SHORT COMMUNICATION

Comparative evaluation of effects of different sources of groundnut meals on digestibility, growth performance and economics of production of growing rabbits

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Abstract

Three groundnut meals namely, groundnut cake (GNC), locally processed groundnut cake (kulikuli) and toasted groundnut seed(kernel) meal (TGSM) were incorporated in rabbit diets at two levels to generate six diets: 18% GNC, 22% GNC, 18% Kulikuli, 22% Kulikuli, 18% TGSM and 22% TGSM respectively, and 18% GNC also served as the control diet. Twenty four (24) six weeks-old growing rabbits of mixed breeds and sexes with mean initial weight of 568.75 ± 12.85 g were randomly allocated to the six dietary treatment groups, such that each had four rabbits and each rabbit formed a replicate in a completely randomized design laid out in a 2X3 factorial arrangement and fed ad libitum, for 70 days. The main effects showed that while the treatment groups fed TGSM were significantly depressed ($p < 0.05$), rabbits fed GNC and kulikuli were not significantly different ($p > 0.05$) for average daily feed intake, daily body weight gain and final body weight. Feed conversion ratio (FCR) was not significantly ($p > 0.05$) affected among treatment groups. Rabbits fed TGSM had significantly ($p < 0.05$) better apparent digestibility coefficient (78.04%) than those on kulikuli (75.81%) and the group on kulikuli were better than animals fed GNC (72.09%) for fat digestibility. Fibre digestibility was also significantly different ($p < 0.05$), with rabbits fed kulikuli having the poorest fibre digestion (15.63 %). Crude protein, dry matter and NFE apparent digestibility coefficients were not significantly ($p > 0.05$) affected. Among all the parameters measured, only fat and fibre digestibility coefficients had significant ($p < 0.05$) interactions and NFE digestibility was significantly affected ($p < 0.05$) by level of inclusion, with groups fed 22% digesting it better. Feed cost kg^{-1} gain did not differ significantly ($p > 0.05$) among the treatment groups. Growth was still on the rise and there was a significantly ($P < 0.01$) strong relationship (correlation and regression) between feed intake and weight gain for all the treatment groups. It was concluded that both kulikuli and TGSM are potential feed resources for rabbits, more available to house hold farmers, equally economical as GNC and better still if groundnut farmers and or processors of kulikuli raise rabbits, though TGSM had less value for growth rate compared to GNC and Kulikuli at these levels of inclusion.

Key words: Rabbits, kulikuli (locally made groundnut cake), groundnut cake, toasted groundnut seed, digestibility, performance, economics.

Introduction:

The fact that people living in the developing countries of the world do not consume adequate protein, particularly; animal protein is no longer news. This ugly

situation, occasioned by high cost of animal products due to high cost of conventional feed stuffs such as maize, soyabean meal and groundnut cake has received serious response from animal nutritionists and

other players in the livestock industry by diverting from sole dependence on conventional feedstuffs to non conventional feedstuffs which have two important advantages over the conventional feedstuffs – availability and low cost. Oluremi *et al.* (2005) reported all year round free access to sweet orange fruit rind which replaced 40% maize in rabbit diets without adverse effect on the performance of the rabbits. Among the conventional feedstuffs, groundnut cake and soyabean cake are major sources of plant protein (Aduku, 2004). Groundnut availability world wide is uncontestable as 34.9 million metric tones were produced in 2007 (FAO, 2007) and Nigeria produced 2 million metric tones in 2012 (FORA, 2012). However, due to the scarcity and difficulty of accessing these protein sources (groundnut cake and soyabean cake) as a result of collapsed oil milling industries in most parts of Nigeria (Musa, 2010), several alternatives such as full fat soyabean (Ikurior *et al.*, 1992), beniseed meal (Adetoro *et al.*, 2012) and locally made ground nut cake known nation- wide as kulikuli (Aguihe, 2012) have been utilized with results from feeding trails on farm animals comparable to conventional feedstuff based diets.

Expanded rabbit production will increase healthy meat supply to meet the ever-increasing demand for animal protein, guarantee food security, increase the farmers' income and flourish rural economy (Gao, 2009). According to Aduku and Olukosi (1990), rabbit production has the potential to improve the living standard of many poor households in the developing world. It is however certain, that house hold production of rabbit cannot thrive on conventional feedstuffs alone, due to their scarcity and or high cost.

This study was therefore aimed at

evaluating the comparative utilization of three sources of groundnut meals (groundnut cake, kulikuli and toasted groundnut seed meal) by growing rabbits.

Materials and methods

The experiment was conducted at the Rabbit House of the Livestock unit, Teaching and Research Farm, University of Agriculture Makurdi, Benue State. The area is warm, with an ambient temperature range of $26.42 \pm 1.4^{\circ}\text{C}$ minimum temperatures and $36.33 \pm 3.70^{\circ}\text{C}$ maximum temperatures respectively (TAC, 2009).

Feed ingredients: the test ingredients were processed as follow; Kulikuli, a locally made groundnut cake was purchased from North Bank Market in Makurdi Benue State and was pounded into meal using pestle and mortar. Raw groundnut seed was purchased from the North Bank market, Makurdi, Benue state, and toasted as described in the toasting of full fat soya bean by Ikurior *et al.* (1992). The toasted groundnut was then pound into toasted groundnut seed meal (TGSM) using pestle and mortar. Kulikuli and toasted groundnut meal were analyzed for proximate, calcium and phosphorous (Table 1) and used in formulating and compounding the diets.

Experimental diets:

A total of Six (6) diets were formulated and compounded such that each source of groundnut meal (GNC, kulikuli and TGSM) had two levels of inclusion (18 % and 22%) and coded GNCL₁₈, GNCL₂₂, KulikuliL₁₈, kulikuliL₂₂, TGSM₁₈, and TGSM₂₂ respectively. GNC L₁₈ also served as the control - Table 2.

Experimental animals and design:

A total of twenty four (24) unsexed weaned rabbits of mixed breed and sex, aged approximately six weeks with a mean live weight of $568.75 \pm 12.85\text{g}$ were obtained

Table 1: Proximate, calcium and phosphorous composition of GNC, kulikuli and toasted groundnut seed (kernel) meals

Nutrients	Kulikuli (%)	TGSM (%)	GNC (%)
Moisture	4.85	3.7	8.60 ²
Crude protein	31.08	27.72	45.00 ¹
Crude fibre	7.50	8.91	9.16 ¹
Etter extract	19.30	37.75	3.80 ¹
Ash	5.00	2.4	6.20 ²
NFE	32.27	19.5	36.70 ²
Calcium	0.25	0.23	0.2 ¹
Phosphorus	0.2	0.14	0.60 ¹
ME* (kcal/kg)	3774.29	4705.84	2640 ¹

²Bhatt *et al.* (2005), ¹ Aduku (2004), ME* calculated energy using the procedure outlined by Pauzenga (1985), ME=37(%cp) +81.8(%EE) + 35.5(%NFE) ±100

from the Rabbitry Section of Dagwom Farm Division, National Veterinary Research Institute, Vom, Plateau State, Nigeria and used for the study. The animals were randomly allocated to six dietary treatment groups of four rabbits per group, and each rabbit formed a replicate in a completely randomized design (CRD) laid out in a 2x3 factorial arrangement.

Housing and management of experimental animals:

The rabbits were housed in hutches with a dimension of 60cm X 60cm X 60cm inside a wall less structure. The initial weights of the animals were taken, balanced and randomly allocated to the hutches. Known quantities of diets were served daily and cool clean water served *ad-libitum* throughout the feeding trial which lasted for 70 days. Necessary management practices (Fielding, 1991) were duly observed.

Data collection and analysis:

The performance parameters measured were average daily feed intake, weekly weight, and final weight. Weekly and total

weight gain was calculated by difference; average feed conversion ratio, *daily* feed intake and daily weight gain were also calculated. Five days to the end of the feeding trial, faecal materials were collected, oven dried and weighed. After that, both faecal and feed were analyzed for proximate composition according to standard procedures (AOAC, 1995). Nutrients in diets and faeces (in grams) were calculated using their weighed quantities and determined compositions, from which apparent digestibility coefficients were calculated (McDonald *et al.*, 1995). Economic parameters were determined as outlined by Orayaga (2010). Some data were subjected to analysis of variance using MINITAB (2004), and where significant differences between means occurred, they were separated using LSD for main effects as outlined by Little and Hills (1977) and Duncan multiple range test (Duncan, 1955) for treatment combinations. Where percentages below 30 or above 70 were involved, they were

Table 2: Composition of experimental diets (%)

Ingredients	Experimental diets					
	GNC		Kulikuli		TGSM	
(%)	L ₁₈	L ₂₂	L ₁₈	L ₂₂	L ₁₈	L ₂₂
GNC	18	22	-	-	-	-
Kulikuli	-	-	18	22	-	-
TGSM	-	-	-	-	18	22
Maize	44.95	40.95	44.95	40.95	44.95	40.95
Rice Offal	20.00	20.00	20.00	20.00	20.00	20.00
Maize Offal	10.00	10.00	10.00	10.00	10.00	10.00
Blood Meal	3.00	3.00	3.00	3.00	3.00	3.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00
Pre Mix ^a	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30
Calculated nutrients composition						
ME (kcal/kg)	2360.43	2324.35	22584.40	2598.10	2752.08	2803.04
Crude Protein	16.45	17.89	13.94	14.82	13.34	14.08
Fat	4.96	5.04	7.36	7.72	10.68	12.08
Crude Fibre	10.60	10.72	11.05	11.27	11.31	11.58
Calcium	1.12	1.13	1.13	1.14	1.13	1.14
Phosphorus	0.62	0.60	0.62	0.62	0.61	0.61
Lysines	0.74	0.80	0.43	0.42	0.43	0.42
Methionine	0.49	0.50	0.41	0.40	0.41	0.40
Feed Cost/KG (₦)	50.56	53.76	66.40	73.12	65.68	72.24
Determined nutrient composition						
Moisture	6.5	7.65	9.85	7.25	7.00	6.50
Crude Protein	15.11	16.21	11.61	12.59	13.75	13.10
Crude Fiber	8.20	8.50	8.20	10.40	11.70	9.25
Crude Fat	3.30	4.50	6.80	6.30	5.85	14.20
Ash	8.35	8.8	7.45	9.00	7.40	7.55
Nfe	57.39	54.34	53.09	54.46	45.70	49.40
Calcium	0.58	0.88	0.75	1.13	0.70	0.88
Phosphorus	0.28	0.27	0.39	0.26	0.20	0.23

a: vitamin/mineral premix contains Vitamin A 7,000,000 I.U., Vit. D₃ 1,400,000 IU, Vit. E 5,000 I.U., Vit. K 2.2 I.U., Thiamine-B₁ 1.5 GR, Riboflavin-B₂ 4.8 GR, Pyridoxine-B₆ 1.5 GR, Vit. B₁₂ 10 MGR, Biotin 20 MGR, Niacin 15.0 GR, Pantothenic acid 5.0 GR, Folic acid 0.5 GR, Manganese 75 GR, Zinc 45 GR, Iron 20 GR, Copper 5.0 GR, Iodine 1.0 GR, Selenium 100 MGR, Cobalt 200 MGR, B. H. T 125 GR and Choline chloride 100 GR per 2.5kg. ME (Kcal/kg) of the diets was obtained using nutrient tables by Aduku (2004) and energy values determined from kulikuli and TGSM, GNC= ground nut cake TGSM= Toasted groundnut seed meal, Kulikuli = locally made groundnut cake, L₁₈ and L₂₂ = Levels of inclusion

subjected to arcsine transformations as outlined by Little and Hills (1977) before analysis of variance was done. Other data were analyzed by correlation and regression using Microsoft Excel (2007). Growth trend was determined graphically using Microsoft Excel (2007).

Results and discussion

The result of the proximate composition of the test ingredients (kulikuli and toasted groundnut seed meal) is presented on table 1. It revealed the crude protein contents of kulikuli and TGSM as 31.08% and 27.72% respectively. These were lower than that the protein content of GNC (45.6%) reported by Bhatt *et al.* (2005), but higher than that of raw groundnut seed (25.78%) as reported by Asibuo *et al.* (2008). Their fat contents (kulikuli 19.30% and TGSM 37.75%) were higher than the 2.47% reported by Bhatt *et al.* (2005) for GNC, but lower than that of raw groundnut seed (54.95%) reported by Asibuo *et al.* (2008). These observed differences might be due to processing

method, groundnut variety and or quality. Fat, to a large extent is not a problem to rabbits (Aduku and Olukosi, 1990).

The performance of rabbits (Table 3) showed that average feed intake, body weight gain and final live weight were significantly affected ($p < 0.05$) with the rabbits fed TGSM, significantly depressed ($P < 0.05$). Main effect ranges of 41.94% – 59.13%, 11.65% – 17.03% and 3.44% – 3.48% for average feed intake, daily weight gain and FCR were similar to the report of Egbeyale *et al.* (2012). However, the feed intake and weight gain are lower than the 77.64g – 87.51g and 14.04g – 16.73g reported by Attah *et al.* (2011) There was however no significant difference ($p > 0.05$) among treatment groups fed GNC and kulikuli. This to a large extent agrees with Aguihe (2012) who reported no significant difference ($p > 0.05$) in digestibility among broiler birds fed local groundnut cake (kulikuli) or soyabean meal. The low feed intake observed for the animals on TGSM diets may be attributed to the high fat and

Table 3: Main effects of sources or levels of groundnut meals on the performance of growing rabbits

Parameters	GNC	Kulikuli	TGSM	SEM	18%	22%	SEM
AFW	1718.75 ^a	1612.5 ^a	1376.75 ^b	±110.08	1603.25	1535.58	±134.82
DWG	17.03 ^a	15.23 ^a	11.65 ^b	±6.01	15.10	14.18	±7.36
TWG	1175.00 ^a	1062.50 ^a	839.38 ^b	±101.20	1065.75	985.50	±126.39
%IW	170.00	166.92	142.5	±26.57	169.70	1499.93	±32.54
ADI	59.13 ^a	51.37 ^a	41.94 ^b	±5.10	52.05	49.58	±6.25
F.C.R	3.48	3.44	3.46	±0.57	3.46	3.46	±0.70

Means with different superscripts within the same row differ significantly ($p < 0.05$), AFW= average final weight, DWG= daily weight gain, TWG= total weight gain, %IW= percentage increase in weight, ADI= average daily feed intake, FCR = feed conversion ratio, SEM= standard error of mean

Table 4: Main effects of sources or levels of groundnut meals on digestibility of nutrients by growing rabbits

Nutrients	GNC	Kulikuli	TGSM	SEM	18%	22%	SEM
CP	67.40	63.24	40.71	±4.62	62.70	65.37	±5.66
FAT	72.09 ^c	75.81 ^b	78.04 ^a	±1.45	75.90	74.73	±1.77
FIBRE	28.49 ^b	15.63 ^c	38.92 ^a	±4.73	25.10	30.25	±5.79
NFE	68.70	67.44	64.87	±4.06	62.80 ^b	71.20 ^a	±4.97
DM	59.96	58.28	59.15	±4.09	55.67	62.60	±5.01

^{ab} means on the same row with different superscripts for a factor are significant ($p < 0.05$). CP= crude protein, NFE= nitrogen free extract, DM= dry matter SEM= standard error of mean

energy content. Rabbits will consume less feed when the energy and or fat content are high (Omole *et al.*, 2007). However, FCR was not adversely affected ($p > 0.05$) by the sources of groundnut meal. This means the low growth rate of rabbits fed TGSM was due to low feed intake and not utilization. Growth was still on the rise (fig 1) and the relationship between feed intake and growth of rabbits fed different sources of groundnut meals presented on table 9 shows a strong significant ($p < 0.01$) relationship between feed intake and growth performance for all the treatments. These indicated that time alone was needed for the animals on TGSM to reach the optimal weight. This is supported by the fact that the FCR was similar ($p > 0.05$). Results of treatment combinations for performance are presented on Tables 6.

The result of apparent digestibility coefficients of nutrients by rabbits fed different sources of groundnut meals as summarized on Table 4 were significantly affected ($p < 0.05$). Rabbits fed TGSM utilized fat better (98.98%) than the rabbits

on kulikuli and those fed kulikuli did better than groups on GNC. This confirms the report of Aduku and Olukosi (1990) that rabbits can utilize up to 20-25% fat without any adverse effect. The higher fat contents of these diets occasioned by higher fat contents of these test materials (TGSM and kulikuli) did not affect fat digestibility negatively. According to Fernández *et al.* (1994), fat addition to rabbit diets increases fat digestibility. Fibre digestibility was significantly affected ($p < 0.05$) and poorly digested with rabbits on kulikuli utilizing it least (16.63%). The fibre digestibility range of 16.63% - 38.92% for the main effect is low compared to the 34.41% - 49.99% reported by Attah *et al.* (2011). In most works on the digestibility of nutrients in rabbits, fibre digestibility is low compared to other nutrients. Crude Protein and dry matter were not significantly ($P > 0.05$) affected. The crude protein digestibility range of 40.71% to 67.40% is quit wide, though it did not show significant differences. While the range falls below some reported values; 69.65% to 81.25%

Table 5: Main effect of sources or levels of groundnut meals on economics of production of growing rabbits

PARAMETERS	GNC	Kulikuli	TGSM	SEM	18%	22%	SEM
Feed Cost	212.68	206.83	177.14	±18.42	195.73	200.05	±22.56
Total Cost	905.73	899.88	867.29	±18.35	888.75	893.00	±22.47
Selling Price	1718.75 ^a	1612.50 ^a	1377 ^b	±93.55	1603.25	1535.50	±114.58
Profit	813.01 ^a	713.62 ^a	509.67 ^b	±79.92	714.50	642.25	±97.89
Cost / Kg Gain	181.61	199.47	215.22	±17.40	194.33	203.20	±21.31
% Feed Cost	28.88	28.59	26.57	±1.11	27.88	28.15	±1.35
% Cost/Weaner	48.04	48.23	49.43	±0.67	48.65	48.48	±0.82

^{abc}Means with different superscripts within the same row differ significantly ($p < 0.05$), SEM=Standard error of mean, GNC= Conventional industrial groundnut cake Kulikuli= locally made groundnut cake TGSM= Toasted groundnut seed meal

(Attah *et al.*, 2011), 71.63% to 93.08% (Babatunde *et al.*, 2000), it was similar with the 43.98% - 65.25% reported by Egbeyale *et al.* (2012). This means that the higher fat content of kulikuli and TGSM did not hinder digestibility of nutrients. Except for fat and fibre, no significant interaction ($p > 0.05$) occurred in any other parameter measured (Table 7).

The result of the economic of production as shown on Table 5 revealed that cost per kg weight gain was not significantly affected ($P > 0.05$), while interaction effects are shown in Table 8. However, revenue and profit were significantly lower ($p < 0.05$) for rabbits fed TGSM, but did not differ ($p > 0.05$) between rabbits fed GNC and those on kulikuli. Interestingly there was low cost of production due to feed (26.57% to 28.88%) observed in the experiment as compared with the very high percentage (70% and above) usually reported (Omole *et al.*, 2007; Adeniji, 2012). This might be due to the escalating price of weaned

rabbits which occupied a very large percentage (48.04% to 49.43%), leaving about half of the cost to be shared between miscellaneous and feed cost.

Conclusion

It was concluded that both kulikuli and TGSM are potential feed resources for rabbits. However, while kulikuli could exactly replace GNC in rabbit diets at 18% and 22% levels of inclusion, TGSM has less value for growth and could only replace GNC at these levels if fast growth rate is not the priority. It was recommended that since kulikuli and TGSM are more available to house hold farmers, equally economical as GNC and better still if ground nut farmers and or processors of kulikuli raise rabbits, they should be used by the house hold rabbit farmer as a source of protein in place of scarce GNC.

Table 6: Interactive effects of sources and levels of groundnut meals on the performance of growing rabbits

Parameters	Experimental Diets						SEM
	GNC		Kulikuli		TGSM		
	L ₁₈	L ₂₂	L ₁₈	L ₂₂	L ₁₈	L ₂₂	
Initial Weight (g)	537.5	550	537.50	562.50	537.50	537.50	±4.27
Final Weight	1787.5 ^a	1650 ^{ab}	1606.25 ^b	1618.75 ^{abc}	1416.67 ^{bc}	1337.5 ^c	± 67.07
Total Weight Gain	1250 ^a	1100 ^{ab}	1068.75 ^{abc}	1056.25 ^{abc}	878.75 ^{bc}	800 ^c	± 66.12
Daily Weight Gain	18.12 ^a	15.94 ^a	15.94 ^a	15.31 ^b	11.83 ^b	11.59 ^b	± 1.05
Feed Intake	60.01 ^a	58.23 ^{ab}	51.61 ^{abc}	51.14 ^{abc}	44.79 ^{bc}	39.33 ^c	±3.21
F.C.R	3.31	3.65	3.33	3.34	3.79	3.39	± 0.08
Mortality	0	0	0	0	0	0	

^{abc}Means with different superscripts within the same row differ significantly ($p < 0.05$), SEM=Standard error of mean GNC= Conventional industrial groundnut cake, Kulikuli= locally made groundnut cake, TGSM= Toasted groundnut seed meal L₁₈ and L₂₂= Levels of inclusion (18% and 22%)

Effects of different sources of groundnut meals on digestibility and economics of production of growing rabbits

Table 7: Interactive effects of sources and levels of groundnut meal on nutrient digestibility of rabbits

Nutrients	Experimental Diets						
	GNC		Kulikuli		TGSM		
	L ₁₈	L ₂₂	L ₁₈	L ₂₂	L ₁₈	L ₂₂	SEM
Crude Protein	86.75	81.12	74.86	80.19	66.79	85.26	± 3.01
Crude Fibre	29.90 ^b	18.70 ^{bcd}	6.80 ^d	11.80 ^{cd}	23.42 ^{bc}	58.58 ^a	± 7.53
Crude Fat	95.55 ^{ab}	83.60 ^d	95.33 ^{abc}	92.32 ^{bc}	90.71 ^c	98.93 ^a	± 2.17
NFE	82.57	88.68	82.82	87.12	69.90	90.79	± 3.05
Dry Matter	74.46	75.26	70.34	74.03	58.66	86.07	± 3.61

^{abc}Means with different superscripts within the same row differ significantly ($p < 0.05$), SEM=Standard error of mean GNC= Conventional industrial groundnut cake Kulikuli= locally made groundnut cake TGSM= Toasted groundnut seed meal L₁₈ and L₂₂= Levels of groundnut inclusion (18% and 22%)

Table 8: Interactive effects of sources and levels of groundnut meals on economics of production of growing rabbits

Production of growing rabbits							
	Experimental Diets						
Parameters	GNC		Kulikuli		TGSM		SEM
	L ₁₈	L ₂₂	L ₁₈	L ₂₂	L ₁₈	L ₂₂	
Fixed Cost (₦)	193.05	193.05	193.05	193.05	193.05	193.05	—
Cost/Weaner (₦)	500.00	500.00	500.00	500.00	500.00	500.00	—
Feed Cost (₦)	209.36	216.01	199.78	214.36	178.52	169.77	±7.96
Total Cost (₦)	902.41	909.66	892.33	907.43	871.53	862.82	± 8.01
Selling Price (₦)	1787.50 ^a	1650.00 ^{ab}	1606.25 ^{ab}	1618.75 ^{ab}	1416.25 ^b	1337 ^b	± 2.12
Profit (₦)	885.10 ^a	740.94 ^{ab}	713.92 ^{ab}	711.32 ^{ab}	544.68 ^{bc}	474.69 ^c	± 60.10
Feed Cost/kg Gain	167.35	196.22	196.22	186.35	201.60	212.08	± 7.58
% Feed Cost	23.07	23.67	22.26	18.05	20.41	19.66	±0.89
% Profit	97.76 ^a	81.58 ^b	79.72 ^b	78.04 ^{bc}	62.21 ^{cd}	54.94 ^d	± 6.21
% Cost/Weaner	55.41	54.97	56.03	555.10	57.37	57.95	± 0.51

^{abc} Means with different superscripts within the same row differ significantly ($p < 0.05$), SEM=Standard error of mean

GNC= Conventional industrial groundnut cake, Kulikuli= locally made groundnut cake, TGSM= Toasted groundnut seed meal L₁₈ and L₂₂= Levels of groundnut inclusion (18% and 22%)

Table 9: Quantitative relationships between feed intake and growth of rabbits fed different sources and levels of groundnut meals

Treatment	r	R ²	prediction equation	S _{yx}	p
GNC L ₁₈	0.91	0.84	Y= 26.37X - 306.9	±170.4	0.01**
GNC L ₂₂	0.94	0.89	Y=26.52X- 348.0	±125.2	0.01**
Kulikuli L ₁₈	0.82	0.67	Y=15.57X+ 247.4	±217.4	0.01**
Kulikuli L ₂₂	0.96	0.92	Y=19.18X+ 91.0	±100.6	0.01**
TGSM L ₁₈	0.84	0.71	Y=18.23X+194.7	±143.3	0.01**
TGSM L ₂₂	0.93	0.87	Y=23.62X+32.7	±96.5	0.01**

r= correlation coefficients, R² = coefficient of determination, S_{yx}=standard error of prediction, p = level of probability, **means regression was significant ($p < 0.01$), GNC= Conventional industrial groundnut cake, Kulikuli= locally made groundnut cake, TGSM= Toasted groundnut seed meal L₁₈ and L₂₂= Levels of inclusion (18% and 22%)

Fig.1 Growth pattern (weight in grams against time in weeks) of rabbits fed different sources and levels of groundnut meals.

D1= GNC L₂₂, D2= GNC L₁₈, D3= Kulikuli L₂₂, D4= Kulikuli L₁₈, D5= TGSM L₂₂, D6= TGSM L₁₈. GNC= Conventional industrial groundnut cake, Kulikuli= locally made groundnut cake, TGSM= Toasted groundnut seed meal L₁₈ and L₂₂= Levels of groundnut inclusion (18% and 22%)

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