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EVALUATION OF THREE PERENNIAL FORAGES SUPPLEMENTED WITH CASSAVA PEEL MEAL–PALM KERNEL CAKE BASED CONCENTRATE FOR GROWING RABBITS (*ORYCTOLAGUS CUNNICULUS*)

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A b s t r a c t: With the objective of using readily available feed resources for small-holder farming, thirty mixed breed (New Zealand × Chinchilla × Dutch) rabbits were evaluated for performance on three perennial forages supplemented with Cassava Peel Meal–Palm Kernel Cake (CPM-PKC) based concentrate. The aim of the study was to investigate the growth, carcass characteristics and meat yield in rabbits fed CPM-PKC based concentrate with forage. The animals were divided into five experimental groups based on five dietary treatments: corn-GNC control (T_1), CPM-PKC control (T_2), *Gliricidia sepium* leaves + CPM-PKC (T_3), *Leucaena leucocephala* leaves + CPM-PKC (T_4) and *Moringa oleifera* leaves + CPM-PKC (T_5). Rabbits on sole concentrate feeding (T_1 and T_2) were fed at 6% of their body weight. Animals in treatments 3, 4 and 5 received concentrate (3%) in the morning and forage (*ad libitum*). Weight gain was the highest in T1 being significantly ($P < 0.05$) different from T_2, T_3 and T_4 but similar ($P > 0.05$) to T_5. Feed intake was highest in the corn–GNC control. Overall carcass yield was not significant ($P > 0.05$) affected by dietary treatment.

Key words: agro-industrial byproducts; carcass; forages; growth; rabbit

ОЦЕНА НА ТРИ ПОВЕЌЕГОДИШНИ ФУРАЖИ ЗА МЛАДИ ЗАЈАЦИ (*ORYCTOLAGUS CUNNICULUS*) СО ДОДАТОК НА КОНЦЕНТРАТ НА БАЗА НА СМЕСА ОД ЛУШПА НА МАНИОКА И ПАЛМИНА СРЦЕВИНА

А п с т р а к т: Со цел искористување на ресурсите на сточна храна лесно достапни за ситните фармери, беше изведено оценување на перформансите на триесет зајаци од мешан вид (New Zealand × Chinchilla × Dutch) хранети со три повеќегодишни фуражи дополнети со концентрат базиран на смеса од лушпа од маниока и погача од палмова срцевина (CPM-PKC). Целта на студијата беше да се испита растот, карактеристиките на трупот и приносот на месо кај зајаци хранети со фураж со додаток на CPM-PKC. Животните беа поделени во пет експериментални групи врз основа на пет режими на исхрана: пченка-GNC – контролна (T_1), CPM-PKC – контролна (T_2), листови *на Gliricidia sepium* + CPM-PKC (T_3), листови на *Leucaena leucocephala* + CPM-PKC (T_4) и листови на *Moringa oleifera* + CPM-PKC (T_5). Количеството на концентратот кај зајаците хранети само со концентрат (T_1 и T_2) изнесуваше 6% од нивната телесна тежина. Животните во режимите на исхрана 3, 4 и 5 (групи T_3, T_4 и T_5) го добиваа концентратот (3%) наутро во фуражот (*ad libitum*). Тежинскиот прираст беше највисок кај T_1, при што значително ($P < 0,05$) се разликуваше од прирастот кај T_2, T_3 и T_4, но беше сличен ($P > 0,05$) на прирастот кај T_5. Внесот на храна беше највисок кај контролната група T_1: пченка-GNC. Режимот на исхрана немаше позначително влијание ($P > 0,05$) врз севкупниот тежински прираст на трупот.

Клучни зборови: агро-индустриски нуспроизводи; труп; фураж; развој; зајак

1. INTRODUCTION

The need to improve rabbit production in Nigeria for increased supply of animal protein is no longer in doubt due to the high cost of chicken, pork and beef. Rabbit production has been reported to be one of the best means of alleviating the prevailing low animal protein consumption in developing countries due to certain characteristic of rabbits and rabbit meat [1], [2]. One of the advantages projected include efficient feed utilization [3] and the ability to thrive on wide range of fresh or preserved

grasses, shrubs and leaves [4]. The rabbit is also a very efficient converter of feed to animal protein. Makinde [5] reported that rabbits are efficient converters of feed to meat and utilize up to 30% fibre as against 10% by most poultry species. Thus, the daily weight gain of rabbit is high in proportion to the body weight which gives them a rapid growth rate before sexual maturity. Rabbits can be produced on forages alone, although production can improve by adding other feed supplements. However, recent observations from the field is that rabbit is as expensive as chicken because of the cost of concentrate feeding. This is because about 80% of the total cost of the operation is spent on feed.

One of the key constraints to the development of a viable rabbit industry in Africa according to Oseni [6] is the dearth of clientele-based research for small-holder rabbit units. One of the key areas in which such small-holder clientele-based research is crucial is in the area of rabbit nutrition. Lukefahr [7] suggested the need for on-farm feed security for backyard rabbit system based on renewable farm resources. Thus the need for specific research into appropriate and specific management practices from one locality to another. The aim of the current study was to investigate the growth, carcass characteristics and meat yield of rabbits fed Cassava Peel Meal–Palm Kernel Cake (CPM-PKC) based concentrate with forage.

According to reports [8, 9] dried cassava peel could be included up to 30% in balanced growing rabbit feeds as source of energy to replace the corresponding amount of maize grain. Similarly, it has also been reported that rabbits can tolerate the inclusion of pal kernel cake in their diet, up to 30% [10]. This research combined 30% cassava peel meal with 30% palm kernel cake as ingredients for concentrate formulation in the feeding of growing rabbits. Ola et al. [11] reported that the greatest challenge that faces forage based rabbit operations in Nigeria is dry season feeding. *Gliricidia sepium, Leucaena leucocephala,* and *Moringa oleifera* are used in this study because they are available all year round.

This study was therefore aimed at determining the feasibility of backyard small-holder rabbit production on *ad libitum* forage (*Gliricidia*, *Leuceana* and *Moringa*) feeding with supplemental agro by-products (CPM-PKC) based concentrate. The forages and agro by-products are easily accessible to the agrarian rural community in the study area.

The specific objectives of the study were as follows:

1. To compare growth, carcass characteristics and meat yield in rabbits fed conventional concentrates and CPM-PKC based concentrate.

2. To compare growth, carcass characteristics and meat yield in rabbits on sole concentrate feeding and forage supplemented with CPM-PKC concentrate.

3. To compare growth and carcass characteristics on the forages; Gliricidia, Leucaena and Moringa with supplemental CPM-PKC concentrate feeding

MATERIALS AND METHODS

Experiment location

The experiment was conducted in the late dry season of December 2017 to February 2018 at the Teaching and Research Farm, College of Agricultural Sciences, Olabisi Onabanjo University, Ayetoro Campus, Ogun State, Nigeria. The University Campus is located in a deciduous/derived savannah zone of Nigeria at latitude $7^{0}15^{1}$N and longitude $3^{0}3^{1}$E. Climate is sub-humid tropical with a mean annual rainfall of 1,909.3 mm. Rainy season is between early April and late October. Rainfall pattern is bimodal with two peaks in June and September. Maximum temperature varies between 29°C during the peak of the wet season and 34°C at the onset of the dry season and mean annual relative humidity is 81% [12].

Animals and experimental design

A total of thirty (30) mixed breed (New Zealand × Chinchilla × Dutch) 16 week-old doe rabbits equalized for the average initial live weight (1.38 ± 0.21 kg) was used in this study. The thirty (30) rabbits were allocated to one of five (5) experimental groups, each group having six (6) replicates of one doe per replicate in a completely randomized design. The grouping was based on five dietary treatments. The groups are: corn-GNC control (T_1), CPM-PKC control (T_2), Gliricidia + CPM-PKC (T_3), Leucaena + CPM-PKC (T_4) and Moringa + CPM-PKC (T_5). The experiment lasted for eight weeks.

Housing and environment

Animals were individually caged in cells measuring 100×60×60 cm made of wooden frames with wire netting on the sides and the base. Feed and

waer were provided in earthen pots secured to prevent spillage. Cages were kept indoors in an open-sided building roofed with corrugated iron sheets. The rabbitry is naturally ventilated and lighted with no thermal insulation or cooling system.

Feeding and nutrition

Rabbits on sole concentrate feeding (T_1 and T_2) were fed at 6% of their body weight. Animals in treatments 3, 4 and 5 received CPM-PKC based concentrate (3% of their body) and forage (*ad libitum*). Concentrate was divided into two halves and fed at 07.00 a. m and 12.00 hours for animals on sole concentrate feeding. Animals on forage and concentrate received concentrate at 07.00 hour and fresh forage at 12.00 hour. The concentrate feeding trough was withdrawn at 12.00 hour in forage-fed rabbits. Animals were given unrestricted access to drinking water. The feed composition of concentrate is shown in Table 1.

Table 1

Composition of experimental concentrate diets (%)

Ingredient	T_1	T_2
Maize	30	10
Groundnut cake	20	10
Wheat offal	23.5	–
Rice husk	22	12.5
Cassava peel meal	–	30
Palm kerel cake	–	30
Blood meal	–	4.0
Bone meal	2.0	2.0
Oyster shell	1.0	1.0
Salt	0.5	0.5
Premix	0.25	–
Lysine	0.25	–
Total	**100**	**100**
Calculated chemical analysis		
DE (Kcal/kg)	2662	2263
CP (%)	16.33	16.96
CF (%)	9.82	10.35
EE (%)	4.44	3.92
Ca (%)	0.95	0.84
P (%)	0.76	0.28
Methionine (%)	0.30	0.18
Lysine (%)	0.67	0.47

$T_3 = T_2$ + Gliricidia, $T_4 = T_2$ + Leucaena, $T_5 = T_2$ + Moringa

Slaughtering and carcass processing

Four rabbit does per treatment were slaughtered. Animals were rendered unconscious by stunning and slaughtered by severing the Vena jugularis. After thorough bleeding, they were skinned and eviscerated.

Data collection

The following parameters were determined.

1) Determination of feed consumption (*FC*):

$$FC\ (\text{g}) = QDF\ (\text{g}) - QRF\ (\text{g}).$$

QDF = quantity of distributed feed, *QRF* = quantity of remaining feed [13].

2) Determination of average consumption (*AFC*):

AFC is the ratio between the total quantity of feed consumed (*QFC*) in a given period over the number of subject fed (*NSF*) in the same period [14].

$$AFC\ (\text{g}) = \frac{\text{QFC (g)}}{\text{NSF}}.$$

3) Determination of average weight (*AW*):

AW is the ratio between total weight of subject (*TWS*) in a given batch and the number of subject (*NS*) of this batch [15],.

$$AW\ (\text{g}) = \frac{TWS\ (\text{g})}{NS}.$$

4) Determination of average weight gained (*AWG*):

AWG is determined as the difference between the average final weight at end of the experiment (*AWf*) and that of the initial (*AWi*),

$$AWG = AWF - AWi.$$

5) Determination of the consumption index (CI):

It is the necessary feed intake needed to increase the unit of the subject weight by one (1). It is obtained from the ratio of average feed consumption (*AFC*) and average weight gained of subjects (*AWG*) [15],

$$C = \frac{AFC\ (\text{g/day})}{AFG\ (\text{g/day})}.$$

6) Carcass characteristics:

a) Hot Carcass Weight (%): Hot carcass weight is the weight of the carcass 15–30 minutes after slaughter. The carcass does not include blood, skin, distal parts of the tail, fore and hind legs, gastrointestinal tract and urinogenital tract. It includes the head, liver, kidneys and organs located in the thorax [16]. The hot carcass weight is expressed as a percentage of the weight at slaughter.

b) Hot Reference Carcass Weight (%): Hot carcass weight minus the head, kidneys and organs located in the thorax and neck (lungs, oesophagus, trachea, thymus and heart). It is expressed as a percentage of weight of slaughter.

c) Chilled Reference Carcass Weight (%): The hot reference carcass after chilling for 24 hours. It is also expressed as a percentage of the slaughter weight.

d) Prime cuts: Shoulder, thigh, rack and loin expressed as a percentage of the chilled reference carcass weight.

7. Organs dimension:

The weight of heart, liver, spleen, kidney, ovary, head, skin, lungs, gastrointestinal tract (*GIT*) expressed as a percentage of the live weight and intestinal length measured in centimeter.

Statistical analysis

All data collected were subjected to analysis of variance using the GLM procedure of [17], employing the model:

$$Y_{ij} = \mu + T_i + E_{ij},$$

where

Y_{ij} = individual observation.

μ = general population mean,

T_i = effect of treatment i (T_1, T_2, T_3, T_4),

E_{ij} = composite error effect.

RESULTS AND DISCUSSION

The mean values for the live performance indices of rabbits are presented in Table 2. All measurements were significantly ($P < 0.05$) affected by dietary treatments. Average Final Weight (*AFW*) was not significantly different ($P > 0.05$) in rabbits on T_1 (corn–*GNC* control), T_2 (*CPM–PKC* control) and T_5 (moringa + *CPM–PKC*). Average Final Weight (AW) was the lowest in rabbits on T_4 (Leucaena + *CPM–PKC*), with a value significantly lower ($P < 0.05$) than that of rabbits on T_1, T_2 and T_5. Rabbits on T_3 (Gliricidia + *CPM–PKC*) have *AFW* which was not significantly ($P > 0.05$) different from that of other treatments. Average weight gained (*AWG*) was significantly ($P < 0.05$) higher in rabbits on T_1 (Maize–*GNC*) compared with rabbits on T_2 (*CPM–PKC*) which was also significantly ($P < 0.05$) higher than the *AWG* of rabbits on T_3 and T_4.

Table 2

Live performance in doe rabbits fed three perennials forages supplements with cassava peel meal–palm kernel cake (CPM-PKC) based concentrates

Measurement	Treatment				
	1	2	3	4	5
Average initial weight (kg)	1.35±0.04	1.45±0.09	1.54±0.03	1.39±0.03	1.25±0.01
Average final weight (kg)	2.11±0.23^{a}	1.99±0.23^{a}	1.81±0.16^{ab}	1.51±0.29^{b}	1.96±0.15^{a}
Average total weight gain (kg)	0.76±0.21^{a}	0.54±0.21^{b}	0.27±0.23^{c}	0.27±0.16^{c}	0.72±0.18^{ab}
Total feed intake (g)	**5.53±0.87^{a}**	**4.34±0.37^{b}**	**3.11±0.16^{e}**	**3.47±0.44^{d}**	**4.27±0.80^{c}**
Concentrate (g)	5.53±0.87^{a}	4.34±0.37^{b}	0.61±0.15^{c}	1.45±0.37^{a}	1.35±0.31^{b}
Forage (g)			0.61±0.15^{c}	1.45±0.37^{a}	1.35±0.31^{b}
Consumption index	7.44±0.96^{c}	8.00±0.63^{c}	11.47±0.92^{b}	15.60±0.72^{a}	5.46±0.47^{d}

^{abcd} means on the same row with different superscript are significantly different ($p < 0.05$)

Feed intake was significantly ($P < 0.05$) higher in sole concentrate-fed rabbits, being the highest ($P < 0.05$) in the corn-*GNC* control (T_1). Among rabbits fed forage, total feed intake was the highest ($P < 0.05$) in rabbits on Moringa (4.27± 0.80 kg) and the lowest ($P > 0.05$) in rabbits on Gliricidia (3.11 ± 0.16 kg). Concentrate intake in forage-fed rabbits was: Moringa (2.92 ± 0.44 kg) > Gliricidia (2.50 ± 0.27) > Leucaena (2.02 ± 0.32) ($P < 0.05$). However, forage intake was Leucaena (1.45 ± 0.37 kg) > Moringa (1.35 ± 0.31 kg) > Gliricidia (0.61 ± 0.15) ($P < 0.05$).

Consumption index was the lowest ($P < 0.05$) in Moringa-fed rabbits (T_5, 5.46 ± 0.47) and the highest ($P < 0.05$) in rabbits on Leucaena (T_4, 15.60 ± 0.72). Consumption index was statistically similar ($P > 0.05$) in sole concentrate-fed rabbits (T_1, 7.44 ± 0.96 and T_2, 8.00 ± 0.63), with values significantly lower ($P < 0.05$) than that of rabbits on *Gliricidia* (T_3, 11.47 ± 0.92) and Leucaena (T_4, 15.60 ± 0.72).

The carcass characteristics and meat yield of the doe rabbits fed three perennial forages supplemented with cassava peel meal-palm kernel cake (*CPM–PKC*) based concentrate are presented in Table 3. There were significant ($P < 0.05$) differences among the treatment means in slaughter live weight. The rabbits fed the control diet (T_1) had the highest ($P < 0.05$) value for slaughter weight, *CPM–PKC* (T_2) slaughter weight was statistically comparable ($P > 0.05$) with T_5 (Moringa + *CPM–PKC* concentrate). Rabbits on T_3 (Gliricidia + *CPM–PKC*) and T_4 (Leucaena + *CPM-PKC*) have statistically similar ($P > 0.05$) slaughter weight which was significantly lower ($P < 0.05$) than that of rabbits on sole concentrate feeding (T_1 and T_2) and Moringa + *CPM–PKC* (T_5). Carcass weight, hot reference carcass weight and chilled carcass weight were not significantly ($P > 0.05$) affected by dietary treatments. The retail cuts (thigh, rack, shoulder and loin) were also statistically similar ($P > 0.05$) across treatments.

Table 3

Carcass characteristics and meat yield in doe rabbits fed three perennial forages supplemented with cassava peel meal–palm kernel cake (CPM-PKC) based concentrate

Measurement	Treatment				
	1	2	3	4	
Slaughter weight (kg)	2.27±0.53[a]	2.03±0.76[b]	1.77±0.58[c]	1.60±0.86[c]	2.03±0.13[b]
Hot carcass weight (%)	65.26±1.88	63.72±8.02	66.11±4.15	62.11±0.22	64.89±3.07
Hot ref. carcass weight (%)	55.84±4.19	52.54±6.74	57.46±4.15	50.89±5.39	58.32±3.42
Chilled ref. carcass weight (%)	55.72±0.95	50.08±6.70	54.68±1.51	47.32±4.91	54.89±3.59
Shoulder (%)	29.15±1.04	29.71±2.81	30.29±4.74	29.18±3.10	29.28±8.86
Thigh (%)	38.50±2.69	336.31±3.42	36.94±1.63	35.46±6.74	35.46±6.74
Rack (%)	12.11±2.04	11.34±0.63	10.56±0.49	12.37±2.23	12.37±2.23
Loin (%)	23.42±2.45	23.75±1.98	22.52±3.35	22.96±3.21	22.96±3.21

[a b c] means on the same row with different superscript are significantly different ($p < 0.05$)

The organs measurements of the doe rabbits fed three perennials forages supplemented with cassava peel meal–palm kernel cake (*CPM–PKC*) based concentrate are presented in Table 4. The heart, liver, spleen, kidney, ovary weight, head, skin, lungs and uterus (expressed as percentage of live weight) did not show significant differences ($P > 0.05$) across the dietary treatments. However, there were significant differences ($P < 0.05$) in intestinal length and gastro-intestinal weight (as percentage of live weight). The value recorded for intestinal length was the longest ($P < 0.05$) in T_5 (Moringa + conentrate, 306.00 ± 51.47 cm). Corn-*GNC* (T_1, 279.83 ± 22.23 cm) and *CPM-PKC* (T_2, 275.57 ± 21.48 cm) resulted in similar ($P > 0.05$) intestinal length which was longer ($P > 0.05$) than that of T_3 (Gliricidia + concentrate, 257.83 ± 35.87 cm) and T_4 (Leucaena + concentrate, 257.50 ± 77.58 cm). T_3 and T_4 have similar ($P > 0.05$) values for intestinal lengths. The *GIT* weight was the highest ($P < 0.05$) in rabbits on sole *CPM-PKC* (T_2). Rabbits on corn–*GNC* have the smallest value for *GIT* weight, but it was statistically similar ($P > 0.05$) to that of rabbits on forages.

Table 4

Organ dimension in doe rabbits fed three perennial forages supplemented with cassava peel meal–palm kernel cake (CPM-PKC) based concentrate

Measurement	Treatment				
	1	2	3	4	5
Heart	0.18±0.13	0.25±0.51	0.23±0.31	0.24±0.22	0.22±0.38
Liver	1.92±0.32	1.43±0.75	1.74±0.16	1.78±0.21	1.73±0.25
Spleen	0.53±0.85	0.50±0.23	0.39±0.11	0.30±0.16	0.36±0.43
Kidney	0.41±0.70	0.39±0.24	0.49±0.32	0.55±0.72	0.46±0.44
Intestinal length (cm)	279.83±22.23^{b}	275.57±21.48^{b}	257.83±35.87^{c}	257.50±77.58^{c}	306.00±51.47^{a}
Ovary weight	0.17±0.65	0.39±0.41	0.22±0.16	0.21±0.15	0.44±0.59
Head	5.50±0.35	5.96±0.54	5.69±0.13	5.81±0.38	5.78±0.37
Skin	10.29±0.89	9.29±1.44	9.59±0.61	9.98±0.67	10.53±2.04
GIT	10.51±2.94^{bc}	14.61±7.97^{a}	13.24±1.88^{b}	12.63±0.76^{bc}	13.11±0.88^{b}
Lungs	0.41±0.42	0.35±0.52	0.35±0.66	0.36±0.16	0.22±0.18
Uterus	0.38±0.16	0.37±0.82	0.31±0.45	0.27±0.71	0.23±0.66

$^{a\,b\,c}$ means on the same row with different superscript are significantly different ($p < 0.05$)

The growth rate of rabbits **o**n sole concentrate feeding; maize-*GNC* (T_1) & *CPM-PKC* (T_2) **a**nd T_5 (Moringa + *CPM-PKC*) translates to 13.57 g/day, 9.64 g/day and 12.85 g/day for T_1, T_2 and T_5, respectively. These values are in agreement with those observed in previous studies [18 – 21]. However, rabbits on Gliricidia (T_3) and Leucaena (T_5) supplemented with CPM-PKC based concentrate have significantly reduced growth rate (4.82 g/day) than those previous studies. With the exception of rabbits on *Gliricidia* and *Leucaena*, feed intake was generally higher in this study than what was previously reported [18–23]. This experiment was conducted with rabbits aged 16 weeks which are older and bigger than the 6–8 weeks old rabbits used by the previous researchers. This explains the higher average daily feed intake of rabbits in this study.

Leucaena is the most preferred forage in this research. This agrees with the report of a greater preference for Leucaena over Gliricidia [24]. As a result of the higher intake of forage by rabbits on Leucaena, their concentrate intake was the least. The observed reduced rate of gain and feed efficiency of rabbits on Leucaena compared with Gliricidia agrees with the finding of Onwudike [25]. Increasing levels of Gliricidia [24] and Leucaena [18, 26] have been reported to reduce growth rate and feed intake in the domestic rabbit. The reduction in growth and feed intake are due to anti-nutritional factors which are present in these legumes [26]. Alopecia reportedly associated with the intake of Leucaena [26] was not observed in this study. The stimulating effect of fibre on feed intake due to increased forage feeding in rabbits reported by [19I and [27] was also not observed in this study as rabbits on sole concentrate feeding had higher feed intake than rabbits on forage supplemented with concentrate. However, the concentrates in this experiment were already formulated to meet the fibre requirement of the domestic rabbit. With the exception of rabbits on Moringa leaves (T_5), *ad libitum* forage with supplemental concentrate resulted in reduced growth rate as reported by [28] and [29]. The positive effects of Moringa on intake, growth rate and feed efficiency in this research agree with earlier research report on Moringa as feedstuff for the domestic rabbit [30 – 33]. Sole concentrate feeding of maize-*GNC* concentrate (T_1) resulted in higher feed intake and better growth rate than *CPM-PKC* based concentrate (T_2) apparently due to the better palatability and better nutrient composition/availability of the latter. Maize is richer in energy and protein than *CPM* while *GNC* is also richer in protein in terms of quantity and quality than *PKC*.

With the exception of rabbits on Morin*g*a (T_5, *FCR*, 5.46), the *FCR* were higher in other treatments (T_1, 7.44; T_2, 8.00; T_3, 11.47; T_4, 15.60) than 6.21 – 6.49 reported by [20], 4.06 – 6.33 by [18] and 3.29

– 4.54 by [5]. The *FCR* of 7.44 and 8.00 observed in rabbits fed maize-*GNC* (T_1) and *CPM-PKC* (T_2) based concentrate, respectively, still fall within the range of 5.56 – 8.28 obtained in rabbits fed groundnut forage meal with or without palm oil supplementation by [19]. The comparable *FCR* value in both the maize-*GNC* and *CPM-PKC* concentrate affirms the earlier submission of [8] and [10] on the feasibility of using *CPM* and *PKC*, respectively, at up to 30 % of the diet for rabbits.

Meat yield in rabbits may be predicted using only carcass weight or slaughter weight as the criterion [34] and the finding of this study lay credence to this, as all other measurements expressed as percentage of slaughtered weight were not significantly different. Differences in intestinal length and *GIT* weight have been reported to be affected by the nature, forms and size of the dietary treatment given to livestock [35]. *GIT* weight in this research was obviously influenced by the nature of the concentrate. The *CPM–PKC* concentrate increased the *GIT* weight. The differences in the intestinal length did not follow a consistent pattern.

The findings of this research showed that corn-*GNC* based concentrate resulted in a higher feed intake, weight gain and slaughter weight than *CPM–PKC* based concentrate, the two have similar efficiency of feed utilization. Rabbits on Moringa + *CPM–PKC* concentrate have similar feed intake, weight gain and slaughter weight with those on sole *CPM–PKC* concentrate. The efficiency of feed utilization was however better in rabbits fed Moringa + *CPM–PKC* concentrate. Leucaena and Gliricidia have similar results for feed intake, weight gain and slaughter weight

Though concentrate was intended as a supplementary feed, rabbits on forage plus concentrate had higher concentrate dry matter intake in the 5 hours of concentrate feeding than dry matter intake of forage in the 19 hours of forage feeding. Although on as-fed basis forage intake was higher.

Based on the findings of this study, the agro by – products, cassava peel and palm kernel cake can be combined, each at 30 % inclusion rate in the diet of growing rabbits, without any deleterious effect. There was no mortality in any of the experimental groups. Similarly, Moringa, Gliricidia and Leucaena can be used in small holder backyard rabbit feeding in that order. From the result on feed intake, rabbit should be fed about 50 % of their *ad libitum* concentrate requirement in combination with any of the three forages, free choice for good performance. When availability and cost are factored into small holder rabbit production, the findings of this research supports the use of cassava peel meal and palm kernel cake as major ingredients over maize, groundnut cake/soybean in rabbit concentrate formulations. Similarly, the combined feeding of concentrate with any of the three perennial forages is recommended with greater preference for Moringa leaves.

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