



Effect of Quantitative Feed Restriction Using Raw and Toasted Bambara Nut (*Vignasubterrenea* (L) Verd Court) on the Performance of Weaner Rabbit's

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Abstract – Effect of quantitative feed restriction using raw and toasted Bambara nut on the growth performance, body anthropometrics, haematological indices and economics of production of weaner rabbits were studied. Fifty four (54), cross bred (Newzealand white × Callifornia) weaner rabbits aged 6 weeks old, were divided into three treatment groups with six replicates each. Three experimental diets were formulated for the various treatments, such that T₁ contained no Bambara nut, T₂ contained 20% raw Bambara nut, T₃ contained 20% toasted Bambara nut. All treatments were quantitatively restricted of concentrate based diets at the 3rd week (50%/day/rabbit) and 6th week (100%/day/rabbit). The rabbits were quickly followed up by *ad libitum* feeding after restrictions till the end of the experiment at age 12 weeks old. Final body weight, total feed intake, daily feed intake and feed conversion ratio were statistically influence ($p < 0.01$) in favour of treatment three with toasted Bambara nut. Compensatory weight gain after 3rd week and 6th week also were influenced statistically ($p < 0.01$) in line with other body parameters measured. Haematological indices at 3rd week showed lack of significant difference ($p > 0.01$) between diet one (control) and T₂ but were both significantly different from diet three. Nevertheless, the haematological parameters did not reflect any significant ($p > 0.05$) differences between diet one (control) and diet three. Diet two was significantly ($p < 0.01$) different from the other two in all the haematological parameters. No mortality was observed throughout the duration of study. There was no significant ($p > 0.05$) differences observed in the haematological parameters during the period without restriction. All haematological values fell within normal ranges in literature. Body linear relationship were significantly ($p < 0.01$) different, with treatment three blazing the trail whereas treatment two did not reflect much difference from the treatment one (control). The results of the coefficient of correlation of linear body measurements were found to be positive and highly significant ($p < 0.01$) and ranged from 0.535 to 0.975 reflecting possibility of high predictability of live weight among the linear parameters. The economics of production revealed a marginal increase in the total cost of production as feed cost/kg weight gain increased from T₁ to T₃, with T₃ recording the highest cost. The cost benefit ratio was best for rabbits fed treatment two (raw Bambara nut) while treatment three was the least.

Keywords – Feed Restriction, Bambara Nut, Rabbits, Compensatory Weight Gain, Haematological, Body Linear Relationship.

I. INTRODUCTION

Feeding strategy in growing rabbits could be used to produce animals with maximum lean body mass, the lowest feed conversion ratio, and the best meat quality.

The early-life fast growth rate is accompanied by a number of problems, namely increased body fat deposition, high incidence of metabolic disorders, high mortality and high incidence of skeletal diseases. In the growing rabbits, an early feed restriction applied around post-weaning age could be of interest to improve feed efficiency (Tůmová *et al.*, 2002; Yakubu *et al.*, 2007; Gidenne *et al.*, 2009; Gidenne *et al.*, 2012), induce compensatory growth (Tůmová *et al.*, 2002; Foubert *et al.*, 2008), reduce carcass fat deposition (Tůmová *et al.*, 2004), improve digestibility of nutrients during the restricted feeding period (Tůmová *et al.*, 2004; Di Meo *et al.*, 2007) and reduce post weaning digestive disorders namely the Epizootic Rabbit Enteropathy syndrome (ERE) (Boisot *et al.*, 2003).

In fact, digestive disorders are the main cause of morbidity and mortality in growing rabbits which are responsible for important economic losses in industrial rabbit farms. Therefore, early feed restriction could be a useful tool to improve the biological and economic performance (Tůmová *et al.*, 2007), which consequently are involved in reducing the costs of production (Yakubu *et al.*, 2007). Feed for growing rabbits is rationed to reduce the incidence of enteropathies that leads to animal losses. Nevertheless, feed restriction can be used at different periods (usually from one to three weeks after weaning) or at different levels (restriction percentage in relation to feed intake), (Di Meo *et al.*, 2007). Feed restriction suppresses growth during the restriction period, but the growth reduced can be compensated with greater future intake (Govaets *et al.*, 2000). Limiting the time of access to feed and quantitative feed of rabbits may prevent feed wastage and possible overfeeding.

Safaloah (2004) showed that reducing eating time down to 9 hours of growing rabbits (from 4-12 weeks of age) had reduced daily feed intake by 15% and improved feed conversion by 13% without changing the average daily gain.

Bambara nut seeds are reported to have higher antitryptic activity than soybean and the level of activity depends on the variety (landrace) (Tibe *et al.*, 2007). To this effect, heat treatments such as boiling or roasting are usually effective in destroying trypsin inhibitor. On the other hand, notwithstanding the anti-nutrients in raw Bambara nut, it has been reported to possess anti-helminthic, antimicrobial and antioxidant potentials (Grace, 2015). Subsequently, Uche *et al.*, (2014) reported an increase in crude protein, Crude fibre and

Metabolizable energy of raw Bambara nut when compared to the roasted Bambara nut.

In view of the forgoing, this work was done to determine the effect of quantitative feed restriction using raw and toasted Bambara nut on the growth performance, body anthropometrics, haematological indices and economics of production of weaner rabbits.

II. MATERIALS AND METHODS

A. Experimental Site

The experiment was carried out at the Rabbit Unit of the Department of Animal Science, Faculty of Agriculture and Natural Resource Management, Ebonyi State University Teaching and Research Farm Abakaliki Nigeria. Abakaliki is located within latitude 07° 30E, 08° 30E and longitude

of 5° 40N and 6° 45N and situated in the humid zone of the south east. (Nwakpu 2008)

B. Experimental diet, source and processing of Bambara nut

The Bambara groundnut used in this experiment was gotten from Abakaliki main market in Ebonyi State. Toasting of the Bambara groundnut was done by pouring the needed quantity of the nut into a Garri frying pan, set over fire. The nuts were stirred to avoid excessive burning. The turning of the nuts while on fire continued until it turned brownish. Excessive burning was avoided so as not to completely destroy the essential amino acids. The toasting lasted for about 15 minutes and was done in batches. Subsequently, the raw Bambara nut used was sorted of debris and stones, milled and incorporated into other feed ingredients.

Table 1: Proximate composition of experimental diet

Ingredients	T ₁ (control)	T ₂ (20% Raw)	T ₃ (20% Toasted)
Maize	45.00	45.00	45.00
Groundnut Cake	25.00	15.00	15.00
Wheat offal	27.00	17.00	17.00
Raw Bambara nut	0.00	20.00	0.00
Toasted Bambara nut	0.00	0.00	20.00
Bone meal	2.50	2.50	2.50
Premix	0.25	0.25	0.25
Salt	0.25	0.25	0.25
Total (%)	100	100	100
Calculated (%CP)	20.64	18.26	18.26
Energy (ME) kcal/kg	2709.3	2331.86	2331.86
Crude Fibre	4.45	4.363	4.363

C. Experimental Rabbits and Management

Fifty four cross breeds (Newzealand white × Callifornia) rabbits aged 6 weeks old were used in this study. The rabbits were divided into three treatment groups of 18 rabbits each. The average initial body weight of different treatments was approximately similar. Each treatment had six replicates of 3 rabbits each. Each replicate was housed in an esparto hutch. The rabbits were fed a formulated diet of 19.05% protein and 2457.67 ME/kg feed. Quantitative concentrate feed restrictions was done at the 3rd week and 6th week for all the treatments and quantities of feed provided was at 50%/day/rabbit and 100%/day/rabbit with treatment one (diet 1) as control with neither raw nor toasted Bambara nut; treatment two (diet 2) contained 20% raw Bambara nut; while treatment three (diet 3) contained 20% toasted bambara nut respectively, followed by *ad libitum* feeding up to the end of the experiment at the age of 12 weeks. Rabbits in all treatments had full access to drinking water.

D. Data Collection

Data on average body weight, body weight gain, feed intake, feed conversion ratio, body anthropometrics as well as mortality were recorded and calculated weekly up to the 12th week of age for each individual replicate. Blood samples was taken from the marginal ear vein at the 3rd, 6th and 9th weeks from each replicate and haematological

F. Statistical analysis

parameters analyzed includes; Haemoglobin (Hbc), Pack Cell Volume (PCV), Total White Blood Cell (TWBC), Red Blood Cell (RBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC).

E. Economics of Production

The economics of production to show the profitability of the test diet was also calculated using the method of Sonaiya *et al.* (1986) where the economic benefit of replacing raw and toasted Bambara nut was assessed by obtaining the cost (₦)/kg feed, Total cost (₦), Revenue, Benefit and cost benefit ratio for each treatment diet using the following formula.

Total cost = cost of feed intake + cost of rabbits + miscellaneous

Revenue = Final Body Weight (kg) x cost (₦)/kg Live weight

Benefit = Total Revenue – Total cost

$$\text{Cost benefit Ratio} = \frac{\text{Total cost}}{\text{Benefit (gain)}}$$

$$\text{Cost (₦)/kg feed intake} = \frac{\text{feed cost (₦)/kg} \times \text{total feed intake}}{\text{total feed intake}}$$

$$\text{Cost (₦)/kg weight gain} = \frac{\text{Total feed cost (₦)}}{\text{Kg weight gain/Rabbit}}$$

The statistical analysis were carried out according to SAS programme (2002) utilizing the following model;
 $Y_{ijk} = u + D_i + A_j + (DA)_{ij} + e_{ijk}$ where;
 Y_{ijk} = observed value of the concerned
 u = overall mean for the concerned

D_i = the fixed effect due to duration of severe restriction (i)
 A_j = the fixed effect due to age (j)
 $(DA)_{ij}$ = the interaction effect between duration of severe restriction and age (j)
 e_{ijk} = random error.

III. RESULTS

Growth Performance

Table 2: Growth Performance Characteristics of rabbits quantitatively restricted of feed using raw and toasted Bambara nut.

Parameter	T ₁	T ₂	T ₃	± SEM
Initial body weight (g)	752.27	751.40	751.93	23.68
Final body weight (g)	1438.80 ^b	1480.20 ^b	1586.7 ^a	7.94
Body weight gain (g)	686.53 ^b	728.80 ^b	834.77 ^a	24.66
Daily weight gain (g)	10.90 ^b	11.57 ^b	13.25 ^a	0.39
Total feed intake (g)	4423.13 ^c	4480.50 ^b	6510.00 ^a	7.75
Daily feed intake (g)	70.21 ^c	71.12 ^b	103.33 ^a	0.12
Feed conversion ratio (g)	6.44 ^b	6.17 ^c	7.81 ^a	0.22
Compensatory weight gain (1)(g)	116.80 ^c	159.00 ^a	140.90 ^b	3.45
Compensatory weight gain (2) (g)	181.40 ^b	202.83 ^a	216.20 ^a	4.04

❖ abc: Means with the same superscript in the same row are not statistically significant ($p > 0.01$). SEM-standard error of means

Table 2 showed that significant differences ($P < 0.01$) existed among all growth parameters aside from the initial body weight. For final body weight, T₁ and T₂ were non-significantly ($p > 0.01$) different, while T₃ with higher numeric value was significant ($P < 0.01$). Values for body weight gain and daily weight gain were non-significant ($P > 0.01$) for T₁ and T₂, while T₃ with higher numeric value was significantly different ($P < 0.01$). In terms of total feed intake and daily feed intake, all treatments were significantly different ($p < 0.01$), with T₃ having the

highest intake. This elucidates why it had the highest weight gain. Subsequently, the various experimental diets had effect on the feed conversion ratio, as T₃ was significant ($P < 0.01$), while T₂ and T₃ were non-significant ($P > 0.01$). Compensatory weight gain for all treatments were significant ($P < 0.01$) with T₂ recording the highest compensatory weight gain after the first restriction period, while T₃ recorded highest after the second restriction period.

Haematological Indices

Table 3: Haematological indices of rabbits quantitatively restricted of feed using raw and toasted Bambara nut

Parameters	Collection periods	T ₁	T ₂	T ₃	± SEM
PCV (%)	Week 3	35.00 ^a	32.00 ^b	34.00 ^a	0.58
	Week 6	31.00 ^a	21.00 ^b	29.00 ^a	0.82
	Week 9	37.00 ^a	35.00 ^b	37.50 ^a	0.50
HBC (g/dl)	Week 3	14.50	14.20	14.40	0.08
	Week 6	10.50	10.60	11.20	0.34
	Week 9	14.50	14.30	14.50	0.18
TWBC (g/dl)	Week 3	140.50 ^b	100.50 ^c	150.30 ^a	0.67
	Week 6	159.30 ^c	178.13 ^a	160.27 ^b	0.41
	Week 9	111.00 ^b	128.00 ^a	115.00 ^b	0.82
RBC (X10 ⁹ /l)	Week 3	2.72 ^b	2.40 ^b	2.98 ^a	0.05
	Week 6	2.70 ^a	2.05 ^b	2.97 ^a	0.06
	Week 9	3.21 ^{ab}	3.10 ^b	3.35 ^a	0.03
MCV (fl)	Week 3	115.53 ^c	127.53 ^a	118.20 ^b	0.35
	Week 6	124.80 ^b	116.20 ^a	114.70 ^b	0.54
	Week 9	155.30 ^a	131.60 ^b	142.50 ^b	2.33
MCH (pg)	Week 3	60.80 ^b	58.30 ^b	98.20 ^a	1.41
	Week 6	59.27 ^a	60.10 ^a	56.33 ^b	0.41
	Week 9	62.60 ^a	63.20 ^b	68.00 ^b	0.86
MCHC (p/dl)	Week 3	46.50 ^b	50.30 ^a	47.10 ^b	0.31
	Week 6	49.30 ^b	52.10 ^a	48.20 ^c	0.19
	Week 9	50.30	49.20	51.30	0.56

❖ abc: Means with the same superscript in the same row are not statistically significant ($p > 0.01$). SEM-standard error of mean.

The result of quantitative feed restriction using raw and toasted Bambara nut on the haematological indices of rabbits is presented in Table 3. For PCV, significant ($p < 0.01$) variations was observed in all treatments for the three collection periods. T_1 had the best non significant ($p > 0.01$) value of PCV with T_3 . For HBC, no significant ($p > 0.01$) differences was observed across the three treatments for the various periods. For TWBC, significant ($p < 0.01$) differences was observed across the three treatments for the various periods. At week 3, the TWBC of T_3 recorded the highest value that is significantly ($p < 0.01$) different to T_1 and T_2 , whereas at weeks 6 and 9, T_2 had the highest significant ($p < 0.01$) mean value across the various treatments respectively. For RBC, T_3 recorded the highest significant ($p < 0.01$) mean value across the three treatments for the three collection periods respectively. Although no significant ($p > 0.01$) differences

in RBC was observed between T_3 and T_2 in weeks 3 and 6 respectively, whereas T_1 and T_2 with lower mean values were non significantly ($p > 0.01$) different in weeks 3 and 6 respectively. For MCV, T_2 recorded the highest significant ($p < 0.01$) mean value across the three treatments in week 3 and 6 as T_1 and T_3 , whereas T_3 recorded the highest significant ($p < 0.01$) mean value in week 9. For MCH, T_3 was highest in mean value for week 3 and was significantly ($p < 0.01$) different to T_1 and T_2 . Whereas, T_1 recorded the highest significant ($p < 0.01$) mean value in week 9, as T_2 had the highest significant value for MCH in week 6. For MCHC, significant ($p < 0.01$) differences was observed across the three treatments in weeks 3 and 6, whereas T_2 recorded the highest significant ($p < 0.01$) mean value respectively. While in week 9, no significant ($p < 0.01$) differences were observed across the three treatments for MCHC.

Linear body Measurement

Table 4: Linear body measurement (Anthropometrics)

Parameter	T_1	T_2	T_3	\pm SEM
Weight	1438.80 ^c	1480.20 ^b	1586.7 ^a	7.94
Ear length	10.87 ^b	10.50 ^c	11.30 ^a	0.01
Neck	11.50 ^b	10.50 ^c	12.60 ^a	0.12
Leg	25.50 ^{ab}	25.00 ^b	25.94 ^a	0.10
Body	36.25 ^b	35.75 ^b	37.33 ^a	0.56
Tail	8.13 ^b	7.00 ^c	8.67 ^a	0.08
Height at withers	14.5 ^{ab}	14.00 ^b	15.00 ^a	0.12
Body girth	22.25 ^b	22.25 ^b	23.33 ^a	0.06

❖ abc: Means with the same superscript in the same row are not statistically significant ($p > 0.01$). SEM-standard error of means

The linear body measurements of rabbit's quantitatively restricted of concentrate feed using raw and toasted Bambara nut is presented in Table 4. Significant ($p < 0.01$) differences were observed across all treatments for the

various parameters respectively. T_3 recorded the highest significant ($p < 0.01$) mean values in all parameters respectively.

Table 5: Coefficient of correlation analysis of linear body measurements

	BW	EL	NC	LL	BL	TL	HW	HG
BW	1	0.72*	0.74*	0.627*	0.770**	0.535	0.660*	0.953**
EL		1	0.975**	0.935**	0.951**	0.956**	0.939**	0.881**
NC			1	0.938**	0.945**	0.958**	0.914**	0.840**
LL				1	0.886**	0.927**	0.969**	0.775**
BL					1	0.878**	0.848**	0.893**
TL						1	0.891**	0.722*
HW							1	0.814**
HG								1

* Correlation is significant at the 0.05 level (1 tailed)

** Correlation is significant at the 0.01 level (1 tailed).

BW (body weight), EL (ear length), NC (neck circumference), LL (leg length), BL (body length), TL (tail length), HW (height at withers), HG (heart girth).

The results showed a positive, significant ($p < 0.05$) and highly significant ($p < 0.01$) coefficients of correlation among the variables (linear measurements) and ranged

from 0.535 to 0.975. This implies high predictability of live weight among the variables.

Table 6: Economics of Production of rabbits quantitatively restricted of feed using raw and toasted Bambara nut.

Parameters	T₁	T₂	T₃
Cost of rabbits	1500	1500	1500
Cost of feed k/kg ₦	92.50	100.45	104.8
Cost of medication and miscellaneous	38.65	38.65	38.65
Cost of feed consumed/Rabbit	409.14	450.07	682.25
Total feed consumed/rabbit	4.42313	4.4805	6.510
Feed cost(₦/kg) weight gain/rabbit	284.13	304.10	429.09
Final weight gain/rabbit	1.43880	1.48020	1.5867
Total cost of production	1947.79	1988.72	2220.90
Cost of rabbit/kg live weight	1700	1700	1700
Total revenue generated/rabbit	2445.96	2516.34	2697.39
Net return/rabbit	498.17	527.62	476.49
Cost benefit ratio	3.91	3.77	4.66

Table 6 presents the economics of production of quantitative feed restriction using raw and toasted Bambara nut on growing rabbits. The result revealed a marginal increase in the total cost of production as feed cost/kg weight gain increased from T₁ to T₃, with T₃ recording the highest cost respectively. The study also showed that subsequently after production, T₃ generated more revenue followed by T₁ and T₂. The cost benefit ratio which is the ratio of the cost of the production expressed in monetary term was best on rabbits fed diet T₂ containing raw Bambara nut, followed by the control diet (T₁) and then T₃ as the least.

IV. DISCUSSION

Growth Performance

Significant difference ($p < 0.01$) were observed in the growth performance parameters of rabbits quantitatively restricted of feed using raw and toasted Bambara nut. Rabbits fed diet T₃ containing toasted Bambara nut recorded the highest final weight, body weight gain, daily weight gain, total and daily feed intake and feed conversion ratio. This development could be attributed to the improved nutrient utilization as a result of reduced anti-nutrients in toasted Bambara nut. This result is related to the report of Uche *et al.* (2014) who stated that processing significantly lowered the levels of anti-nutrients in Bambara nut thereby making it safer to consume. The result is not in agreement with the reports of Ironkwe and Esonu, (2012) on the performances of finisher broiler birds, in which case, they concluded that raw Bambara nut can be used to supplement groundnut meal in broiler finishers' diets as in birds and rabbits diets. The merit of raw Bambara nut over the toasted may be attributed to the heat applied which probably may have denatured the available protein during toasting, making them insoluble and less digestible (Ironkwe and Esonu, 2012). On the other hand, feed restriction could be a secondary factor that facilitated growth performances, as a result of increased and effective feed intake after restrictions.

Furthermore, after the first restriction period (50%/day/rabbit), rabbits that received diet T₂ containing

raw Bambara nut compensated with higher weight gain than other treatments. This could be justified by the nutritional values of raw Bambara nut which was reported by Uche *et al.* (2014), to possess higher crude protein, crude fibre and metabolizable energy than the roasted Bambara nut. On the other hand, after the second restriction period (100%/day/rabbit), rabbits fed T₃ diets containing toasted Bambara nut had higher compensatory weight gain than other treatments in which case better nutrient utilization in the absence of anti-nutrients in toasted Bambara nut was justified. Subsequently, it was observed that compensatory weight gain for the second restriction period (week 3) at 100%/day/rabbit was higher than that of the first period (week 6) at 50%/day/rabbit. This could be justified by the physiology of compensatory growth, as observed by David and Alan (2002). During restriction, a reduction in basal metabolism takes place, the gut tissue are the first to reduce in weight and activity; then, during re-feeding phase, an increase in feeding enables more dietary protein and energy to be contributed for tissue growth instead of basal metabolism. Compensatory growth for both period of this study is in agreement with the reports of Tumova *et al.*, (2004); feed restriction resulting in accelerated growth, but compensatory growth was observed only in rabbits restricted for one week.

Haematological Indices

During restrictions (weeks 3 and 6), the PCV though reduced falls within the normal range of 30 – 50% as reported by Poole, (1987), and is in agreement with the reports of El-Moty, (1991), which concluded that PCV was significantly decreased by feed restrictions in rabbits. To this effect, Bawala *et al.*, (2007) stated that low haematological values such as 30% Packed Cell Volume (PCV), Haemoglobin Concentration (Hb) of 10.30g/dl and Red Blood Cell (RBC) counts of $7.10 \times 10^6/\text{ml}$ as reported by could be due to the harmful effects of high dietary content, in which case, Bambara nut was suspected.

During restrictions (weeks 3 and 6), a reduction in MCH and RBC below values gotten from week 9 (no restriction) and also below the normal ranges of (5.0 - 8.0) and (19.7 - 19.8) respectively as reported by Olabanji *et al.* (2007), could be as a result of restriction. This is in agreement

with the reports of Ebeid *et al.* (2012), which observed a mean significant ($p < 0.05$) reduction in haemoglobin concentration and red blood cells, as a result of restrictions in fattening rabbits. The HBC during restrictions were non-significant ($p > 0.01$) and when compared with that of week 9 (no restriction), was within the normal range of 8-17 as reported by Olabanji *et al.* (2007). The reduction in HBC could be due to the observed reduction in RBC counts.

The increase in MCV was due to restriction and is in accordance with the findings of Ebeid *et al.* (2012), who reported that mean cell volume (MCV) was increased by 1.5 and 2.7% in 50g restriction/day/rabbit and 65g restriction/day/rabbit, respectively ($P < 0.05$) during one week of intensive restriction. Differences observed in Packed Cell Volume (PCV) and MCV for animals in different treatment groups may be attributed to the physiological and nutritional status of the animals (Esonu *et al.* 2001).

There was an increase in TWBC and MCHC at week 6. The increased TWBC could be attributed to the stress as a result of restriction, while increased MCHC was because the haemoglobin is more concentrated inside the red blood cell. All values still fall within the normal range but were more reduced when compared with values of week 3. This then could be attributed to the presence of anti-nutrients in Bambara nut which predisposes the cells to high immunity during restriction (100%/day/rabbit).

It was generally observed that after restriction, all haematological indices falls within the normal range as reported by Olabanji *et al.* (2007) meaning that experimental diets had no adverse effect on the rabbit's metabolic status.

Linear Body Measurement (Anthropometrics)

Linear body measurements contributed to the significant difference in body weight for all three treatments at the end of the experiment. It is worthy of note that all values from linear body measurements were similar to the reports of Chineke *et al.* (2000) and Abdullah *et al.* (2003). From all indications it was observed that any increment in the various body measurements irrespective of the diet consumed, resulted in the marginal weight gained by various treatments.

Coefficient of Correlation

Table 5 presents the Pearsons coefficient of correlation between body weight and linear body measurements in rabbits. Positive significant ($p < 0.05$) and highly significant ($p < 0.01$) coefficients of correlation were obtained among the variable ranging from 0.535 to 0.975. This implies highly predictability among the variables. A similar observation was reported by Yakubu and Ayoade (2009) in New Zealand White x Chinchila Rabbits. Also results were in accordance with the report of Tiamiyau *et al.* (2004) linear body measurements when taken sequentially over a period of time can be used to predict animal live weight.

Economics of Production

Table 6 presents the economics of production of quantitative feed restriction using raw and toasted Bambara nut on growing rabbits. On the basis of the

verdict from this study, commercial rabbit farmers can be advised to adopt the use of raw Bambara nut, because it recorded the best cost benefit ratios than other treatment diets.

V. CONCLUSION AND RECOMMENDATION

The verdict of this research has shown that quantitative feed restriction using either raw or toasted Bambara nut for one week can be adopted in rabbit production as it yielded more compensatory growth than the control diet. The study further revealed that Bambara nut could also be used at 20% as perfect replacement for protein sources in events of scarcity of most conventional plant protein sources. Feed restriction as revealed in this study would be best practiced at 100%/day/rabbit for one week, as it compensated more weight gain than partial restriction of 50%/day/rabbit. It is therefore no surprise in educating commercial rabbit farmers that their animals could survive when placed under forages alone for one week and thus replenishing more of their lost weight during *ad libitum* re-feeding with concentrate diets and forages.

Furthermore there was no significant effect in the haematological indices of these rabbits during restrictions because, values for the various haematological indices still fall within the normal physiological range required for optimum performance of rabbits. Values from the linear body measurements was a good indication that weight is dependent on body anthropometrics, and could serve as yardstick in predicting live weight of rabbits without scale measurements and is therefore recommended.

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