price [3]. In order to maximize food production and meet protein requirements, viable options should be evaluated [4]. Among such alternatives is the use of livestock species most especially rabbit that could play a major role in animal production of a developing country. Rabbit production has proven to be a veritable means of alleviating animal protein deficiency [5]. The rabbit has excellent properties of high growth rate, high efficiency in converting forage to meat, short gestation period, high prolificacy, relatively low cost of production and high nutritional quality of rabbit meat which includes low fat, sodium and cholesterol levels. It also has a high protein level of about 20.8% and its consumption is not influenced by cultural and religious biases [6]. Domestic rabbits (*Oryctolagus cuniculus*) are ubiquitous and apart from a nutritional food, serves as a research models and as pets. Rabbit meat appears as a great alternative to reduce the shortage of animal protein in developing countries, where grains are mainly used for human consumption [7,8].

Rabbits do not compete directly with human for both cereal and legume grains and can subsist on a diet consisting primarily of grass as monogastric herbivores. In contrast to these characteristics of rabbits compared to the rest of livestock, the cost production remains high due to the increasing cost of concentrate formulated feeds. It is reported however that a non-conventional feedstuff (NCF) can serve as a great alternative for the reduction of feeding cost which ultimately leads to reduction in the price of animal products [9]. This production-cost reduction could be accomplished after the optimization of availability, procurement and processing of this non-conventional feedstuff.

Rabbits could utilize forages [10], a fact that minimizing the cost of feeding compared to poultry which competes with man for cereal and legume based feed resources. Previous researchers [11] stated that the development of high quality forage based diets with simple supplements is a priority research area in developing countries. Although rabbits can survive by consuming virtually all forage diets, performance is better enhanced by offering a mixed feeding regime including forage and formulated feeds [12,13]. Bamboo is a woody plant that belongs to the subfamily Bambusoideae of the Gramineae family. It is recorded to be the fastest-growing plant on earth since culms of some species, in just 4 months, can reach 40 m in height and 30 cm in diameter [14]. It is estimated that worldwide there are over 1200 species under 87 genera of bamboo with a natural distribution across a broad range of environments (humid, tropical, subtropical and temperate region) in all continents apart from Europe [15,16]. In addition bamboo is an adaptable plant, with some species being deciduous and others evergreen [17]. Bamboo

(*B. arundinaceae)* leaves contains flavonoids and bioactive compounds, and are already used in folk medicine [18,19] due to their anti-inflammatory and anti-ulcer properties [20]. The chemical composition of the leaves from different species strengthens the possibility of their utilization as potential forage in rabbit diet. The crude protein (CP) and fibre of four different bamboo species (*B. vulgaris vittata*, *B. vulgaris vulgaris*, *B. ventricosa* and *O. abyssinica*) range from 18.39 to 19.39% and 25.88 to 33.19% respectively [21]. These CP levels exceed that of *Penisetum purpureum* (11.95%), *Panicum maximum* (5.5%) [22] and Leucaena (12.80%) [23]. The crude fibre level is also appreciably higher than that of *Gliricidia sepium* (18.10%) [24]. Leaves from various species of bamboo have reportedly been used to feed livestock/ ruminants; *Arundinaria racemosa* in the Himalayas [25] and *Arundinaria tecta* (cane breaks) in North Carolina [26] have been evaluated as cattle fodder. Numerous bamboo species are fed to horses, cattle and sheep worldwide [26]. However, the nutrition of rabbits in Nigeria is primarily based on *Tridax procumbens* and/ or *Centrosema pubescens* leaves whose growth and availability in the dry season cannot sustain rabbit production the whole year [27]. Therefore, this study was carried out to evaluate performance and carcass characteristics of rabbit fed diets with total or partial replacement of *Tridax procumbens* by Bamboo leaves.

2. MATERIALS AND METHODS

2.1 Site

The experiment was conducted at the Rabbitry Unit of the Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba, Ondo State. The university and study site lies on Longitude 5'44' east and Latitude 7'28' north of the equator with temperature ranging from 26-28°C. The experiment was carried out between May and August, 2016.

2.2 Experimental Animals, Diets and Management

Thirty six (36) weaned cross bred rabbits (New Zealand x Chinchilla) of both sexes were purchased from peasant farmers in Akungba. The age and weight of the rabbits ranged from 5 to 6 weeks and from 1.0 kg to 1.15 kg respectively. The rabbits were housed individually in hutches made of wood and galvanized iron (40x60x70 cm), equipped with windows for proper ventilation. Each hutch was also equipped with a drinker made of aluminium and a trough to prevent feed wastage. During the first week, rabbit were allowed to acclimatize and Vitalyte (Phoenix pharmaceuticals U.S.A) which is an anti-stress agent was administered.

Fresh, young *Bambusa arundinacea* foliage leaves were harvested from trimmed branches of bamboo trees within Adekunle Ajasin University. *Tridax procumbens* leaves were also collected from the area. The leaves were washed and chopped into smaller pieces and fed to the animals. The Thirty six (36) weaned rabbits were randomly assigned to six dietary treatments of 6 rabbits (3 does and 3 bucks) per treatment. The proportion of rabbits per breed per treatment for each groups were similar. Freshly harvested *Bambusa arundinacea* and *Tridax procumbens* leaves were offered to the animals at the ratios of 0:0 (T_1), 100:0 (T_2), 75:25 (T_3), 50:50 (T_4), 25:75 (T_5) and 0:100 (T_6) of *B. arundinacea* and *T. procumbens* respectively. Concentrates were fed at a rate of 50% of the offered diets. The animals were daily fed at a level of 4% of their body weight on dry matter basis daily (2% concentrate and 2% forage). Table 1 shows the ingredient and nutrient composition of experimental basal diet.

Table 1. Ingredient and nutrient composition of experimental basal diet

Ingredients	Quantity
Maize	47.24
Wheatbran	38.00
Soyabean meal	12.49
Bone meal	1.12
Periwinkle	0.58
Salt	0.35
Premix	0.15
Total	100.00
Calculated composition	
Crude Protein %	16.02
ME (Kcal/kg)	2400.00
Energy:Protein	150:1

ME= Metabolizable Energy; Premix supplied per type kg diet: Vit. A, 100,00 IU; Vit. D 2,000,000 IU; Vit. E, 23,00 mg; Vit K3 2,000 mg; Vit. B, 3,000 mg; Vit. B2, 6,000 mg;Niacin, 50,00 mg; Calcium. 800 mg; Panthotenate, 10,000 mg; Vit. B6, 5,000 mg; Vit B12, 250 mg; Folic acid, 100 mg; Biotin, 50 mg; choline chloride,40,000 mg; Selenium, 0.12 mg and Anti oxidant, 120,00 mg*

During the 5 days pre-experimental period, rabbits were fed with the basal concentrate diet.

After this period, the rabbits were randomly assigned to the six dietary treatments (6 rabbit per treatment) in a completely randomized design. Water was provided *ad libitum* and similar routine management procedures at the rabbit farm unit (Adekunle Ajasin University, Akungba-Akoko) were followed, viz, daily sweeping of rabbit house, daily washing of drinkers and feeders, provision of clean water daily for the rabbits, consistency in the timely feeding of the rabbits at 8:00 am daily among other things. Proximate analysis of diets (concentrate and forage) was carried out according to the procedure described by AOAC [28] and shown in Table 2. For magnesium determination, strontium chloride was added with the aim of avoiding chemical interference. Iron was determined by atomic absorption spectroscopy.

Feed intake and weight gain were recorded weekly during the experimental period. At the end of the 70-day experimental period, 4 rabbits per treatment (2 males and 2 females) were randomly selected slaughtered and carcass prepared according to the norms of the World Rabbit Association (WRSA) [29]. Weights measurements were carried out using a sensitive electronic kitchen scale (Model: EK 5350).

2.3 Statistical Analysis

Data were analyzed using the one-way ANOVA procedure of SAS software (16).Where dietary treatment was significant (P<0.05), means were compared using Duncan's multiple comparison procedure of the same statistical package.

3. RESULTS AND DISCUSSION

Variations in the nutrient composition of *Bambusa arundinancea* and *Tridax procumbens* leaves (Table 2) were very marginal apart from ash and crude protein with an approximate difference of 4% in favour of bamboo and tridax leaves respectively. Mineral percentages were comparatively higher in tridax compared to bamboo leaves (Table 3).

The performance of rabbits fed with experimental diets is shown in Table 4. Final live weights of rabbits fed with the examintal leaves were not significantly different (P>.05). Total weight gain and average weight gain of rabbits on tridax leaves and concentrate alone (T_6) was significantly lower (P<0.05) compared to the other experimental groups. Feed intake and feed conversion efficiency were not significantly influenced by the varying ratio of experimental leaves. Gradual increase in the levels of bamboo leaves up to 50% in combination with tridax leaves (T_4) resulted in improved performance (total and average weight gain). This finding indicates that bamboo leaves could be effectively combined with tridax leaves up to 50%. Increase in bamboo levels beyond 50% resulted in gradual decrease in performance (not significant). This could be attributed to the concomitant increase of anti-nutrients that are present in the bamboo leaves. The controls diet (T_1) had significantly higher values (P<0.05) for feed intake, final live weight, total weight and average weight gain compared to other rabbits. This is expected considering the fact the control diet comprised only of concentrate containing all the required nutrients in the right proportion. Feed conversion efficiency was poor for all the treatments and control.

The weights of carcass, organ and by-products of rabbits fed experimental diets are shown in Table 5. Rabbits of experimental groups, having leaf diets are compared with each other preferably by considering p<0.05 with various slaughter weight (SW) and various hot carcass weight (HCW). T_2 (100% bamboo levels) and T_1 (control) groups were not significantly different (P>0.05) from each other in SW and dressing percentage. There were significant differences (P<0.05) among animals fed experimental diets in fore-leg and hind leg percentages. Animal fed experimental leaves had higher kidney, trachea, heart and lung weights than the control. Rabbits on diet T_2 (100% bamboo leaves) were not significantly different with rabbit on diet T_6 (100% tridax leaves) in the heart, trachea, liver, lung and kidney weights.

Table 2. Proximate composition of concentrates, *Bambusa arundinancea* and *Tridax procumbens* (DM)

Diets	MC (%)	Ash (%)	EE (%)	CF (%)	CP (%)	NFE (%)
Concentrates	8.77	6.96	5.05	3.27	17.08	67.64
B. arundinancea	11.82	15.29	2.71	13.79	21.85	34.54
T. procumbens	11.60	11.77	2.92	15.32	25.25	33.14

MC=Moisture Content; EE= Ether Extract; CF=Crude Fibre; CP=Crude Protein; NFE=Nitrogen free extract; DM=Dry Matter

Table 3. Mineral composition of experimental leaves

Diet	Na (ppm)	Ca (ppm)	K (ppm)	Fe (ppm)	Mg (ppm)	Zn (ppm)
BL	20.10	51.40	38.40	3.95	4.52	0.37
TL	36.70	70.30	40.00	5.39	7.68	1.20

BL=Bamboo leaf; TL=Tridax leaf; Na=Sodium; Ca=Calcium; K=Potassium; Fe=Iron; Mg=Magnesium; Zn=Zinc

Table 4. Performance of rabbits fed concentrates, *Bambusa arundinancea* and *Tridax procumbens* leaves

Treatment	T1	T2	T3	T4	T5	T6	SEM
Initial weight (g)	1090.00	1100.00	1090.00	1100.00	1040.00	1080.00	28.09
Final live weight (g)	1760.00^{a}	1322.50^{b}	1372.50^{b}	1407.50^{b}	1287.50^{b}	1237.50^{b}	36.18
Total weight gain (g)	669.00^{a}	221.50^{b}	272.50^{b}	307.50^{b}	247.50^{b}	157.50^{c}	32.54
Average weight gain (g/d)	9.13^{a}	3.30^{bc}	3.33^{bc}	4.63^{bc}	3.83^{bc}	2.38^{c}	0.46
FCE (gain/intake)	0.107^{a}	0.050^{b}	0.045^{b}	0.065^{b}	0.058^{b}	0.040^{b}	0.005

Means with different superscripts within the same row are significantly (P<0.05) different. T_1=100% concentrate/formulated feed which serve as the control; T_2=50% concentrate + 50% (100% Bamboo leaf meal (BLM); T_3=50% concentrate + 50%(75% BLM and 25% Tridax leaf meal (TLM); T_4=50% concentrate + 50% (50% BLM + 50% TLM); T_5=50% concentrate + 50% (25% BLM+75%TLM); T_6=50% concentrate + 50% (100% TLM). SEM: Standard Error of Mean. FCE= Feed Conversion Efficiency

Table 5. Dry matter intake (g/d) of rabbit fed *B. arundinancea* as a replacement for *T. procumbens*

Dry matter	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Concentrate	89.62^{a}	35.80^{b}	37.07^{b}	34.62^{b}	35.16^{b}	34.03^{b}	3.55
B. arundinancea	-	33.23^{a}	27.87^{b}	17.02^{c}	8.73^{d}	-	1.99
T. procumbens	-	-	9.38^{d}	17.05^{c}	26.17^{b}	33.72^{a}	2.05
Total	89.62^{a}	69.03^{b}	74.30^{b}	72.9^{b}	70.02^{b}	67.75^{b}	2.18
CP intake	16.78^{a}	14.20^{b}	15.55^{b}	14.65^{b}	15.24^{b}	15.03^{b}	2.12

^{abc}= Means with different superscripts within the same row are significantly(P<0.05) different. T_1=100% concentrate/formulated feed which serve as the control; T_2=50% concentrate + 50% (100% Bamboo leaf meal (BLM); T_3=50% concentrate + 50 %(75% BLM and 25% Tridax leaf meal (TLM); T_4=50% concentrate + 50% (50% BLM + 50% TLM); T_5=50% concentrate + 50% (25% BLM+75%TLM); T_6=50% concentrate + 50% (100% TLM). SEM: Standard Error of Mean

The crude protein of *B. arundinancea* (21.85%) is higher than other species of bamboo leaves; *B. vulgararis vittata* 18.75%; *B. vulgaris vulgaris* 18.39%, *B. ventricosa* 19.02% and *O. abyssnica* 19.39% [21]. However the CP content of bamboo leaf used in this study is lower than that recorded for cassava (*M. utilisima*) and *T. Triangulare* leaves (24.85 and 31.00%, respectively) [30,31]. The high crude fibre concentration (13.79%) suggests that animals will prefer them less compared to alternatives that have lower crude fibre levels such as *P. Purpureum* (9.09%) [32]. This support previous findings [26] that bamboo leaves can impart superior physical tone and stamina to horses since fibre speeds up the process of digestion by improving peristalsis. It has long been established that dietary fibre supply also plays a major role in the prevention of digestive troubles in growing rabbits [33]. Fibre is known to promote caecal fermentation in fattening rabbits [34,35,36]. A sufficient level has been linked with improved digestive health [35,37,38] and especially under epizootic rabbit enteropathy circumstances an increased dietary fibre level has been proven to reduce mortality in growing rabbits [39,40]. Investigations made by [41] and [42] revealed that high crude fibre content could be instrumental in preventing colon cancer and gastrointestinal disorders. The bamboo leaves used in this study contains little amount of crude fat as well as low moisture content. Low moisture content make bamboo leave decay resistant, as these would limit the growth of decay micro-organisms and prolong their storage lives [43]. The crude fat content of the bamboo leaves (2.71%) is low compared to 5.90% reported for *T.Triangulare* and 4.80% for *Amaranthus hybridus* [30,31]. The ash content of the bamboo leaves (15.29%) is lower than 18.18% reported for *P. purpureum* [30].

Table 6. Weight of carcass, organs and by-products of rabbits fed the different experimental diets (calculated as percentage of SW)

Parameters	T_1	T_2	T_3	T_4	T_5	T_6	SEM
Carcass characteristics							
SW	1685.00^{a}	1432.50^{ab}	1332.50^{b}	1322.50^{b}	1240.00^{b}	1175.00^{b}	178.61
HCW	1130.00^{a}	800.25^{b}	781.75^{b}	844.50^{b}	871.75^{b}	776.00^{b}	96.14
Dress. %	64.22^{ab}	60.54^{ab}	60.54^{ab}	58.40^{b}	67.21^{a}	62.91^{b}	2.86
Fore leg %	5.29^{b}	7.37^{a}	6.90^{a}	6.45^{ab}	7.76^{ab}	7.89^{a}	0.94
Hind leg %	7.08^{c}	9.22^{a}	8.69^{ab}	8.18^{b}	8.84^{a}	9.23^{a}	0.52
Linear measurements							
DL (cm)	31.75	31.38	31.13	30.50	30.75	33.00	1.68
LCL (cm)	15.25^{ab}	16.50^{a}	15.50^{ab}	14.63^{ab}	12.13^{b}	14.00^{ab}	1.94
Internal organs							
Heart %	0.17^{c}	0.23^{ab}	0.26^{ab}	0.22^{c}	0.27^{ab}	0.28^{a}	0.03
Trachea %	0.17^{b}	0.24^{ab}	0.18^{b}	0.20^{ab}	0.27^{a}	0.22^{ab}	0.05
Liver %	2.49^{bc}	2.99^{a}	2.31^{c}	2.62^{b}	3.03^{a}	3.04^{a}	0.17
Lung %	0.40^{b}	0.56^{a}	0.45^{ab}	0.50^{ab}	0.57^{a}	0.53^{ab}	0.09
Kidney %	0.52^{c}	0.66^{ab}	0.58^{bc}	0.61^{bc}	0.76^{a}	0.63^{ab}	0.07
Stomach %	2.72	2.82	2.63	2.55	2.61	2.57	0.41
Carcass by-product							
Head %	6.54	6.91	6.95	6.51	7.04	7.12	0.91
Blood %	0.43	0.35	0.30	0.43	0.37	0.51	0.12
Pelt %	12.37	12.35	13.47	12.51	13.74	12.01	1.12

^{abc}= Means with different superscripts within the same row are significantly($P<0.05$) different. T_1=100% concentrate/formulated feed which serve as the control; T_2=50% concentrate with 50% (100% Bamboo leaf meal (BLM); T_3=50% concentrate with 50 %(75% BLM and 25% Tridax leaf meal (TLM); T_4=50% concentrate with 50% (50% BLM + 50% TLM); T_5=50% concentrate with 50% (25% BLM+75%TLM); T_6=50% concentrate with 50% (100% TLM). SW=Slaughtered weight; HCW=Hot carcass weight; Dress= dressing %; DL=Dorsal length; LCL=lumbar circumference

The ash content in the bamboo leaves is higher than that of Tridax leaves (11.77%) and both suggest their content in a large deposit of minerals [44]. The ash contents of plant are directly related to the mineral composition of the soil. This situation is proven by the fact that previous studies for various bamboo species collected from different part of the world by FAO [45] ranged from 3.3% especially for *Arundinaria canna viera* collected in Brazil to 16.9% for *B.vulgaris* collected in Jamaica [46].

Studies have reported significant decrease in total feed intake of rabbits fed concentrate and forages [47,48,49]. However the non- significant effect (P>.05) in total feed intake of rabbits fed concentrate and different forage combination in this study could be attributed to the feed restriction trial adopted. Non significant effect of forage diet combinations on weight gain of rabbits observed in this study (T_2-T_5) agrees with the report of [49] who fed varying levels (100, 75, 50 and 25%) of concentrate and forage to grower rabbits. Alikwe et al. [50] also reported a non-significant difference in weight gain of rabbits fed different inclusion levels of *Alchornea cordifolia* leaves. T_2 (100% inclusion level of bamboo leaves) had numerically better weight gain than T_6 (100% inclusion level of Tridax leaves). This finding suggests that rabbit can thrive well if fed solely with bamboo leaves or in combination with other forages. This conclusion is also in support with previous researchers [51] who stated that rabbits are pseudo-ruminants and as such are able to utilize forages as well as concentrates. There are significant differences between the daily weight gain of rabbits fed varying levels of bamboo and tridax leaves (2.38 to 3.33 g/d) and that of the control (9.13 g/d). This is also found in a previous study [48] where significant differences in daily weight gain of rabbits fed varying levels of concentrate, cynodon and centrosema combinations (10.13-6.51 g/d) and that of rabbits fed only with concentrates (19.22 g/d) were reported. The daily weight gain reported in this study (except T6) are similar to those reported by [48] and [49,52] but lower than that reported by [47] and [53]. Differences in body weight and rate of gain of rabbits can be attributed to differences in the nutrient composition of forages offered and the restricted feeding trial adopted in this study. The low feed

conversion efficiency obtained in this study is similar to that reported by Iyeghe-Erakpotobor et al. [52] who fed rabbits different combinations of concentrate, grass and legume. The low FCR can be attributed to the high fibre content of the forage diets and the nature of the feeding trial. The non-significant differences in FCR of rabbits fed the different forage combination (bamboo and tridax leaves) shows that rabbits responded similarly in terms of feed utilization.

Values of organ/carcass weights of the rabbits fed concentrates and varying levels of forages (bamboo and tridax leaves) are shown in Table 6. The non-significant difference ($P>0.05$) observed in carcass characteristics of rabbits fed varying levels of bamboo and tridax leaves agrees with the findings of Omole et al. [54] who reported a non-significant difference in the dressing percentage of rabbits fed *Stylosanthes guianensis* and Lablab purpureus forage. The results of the present study are also similar with that of Amata [55] who reported non-significant difference in carcass characteristics of rabbits fed Gliricidia leaf meal (GLM). The significant difference obtained in hindleg and forelimb agrees with the report of Abdu et al. [56] who observed significant difference in thigh and loin of rabbits fed carrot leaf meal at 0, 15, 30, 45 and 60% inclusion levels. Variations in heart, lung, liver and kidney weights were significant for the different dietary combinations. The weight of internal organs like the liver and kidney are commonly used in animal feeding experiments as evidence of toxicity [57]. Increased metabolic rate of the organs in an attempt to reduce toxic or anti-nutritional factors in livestock feeds to non-toxic metabolites may cause abnormalities in their weights [58]. It is obvious in this study that the weight of organs such as liver, heart and kidney were significantly higher in rabbits fed T_2 (100% bamboo leaves inclusion levels) and T_6 (100% tridax leaves inclusion levels) when compared to the control diet. This could be attributed to the anti-nutrient agents present in leaves used. However, the organ weights of rabbits on diet T_2 (100% bamboo leaves inclusion levels) were not significantly ($P>.05$) higher than rabbits on diet T_6 (100% tridax leaves inclusion levels) a fact that implies similar effects of bamboo and tridax leaves on the health status of rabbits. This result is similar to the reports of [59,60] who observed non-significant differences in lung, kidney, heart and pancreas weights in rabbit fed sorghum offal-based diets. Values reported for the various organs in this study agrees with those reported for rabbits fed concentrates, *Aspilia africana* and *Tridax procumbens* [61], rabbits fed *Mucuna utilis* leaf meal [62] and rabbits fed boiled pigeon pea seed meal [63]. The carcass by-products were not significantly influenced by the various forage combinations and concentrates.

4. CONCLUSION

It can be concluded from this study that bamboo leaves, when combined with tridax leaves, up to 50% inclusion levels could be utilized as forages for feeding grower rabbits. Giving the perennial nature of bamboo leaves, it could help in reducing the overdependence on concentrate thereby reducing the cost of production especially during the dry season.

ETHICAL APPROVAL

All authors hereby declare that Principles of laboratory animal care were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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