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Original Article

Chemical composition and quality of pelleted forages for rabbit production

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Abstract
This study examined the chemical profile and pellet quality of five selected forages *(Albizia odoratissimsa*, *Ficus thonningii*, *Leucaena leucocephala*, *Mangifera indica*, and *Moringa oleifera)* in the tropics. The forages were individually compounded with concentrates in equal proportions labelled T1, T2, T3, T4, T5 and T6, respectively. Proximate composition, phytochemical profile and pellet quality were assessed. Forage T6 had higher ($P<0.05$) crude protein (24.13%) than the other treatments. Ash content in T1 (9.53%) and T2 (9.30%) were not different ($P>0.05$) while ether extract of T5 (4.70%) and crude fibre of T3 (9.16%) were the highest. Treatment 6 had more concentrations of phytochemicals while the least concentrations of phytate (0.10%), oxalate (0.05%), saponin (0.09%), tannin (2.09×10^{-3}) and trypsin inhibitor (7.72mg/100g) were observed in T1. Pellet hardness (N) in week 1 was significantly higher than for other weeks while initial and final friability in treatments 1 and 2 were similar. Higher ($P<0.05$) bacteria load ($\times 10^{-4}$CFU) was recorded in T1 (40.43) while total fungi count ($\times 10^{-4}$CFU) in T1 (2.14), T3 (2.00), and T5, were statistically similar ($P>0.05$). Total bacterial and fungi counts in the diets of grower rabbits were significantly affected by duration of storage. Highest bacteria count (82.08×10^{-4}CFU) was observed at week 4 and the least (1.36×10^{-4}CFU) at week 1. The effect of interaction of leaf type and storage duration on microbial loads was significant for all treatments. Pellets of desirable qualities can be produced from selected forages available in the tropics for rabbit production.

INTRODUCTION

The nutrition of the rabbit is a rather complex one and thus requires adequate consideration for optimum productivity. Rabbit unlike poultry are not that popular for meat production in the tropics and as such the production of their feed in commercial quantity is somehow limited. Although the rabbits can be fed on high energy dense diets for poultry, it is rather unsustainable in terms of economics of production and its overall health implications due to low crude fibre in poultry diets. These limitations far outweigh the benefits and as such nutritionist are faced with the dilemma of

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meeting the nutritional requirement of the rabbit on one hand and reducing the cost of feeding the rabbit.

Forages which are abundant in the tropics could be harnessed for this purpose. Forage legumes have the potential to serve as a good and reliable source of quality crude protein and crude fibre for rabbit production (Foenay and Koni, 2021). Akinyemi (2023) had earlier documented the nutritional profile of some potential tropical forages and found them useful for the utilization of the rabbit. To have a well-nourished diet for the rabbit, Mcnitt *et al*. (2011) suggested that forages for rabbit feed be incorporated with concentrates. Little however is known about forage concentrate mix in rabbit diets, thus the need to explore. Also, a major issue associated with feed prepared from forages is bulkiness and acceptability, this however, may be addressed if feeds are presented in the form of pellets. Pelletizing has been reported to reduce wastage and dustiness, improve consumption and overall performance (Abdollahi *et al.,* 2013). However, the quality of a pellet is dependent on the composition of the ingredients from which the diet is prepared (Foenay and Koni, 2021). Information on the quality of pellets from forage sources for rabbit production is limited in literature. This study therefore assessed the nutrient composition and pellet quality of five selected forages for rabbit production.

MATERIALS AND METHODS

Experimental Location

This study was carried out in the Department of Animal Science, University of Ibadan, Ibadan, Nigeria. The study area lies between longitude 7°27.05 north and 3°53.74 of the Greenwich Meridian east at an altitude 200m above sea level. Average temperature and relative humidity of the location is between 23-42 °C and 60-80%, respectively.

Experimental diets

Five forages *(Albizia odoratissimsa*, *Ficus thonningii*, *Leucaena leucocephala*, *Mangifera indica*, and *Moringa oleifera)*, were individually compounded with concentrates in equal proportions (50:50%). The composite meal were included at 50% level of inclusion. The diets were labeled as T1- Concentrates, T2- *Albizia odoratissimsa* based diet, T3- *Ficus thonningii* based diet, T4- *Leucaena leucocephala* based diet, T5-*Mangifera indica* based diet, and T6- *Moringa oleifera* based diet. The experimental diets as shown in Table 1 were formulated to meet the nutrient requirements of the growing rabbits.

Chemical assay of different leaf meal-based diets fed to growing rabbits

Proximate and phytochemical screening were conducted at the Nutrition Laboratory of the Department of Animal Science, University of Ibadan, Nigeria. Samples of ground leaves were assayed for their chemical properties. Proximate composition of the samples was determined according to AOAC (2000). Dry matter was determined by weighing a known gram of the sample and oven dry until a constant weight was attained. The ash profile was determined by feeding into a muffle furnace for eight hours at 550°C. The Kjeldahl Method, was used to determine crude protein (CP) while Ether extract (EE) was determined using the soxhlet apparatus. Van Soest *et al.* (1991) method was used to determine fibre components of the samples.

Harborne's gravimetric method was used to

Table 1: Gross composition (%) of different leaf meal-based diets offered to the growing rabbits

Ingredients	T1 (Control)	T2 (AOBD)	T3 (FTBD)	T4 (LLBD)	T5 (MIBD)	T6 (MOBD)
Albizia odoratissims	-	50	-	-	-	-
Ficus thonningii	-	-	50	-	-	-
Leucaena leucocephala	-	-	-	50	-	-
Mangifera indica	-	-	-	-	50	-
Moringa oleifera	-	-	-	-	-	50
Maize	30.20	18.00	18.00	18.00	18.00	18.00
Corn bran	26.00	4.00	4.00	4.00	4.00	4.00
Soya bean Meal	23.00	11.00	11.00	11.00	11.00	11.00
Rice bran	9.00	4.80	4.80	4.80	4.80	4.80
Palm Kernel Cake	8.00	8.00	8.00	8.00	8.00	8.00
Limestone	1.20	1.24	1.24	1.24	1.24	1.24
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Salt	0.40	0.38	0.38	0.38	0.38	0.38
Premix-Broilers[1]	0.20	0.24	0.24	0.24	0.24	0.24

[1]Composition of premix per kg of diet: Vitamin A, 12,500 I.U; Vitamin D3, 2,500 I.U; Vitamin E, 40mg; Vitamin K3, 2mg; Vitamin B1, 3mg; Vitamin B2, 5.5mg; Niacin, 55mg; Calcium pantothenate, 11.5mg; Vitamin B6, 5mg; Vitamin B12, 0.025mg; choline chloride, 500mg; Folic acid, 1mg; Biotin,0.08mg; Manganese, 120mg; Iron,100mg; Zinc, 80mg; copper, 8.5mg; Iodine, 1.5mg; Cobalt, 0.3mg; Selenium, 0.12mg; Antioxidant, 120mg. T1-Concentrates, T2-*Albizia odoratissims* based diet (AOBD), T3-*Ficus thonningii* based diet (FTBD), T4- *Leucaena leucocephala* based diet (LLBD), T5- *Mangifera indica* based diet (MIBD), T6- *Moringa oleifera* based diet (MOBD).

quantify saponin through a double solvent extraction. Gravimetric method using alkaline precipitation as described by Harborne (1973), was used to measure the concentration of alkaloids. As described by Chang *et al*. (2002), the levels of flavonoids were determined while Folin-ciocalteu spectrophotometric method (Makkar *et al.,* 1993) was used to measure phenols and tannic acids.

Processing of dietary treatments

Feed pelleting was done at CAPS Feed Mill in Ibadan, Oyo State. The leaf meal and other ingredients were fed into the mill grinding machine and pulverized to form a mash, other additives like vitamin premix were added. The combination was thoroughly mixed in the mill and thereafter the mash moves through the help of a conveyor belt through a screw feeder into a conditioner with moisture under high temperature and pressure. The extruded feed becomes loose and soft and were conveyed into the pellet mill where they were compressed against a metal plate with holes (of predetermined size) at the end, and high-density materials of uniform shape and size (pellets) were formed. The hot pellets is then conveyed into a cooler where they were held for like six minutes to cool and solidify and thereafter through a delivery feeder and bagged. Each of the five leaf meals were subjected to the above treatment.

Pellet properties

The hardness and friability of pelleted feed samples were determined using standard procedures at the Pharmaceutical and Industrial Pharmacy Department, University of Ibadan, Ibadan. The hardness of the pellets was measured with a hardness tester (Monsanto). The force required to break the pellets were recorded. 10 pellets of each were tested randomly per forage. Also, 50 pellets were randomly selected and weighed. The pellets were rotated at 25 rpm for 5 minutes in the friabilator (Electrolab). After the rotation, the pellets were dusted and weighed again and pellet friability was measured as the percentage loss in pellet weight.

Shelf life of pellets during storage

The pellets in storage were evaluated for their shelf life stability. Microbial evaluation of the pellet feeds were done using the plate count method involving culturing the substrate in appropriate media and incubating following standard procedures.

Experimental design

Experiments on proximate and phytochemical screenings were laid out in a completely randomized design while those on pellet quality and microbial integrity were laid out in a 6 x 5 factorial arrangement of a completely randomized design with six leaf types (T1, T2, T3, T4, T5, T6) and five duration of storage (1, 2, 3 4, 5 weeks)

Statistical analysis

Data were subjected to one-way analysis of variance SAS (2013) while interaction of leaf type and duration of storage on pellet quality and shelf life were subjected to two-way analysis of variance using Tukey's HSD Test of the same software.

RESULTS

The proximate composition of various leaf meal-based diets fed to grower rabbits is shown in Table 2. Compared to the other dietary treatments, T6 (24.13%) had higher (P<0.05) crude protein, followed by T5, T4, T1, T3 and T2. Ash content in T1 (9.53%) and T2 (9.30%) were not different (P>0.05), so also was T3 (10.53%) and T4 (10.36%). Ether extract of T5 (4.70%) was the highest but was similar to T6 (4.46%) and T3 (4.46%) and different from treatments 1, 2 and 4. Crude fibre in T3 (9.16%) was the highest, while T1 (8.23%), T2 (8.50%) and T4 (8.20%) were similar (P>0.05) but different from T5 (7.73) and T6 (7.50). The dry matter contents of T6 (94.44%) and T5 (94.12%) differed (P<0.05), but were higher than those from other treatments.

Table 2: Proximate composition of different leaf meal based diets fed to grower rabbits

Parameters (%)	T1	T2	T3	T4	T5	T6	SEM	P value
Crude protein	21.54^{c}	17.39^{f}	17.84^{e}	19.80^{d}	23.21^{b}	24.13^{a}	0.07	<0.0001
Ash	9.53^{d}	9.30^{d}	10.53^{c}	10.36^{c}	13.80^{a}	11.23^{b}	0.12	<0.0001
Ether extract	3.93^{b}	3.93^{b}	4.46^{a}	3.83^{b}	4.70^{a}	4.46^{a}	0.12	<0.0001
Crude fibre	8.23^{b}	8.50^{b}	9.16^{a}	8.20^{b}	7.73^{c}	7.50^{c}	0.09	<0.0001
Dry matter	93.81^{c}	93.44^{d}	93.94^{c}	93.57^{d}	94.12^{b}	94.44^{a}	0.05	<0.0001

^{abcdefg} Means with similar superscripts along a row are significantly the same (P<0.05). T1- Concentrates, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera*, SEM-Standard error of means.

Table 3 shows the composition of phytochemicals in the different leaf meal-based diet fed to rabbits. Treatment 6 had the highest concentrations of the phytochemicals while the least concentrations of phytate (0.10%), oxalate (0.05%), saponin (0.09%), tannin (2.09 x 10^{-3}) and trypsin inhibitor (7.72mg/100g) were observed in T1. Also, Treatment 1 had the least (P<0.05) phenol concentration (0.14%), alkaloids (0.21%), and steroids

(2.00 x 10^{-3}). Glycoside, terpene and anthraquinone concentrations followed the same trend.

Table 3: Composition of phytochemicals present in different leaf meal based diets fed to rabbits

Parameters	T1	T2	T3	T4	T5	T6	SEM	P value
Phytate (%)	0.10^{c}	0.12^{b}	0.12^{ab}	0.11^{b}	0.10^{c}	0.13^{a}	0.0080	0.0005
Oxalate (%)	0.05^{e}	0.06^{d}	0.08^{b}	0.07^{c}	0.05^{e}	0.10^{a}	0.0006	<0.0001
Saponin (%)	0.09^{f}	0.13^{d}	0.17^{c}	0.18^{b}	0.12^{e}	0.20^{a}	0.0009	<0.0001
Tannin (x 10 $^{-3}$)	2.09^{f}	3.70^{d}	8.90^{b}	7.60^{c}	2.35^{e}	10.40^{a}	0.05	<0.0001
Trypsin-inhibitor (mg/100g)	7.72^{e}	9.57^{d}	13.66^{b}	11.91^{c}	7.77^{e}	17.22^{a}	0.01	<0.0001
Flavonoids (x 10 $^{-3}$)	4.77^{f}	5.80^{e}	9.10^{b}	8.10^{c}	7.15^{d}	10.80^{a}	0.16	<0.0001
Phenols (%)	0.14^{e}	0.17^{d}	0.19^{b}	0.19^{b}	0.18^{c}	0.21^{a}	1.57	<0.0001
Alkaloids (%)	0.21^{d}	0.25^{c}	0.27^{ab}	0.25^{c}	0.26^{b}	0.29^{a}	0.004	<0.0001
Steroids (x 10 $^{-3}$)	2.00^{f}	2.80^{e}	5.80^{b}	3.70^{d}	4.90^{c}	7.40^{a}	0.08	<0.0001
Glycoside (%)	0.09^{d}	0.09^{d}	0.11^{b}	0.10^{c}	0.09^{d}	0.12^{a}	0.0009	<0.0001
Terpenes (x 10 $^{-3}$)	1.18^{e}	1.20^{e}	2.40^{b}	1.80^{c}	1.45^{d}	3.00^{a}	0.05	<0.0001
Anthraquinane (x 10 $^{-3}$)	0.09^{d}	0.09^{d}	1.95^{b}	1.70^{b}	1.25^{c}	2.60^{a}	0.07	<0.0001

^{abcdefg} Means with similar superscripts along a row are significantly the same (P<0.05). T1-Concentrate, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera,* SEM-Standard error of means, P value-Probability.

Table 4 depicts the hardness (N) and friability (%) of grower rabbit pellets. Hardness in T3 (0.41) was more (P<0.05) than in T1 (0.25), T2 (0.22), T5 (0.22), and T6 (0.29), but was not different (P>0.05) from T4 (0.34). Duration of hardness (N) shows that hardness in week 1 was significantly higher than for other weeks. Hardness in weeks 2, 3, 4 and 5, however were similar. Initial and final friability (%) in treatments 1 and 2 were similar but higher than in T5 while initial friability in T3, T4 and T6 were similar and higher than in other treatments. Initial friability was highest at weeks 2 and 3 and the least at week 1 while for final friability, it was highest in weeks 2, 3 and 4. Higher powdery score (x10^{-2}) was recorded to be highest in T6 and lowest in T2 and T3 while T4 and T5 had similar powdery score. At weeks 4 and 5, powdery score (-0.03) was significantly (P0.05) higher than in weeks 1, 2 and 3.

Table 5 shows the interaction effect of leaf type and duration on the hardness and friability of dietary treatments. Hardness, initial and final friability, and powdery property were all influenced (P<0.05) by

Table 4: Main effects of leaf type and duration on hardness and friability of dietary treatments fed to rabbits

Parameters	Leaf type						Duration (weeks)					
	T1	T2	T3	T4	T5	T6	1	2	3	4	5	Pooled SEM
Hardness (N)	0.25^{c}	0.22^{c}	0.41^{a}	0.34^{ab}	0.22^{c}	0.29^{bc}	0.43^{a}	0.26^{b}	0.22^{b}	0.28^{b}	0.27^{b}	0.01
Initial friability (%)	3.27^{b}	3.29^{b}	3.62^{a}	3.65^{a}	2.15^{c}	3.56^{a}	2.91^{d}	3.42^{ab}	3.52^{a}	3.37^{b}	3.06^{c}	0.07
Final friability (%)	3.23^{b}	3.21^{b}	3.55^{a}	3.61^{a}	2.11^{c}	3.53^{a}	2.86^{c}	3.34^{a}	3.47^{a}	3.33^{a}	3.03^{b}	0.07
Powdery (10^{-2})	-4^{a}	-8^{b}	-8^{b}	-4^{a}	-4^{a}	-3^{a}	-5^{b}	-9^{c}	-6^{b}	-3^{a}	-3^{a}	0.01

^{abcdefg} Means with similar superscripts along a row are significantly the same (P<0.05).
T1- Concentrates, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera*, SEM- Standard error of means.

Table 5: Interaction effect of leaf type and duration on hardness and friability of dietary treatments fed to rabbits

Parameters	Duration	T1	T2	T3	T4	T5	T6	Pooled SEM
Hardness (N)	1	0.37^{cjk}	0.20^{dl}	0.68^{ai}	0.42^{bj}	0.45^{bj}	0.47^{bj}	
	2	0.25^{ckl}	0.19^{dl}	0.44^{aj}	0.31^{bk}	0.07^{eo}	0.29^{bk}	
	3	0.16^{cm}	0.16^{cm}	0.30^{ak}	0.29^{ak}	0.16^{cm}	0.22^{bl}	
	4	0.23^{cl}	0.28^{bk}	0.31^{bk}	0.38^{ajk}	0.21^{cl}	0.23^{cl}	
	5	0.25^{bkl}	0.26^{bkl}	0.33^{ak}	0.32^{ak}	0.20^{cl}	0.25^{bkl}	0.01
Initial friability (%)	1	1.86^{cp}	3.15^{al}	3.28^{al}	3.39^{akl}	2.59^{bm}	3.18^{ak}	
	2	3.74^{aj}	3.35^{bl}	3.81^{aj}	3.81^{aj}	2.06^{cn}	3.76^{aj}	
	3	4.05^{ai}	3.43^{ckl}	4.18^{ai}	3.87^{bj}	1.92^{dk}	3.69^{bjk}	
	4	3.44^{bkl}	3.59^{bk}	3.57^{bk}	3.78^{aj}	2.21^{co}	3.59^{bk}	
	5	3.24^{bl}	2.91^{clm}	3.26^{bl}	3.41^{akl}	1.96^{dp}	3.57^{ak}	0.07
Final friability (%)	1	1.83^{ep}	3.03^{cm}	3.24^{bl}	3.37^{akl}	2.49^{dn}	3.17^{cm}	
	2	3.69^{abij}	3.29^{cl}	3.55^{bj}	3.76^{aij}	2.04^{do}	3.69^{abij}	
	3	4.03^{ai}	3.31^{cl}	4.16^{ai}	3.74^{bij}	1.89^{dp}	3.67^{bij}	
	4	3.43^{ck}	3.51^{bcj}	3.54^{bcj}	3.76^{aij}	2.18^{dno}	3.58^{bj}	
	5	3.15^{bl}	2.89^{cmn}	3.23^{bk}	3.40^{ak}	1.95^{do}	3.55^{aj}	0.07
Powdery (%)	1	-0.03^{ai}	-0.12^{bk}	-0.02^{ai}	-0.01^{ai}	-0.10^{bj}	-0.02^{ai}	
	2	-0.06^{bj}	-0.06^{bj}	-0.03^{ai}	-0.05^{abj}	-0.02^{ai}	-0.07^{bj}	
	3	-0.02^{ai}	-0.12^{bk}	-0.02^{ai}	-0.13^{bk}	-0.02^{ai}	-0.02^{ai}	
	4	-0.01^{ai}	-0.09^{bj}	-0.03^{ai}	-0.02^{ai}	-0.03^{ai}	-0.02^{ai}	
	5	-0.09^{bk}	-0.02^{ai}	-0.02^{ai}	-0.01^{ai}	-0.01^{ai}	-0.02^{ai}	0.01

^{abcdefgijklmnop}Means of treatments along a column with different superscripts differed significantly (P<0.05).
T1- Concentrates, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera*, SEM- Standard error of means.

type and storage duration of the leaves. Table 6 shows the main effects of leaf type and duration on the microbial load (x 10^{-4}CFU) of rabbit dietary treatments. Higher (P<0.05) bacteria load was recorded in T1 (40.43 x 10^{-4}CFU) while bacteria count in T6 (18.25 x 10^{-4}CFU) was the lowest (P 0.05). Bacteria count in T2 (37.88 x 10^{-4}CFU) and T3 (36.50 x 10^{-4}CFU) were however similar (P>0.05). Total fungi count (x 10^{-4}CFU) in T1 (2.14), T3, and T5, were statistically similar (P>0.05) but lower (P<0.05) than in T2 (2.56 x 10^{-4}CFU), T4 (2.31 x 10^{-4}CFU), and T6 (2.38 x 10^{-4}CFU) that were similar. Total bacterial count and fungi counts in the diets of grower rabbits were significantly affected by duration of storage. Highest bacteria count was

Table 6: Main effects of leaf type and duration on microbial load of dietary treatments fed to rabbits

Parameters ($x10^{-4}$CFU)	Leaf type						Duration (weeks)				
	T1	T2	T3	T4	T5	T6	1	2	3	4	Pooled SEM
Bacteria	40.43^{a}	37.88^{b}	36.50^{b}	20.69^{d}	26.25^{c}	18.25^{e}	1.36^{d}	14.46^{c}	18.83^{b}	82.08^{a}	5.14
Fungi	2.14^{b}	2.56^{a}	2.00^{b}	2.31^{a}	2.06^{b}	2.38^{a}	1.73^{b}	2.04^{b}	2.33^{ab}	2.83^{a}	0.15

^{abcde}Means of treatments along a row with different superscripts differed significantly (P<0.05).
T1- Concentrates, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera,* SEM- Standard error of means.

Table 7: Interaction effect of leaf type and duration on microbial load of dietary treatments fed to rabbits

Parameters ($x10^{-4}$CFU)	Duration	T1	T2	T3	T4	T5	T6	Pooled SEM
	1	1.00^{bm}	2.00^{bm}	0.00^{co}	0.00^{co}	0.00^{co}	5.00^{al}	
	2	15.50^{ak}	21.00^{ak}	18.50^{ak}	5.25^{bl}	7.50^{bl}	19.00^{ak}	
Bacteria	3	18.00^{abk}	23.50^{ak}	21.00^{ak}	10.50^{bkl}	16.50^{abk}	23.50^{ak}	
	4	107.50^{ai}	105.00^{ai}	106.50^{ai}	67.00^{cj}	81.00^{bj}	25.50^{dk}	5.14
	1	0.00^{cl}	2.50^{aj}	1.00^{bk}	2.25^{aj}	1.25^{bk}	2.50^{aj}	
	2	2.50^{aj}	2.25^{aj}	2.50^{aj}	1.50^{bk}	1.00^{bk}	2.50^{aj}	
Fungi	3	2.50^{bj}	2.50^{bj}	1.00^{ck}	2.50^{bj}	2.50^{bj}	3.00^{ai}	
	4	2.50^{bj}	3.00^{abi}	3.50^{ai}	3.00^{abi}	3.50^{ai}	1.50^{ck}	0.15

[abcdefgijkl] Means of treatments along a column with different superscripts differed significantly (P<0.05).
T1- Concentrates, T2- *Albizia odoratissims*, T3- *Ficus thonningii*, T4- *Leucaena leucocephala*, T5-*Mangifera indica*, T6- *Moringa oleifera,* SEM- Standard error of means.

observed at week 4 (82.08 x 10^{-4}CFU) and the least at week 1 (1.36 x 10^{-4}CFU). For fungi count however, the highest count was observed at weeks 3 and 4 (2.83 x 10^{-4}CFU) and lowest at week 1. The effect of interaction of leaf type and storage duration on microbial loads was significant for all treatments as shown in Table 7.

DISCUSSION

The proximate composition of the diets (Table 2) fed to the grower rabbits showed that the forage treatments were standard diets. For example, the CP range was within 18 - 22% that was reported by Akande (2015). Although there were variations in values observed in this study and those reported earlier in literature (Atawodi *et al.*, 2008; Ogunbosoye and Otukoya, 2014; Abu and Turner, 2018; Mawussi *et al.*, 2022). These variations could be attributed to the mixture of the concentrates with the forages which may have diluted the nutrient components. However, the diets were highly comparable in terms of their nutritional composition and in some instances superior to that of the concentrate diet (T1) thus indicating their capabilities to meet the nutrient requirement of the rabbits.

All the pelleted diets had the presence of anti-nutrients in them. Higher concentration of anti-nutrients in a feed material may affect intake or perhaps hinder the absorption of nutrients in the intestine and thus deprive animals of the needed nutrients for their metabolic activities (Kumar, 1991; Cheeke, 1998; Dey, 2016). Although the concentrations of tannin, trypsin, flavonoid, steroids, terpenes and anthraquinone were abundantly rich in the forages, their concentrations were within limits tolerated by ruminants in literature (Kumar, 1991; Salem *et al.*, 2011; Zayed and Samling, 2016; Raimi and Arire, 2024). The properties of the pelleted diets as demonstrated in Tables 3 and 4 indicated that the concentrate and leaf meal pellets have comparable attributes except for T3 and T4 that had superior qualities. The comparison suggests that pelleted diets would behave equally in similar manner with storage days. The superiority of T3 and T4 may be attributed to the relatively higher CF which makes ingredient binding more cohesive. The implication is that these diets would be firmer in texture and able to absorb pressure due to handling and transportation than other pellets.

As observed in Table 5, the microbial loads in the concentrate diet was higher compared to other treatment diets. The lower load of microbes in the leaf meal treatments could be attributed to the inhibitory capabilities of the inherent phytonutrients to microbes. However, fungi activity in T2, T4 and T6 were higher than in the concentrate diet. This may be that the fungicidal properties of these forages are low or perhaps the plants have high affinity to trap moisture which makes a suitable environment for fungi to grow. The higher microbial count observed with weeks of storage might perhaps be linked to the decrease in hardness observed in Table 6 and may equally suggest that the potency of the anti-nutrients have reduced with time due to volatility of the compounds or probably due to exposure to storage temperature.

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