

THE EFFECT OF FEEDING GRADED LEVELS OF ROASTED SUNFLOWER (*Helianthus Annuus* L.) SEED MEAL ON WEANER RABBITS

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ABSTRACT: The effects of feeding graded levels of roasted sunflower seed meal inclusion on the performance, nutrient digestibility and carcass characteristics of weaner rabbits were evaluated. Thirty six (Dutch x chinchilla) breeds of rabbit of mixed sexes were used for the experiment which lasted for nine weeks (63 days). They were matched for weight and randomly allotted to four treatments with nine rabbits per treatment and were replicated three times in a completely randomized block design. The levels of roasted sunflower seed meal were 0, 10, 20 and 30 % respectively. The diets and clean water were offered *ad libitum* throughout the experimental period. The productive performance results showed that rabbits on diet four consumed significantly ($P<0.05$) more feed than those on diets one (control), two and three, and the lowest feed intake were recorded in T₁ (control). The final body weight, total weight gain, daily weight gain and the feed conversion ratio significantly ($P<0.05$) revealed higher mean values in T₃ (20%) and T₄ (30%) inclusion of roasted sunflower seed meal than the T₁ (control). The feed cost (₦/Kg) and Total feed cost (₦) indicated significant ($P<0.05$) reduction among the treatment groups as the roasted sunflower seed meal levels inclusion in the diet increased. Significantly ($P<0.05$) better feed cost/Kg gain were obtained in T₄ than T₁ (control). The nutrient digestibility revealed significant ($P<0.05$) difference among the treatment groups in all the parameters, but the mean values were inferior in the T₁ (control) than the T₂, T₃ and T₄ respectively. The results of carcass characteristics revealed high significant ($P<0.05$) difference among the treatment groups except in the lungs, heart, small and large intestine, spleen and stomach. Based on these results, growing rabbits could tolerate up to 30 % roasted sunflower seed meal in their diets with no adverse effect.

Keywords: Rabbit, Sunflower seed, Performance and Carcass characteristics.

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INTRODUCTION

The increasing competition between man and his livestock for available gains and feed coupled with Nigeria neglect of Agriculture, has led to high cost of available feed resources. Agunbade et al. (2000) noted that apart from the fact that these are keenly competed for by humans, they are being imported into the country resulting in a situation that degenerate into a continuous rise in the cost of feed for human and animal feeding. Measures aimed at alleviating feed cost in animal production centered on the introduction of non-conventional feedstuffs. The non-conventional feed ingredient could be processed into a high quality feedstuff that can favourably supplement protein and energy sources which currently plays the dual note of feeding man and his livestock. Rabbits (*Oryctolagus cuniculus*) have been recommended (Taiwo et al., 2005) as having the best productive advantage to utilize the non-conventional feed sources to bridge the protein gap.

In this respect, Taiwo et al. (2005) showed that sunflower seed has nutritive potentials as a feedstuff for livestock. The percent amino acid content was high and comparable to oil seeds such as soyabean, cotton seed and groundnut seed meal. A preliminary feeding trial conducted by Taiwo et al. (2005) using sunflower seed meal did not have adverse effect on the performance, nutrient digestibility and serum chemistry of rabbits. Sunflower is grown in many semi-arid regions of the world. It is tolerant of both low and high temperature (Putnam et al., 1990). NRC (1984) quoted sunflower seed meal figures 23.3 % protein, 31.6 % crude fibre, 1 % lysine, 0.5 % methionine and 1543 Kcal/Kg metabolizable energy. Reft (1997) reported that the major nutrient in sunflower seeds include protein, thiamine, vitamin E, iron, phosphorus, potassium, calcium and essential fatty acids such as linoleic and oleic acid. Sunflower seed also contained some anti-nutritional factors which include tannins and phytic acid (Khare, 2000; D'Mello, 2000 and Matyka et al., 1993). On this premise, this study was designed to measure the performance, nutrient digestibility and carcass characteristics of weaner rabbits fed rations with roasted sunflower seed meal (SSM) inclusion.



MATERIAL AND METHODS

Thirty six weaned rabbits (Dutch x chinchilla) breeds with age ranging from 5 to 6 weeks were randomly selected and assigned to four dietary treatment groups with nine rabbits per treatment and three per replicate in a completely randomized block design. Rabbits were housed in cages measuring 45 cm x 30 cm. The study lasted for nine weeks (63 days) with an initial one week adjustment period for the rabbits to get accustomed to the feed and confinement. Prior to the commencement the house together with the cages were thoroughly cleaned and disinfected. The rabbits were also pre-conditioned by de-worming them with Ivomec and administered prophylactic doses of coccidiostate for controlling coccidiosis respectively. The four experimental diets contain 0, 10, 20 and 30 % roasted sunflower seed meal in treatments T₁ (control), T₂, T₃ and T₄ respectively. The rabbits were fed in the morning daily. The quantity of feed supplied daily to them were weighed every morning from which the left over was removed to determine the daily feed intake. The rabbits were weighed at the beginning of the study and weekly thereafter while feed conversion ratio was calculated. Fresh clean drinking water was provided *ad libitum* daily. At the end of the 8th week of the experiment, three rabbits from each treatment were transferred into metabolic cages with facilities for separate collection of faeces over a period of seven days for nutrient digestibility studies.

At the end of the experiment three rabbits per treatment were randomly selected for carcass analysis. The rabbits were fasted for 12 hours before slaughtering and dressing was done by flaying dressed weights and gastrointestinal tract (GIT) weight were recorded immediately after evisceration. The different organs were carefully removed, weighed and expressed as a percentage of the live weight.

Processing of the sunflower seed meal

The sunflower seed were sand roasted; this involved the use of clean fine alluvial sand in a wide aluminium frying pan and heating the sand to the temperature of about 90°C. Sufficient quantity of batch of the raw seeds to cover about two-third of the area of sand was placed on the sand. The seeds and sand were mixed together by constant stirring with a wooden stick to prevent the burning of the seed coat and enhance even distribution of heat. The duration of the roasting was 2 – 3 minutes, the sand was then sieved from the seed and allowed to cool and then milled in hammer meal. The heat treated seed meal was used in compounding the experimental diet.

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using completely randomized block design. Significant ($P < 0.05$) difference among treatment means were determined by the least significant difference (LSD), as outlined by Steel and Torrie (1990).

RESULTS AND DISCUSSION

Proximate Composition of Experimental Diets

The results of the proximate composition are shown in Table 1. The analyzed crude protein (CP) value is slightly lower than the calculated value. The lower crude protein in the diet might be attributed to the level of protein in sunflower seed meal as shown in Table 1. NRC (1984) reported that sunflower seed meal contains about 23.30 % crude protein. The values of the ether extract (EE) falls below (10 – 20 %) recommended by Benjamin (1986), but far above the 2 – 25 % for maintenance and 3 – 5% for lactation reported by Bivin et al. (1988). Relf (1997) reported that sunflower seed meal contains about 90% poly unsaturated oil. Sunflower is one of the oldest oil producing plants and its seed have the highest oil content (close to 55 %), Spore (2006). The crude fibre values (CF) increases with increase in the levels of sunflower seed meal. The crude fibre level (8.73 – 10.34 %) is below the recommended levels 14 – 20 % (Lebas, 1980; Champe and Maurice, 1983). The ash content ranges between 7.54 – 9.01 %, which is adequate for rabbit growth. The metabolizable energy (ME) levels of the diet ranged from 2689 – 2908 Kcal/Kg. the energy levels of the diet were within the levels 2500 – 2900 Kcal/Kg recommended by Aduku and Olukosi (1990) for weaner rabbits.

Growth performance

The results of the performance are shown in Table 2. The final body weight, total weight gain, daily weight gain, daily feed intake and feed conversion indicated high significant ($P < 0.05$) difference as influenced by inclusion of roasted sunflower seed meal among the treatment groups. The result of the final body weight (1150.00 – 1625.99 g/rabbit) obtained at the end of the experiment was within the range (1140.11 – 1178.76 g/rabbit) reported by Onifade and Tewe (1993) for rabbits of similar ages. Rabbits on diet 4 (30 % sunflower seed meal) inclusion significantly ($P < 0.05$) gained more weight than those on the other treatment groups. However, the mean daily weight gain (10.65 – 18.25 g/day) falls within the range of 10 – 20 g/day observed in most rabbits reared in tropical environment (Cheeke, 1987). The daily weight gain showed significant ($P < 0.05$) difference among the treatments and is similar to the values 15 – 20 g/day reported by Schiere (1999) and 11.37 – 19.11 g/day reported by Njidda and Igwebuike (2006) for rabbits. The performance by rabbits in this study was significantly higher ($P < 0.05$) than 10 g/day and 7.8 g/day reported by Abu and Ekpeyoung (1993) but lower than 25.50 g/day reported by De-Blas and Garvey (1975) for rabbits under temperate conditions. The higher daily weight gain observed in T₄ (18.25 g/day) may be attributed to the high feed intake observed in T₄. It has been reported that adding fat to the diet increase growth rate of rabbit (Besidina, 1977) and that rabbit can tolerate up to 20 – 25 % fat in the diet depending on their ages (Aduku and Olukosi, 1990). Inclusion of sunflower seed meal up to 30 % in



this study is observed to increase live weight of rabbits. The daily feed intake was significantly higher ($P < 0.05$) in T_4 (58.95 g/day) and lowest in T_1 (46.70 g/day). Minson (1983) reported that animal intake is directly related to dry matter digestibility (DMD). From the result, it clearly shows that the DMD of T_4 was better than the other treatment groups followed by T_2 (66.17 %) and T_3 (63.42 %) respectively. The daily feed intake for T_2 , T_3 and T_4 were figuratively higher than the T_1 (control) group though there were no significant ($P > 0.05$) difference between T_1 and T_2 . The feed conversion ratio (FCR) ranges from (2.79 - 4.38). The best feed conversion ratio (FCR) was observed in T_4 (2.79). The feed conversion ratio (FCR) was lower than 6.91 - 7.30 reported by Abu and Ekpeyoung (1991). The differences observed in the feed conversion ratio (FCR) may be attributed to the composition of the diet. Relatively all the rabbits receiving sunflower seed meal in the diets recorded better FCR than the control (0 % sunflower seed meal). The feed cost (₦/Kg), total feed cost (₦) and feed cost / Kg gain indicated significant ($P < 0.05$) difference among all the inclusion levels. The feed cost (₦/Kg) and total feed cost (₦) decreased with increasing level of roasted sunflower seed meal up to 30 %. The highest feed cost (₦/Kg) and total feed cost (₦) was recorded in T_1 (control) and the least was in T_4 (30%) inclusion of roasted sunflower seed meal. While the feed cost per Kg gain, decreased with increasing level of roasted sunflower seed meal in the diet. The result obtained in this study was desirable in rabbit diet because the inclusion of roasted sunflower seed meal decreased the feed cost and gave better returns in terms of feed cost per Kg gain. This observation agreed with the report of Apata and Ojo (2000) that the high cost of feed was largely due to the exorbitant price and scarcity of conventional feed ingredients. Similarly, Smith *et al.* (1981) also observed that unconventional plant protein sources drastically reduced feed cost (₦/Kg) and these gave better feed cost per Kg gain.

Table 1 - Ingredient and chemical composition of experimental diet

Ingredients	T ₁ (control)	T ₂ 10%	T ₃ 20%	T ₄ 30%		
Maize	32	22	14	5		
Soyabean (full-fat)	19	16	12	9		
Sunflower meal	0	10	20	30		
Groundnut haulms	15	18	20	22		
Maize offal	30	30	30	30		
Bone meal	3	3	3	3		
Salt	0.5	0.5	0.5	0.5		
Min./Vit. premix*	0.5	0.5	0.5	0.5		
Total	100	100	100	100		
Calculated analyses						
Crude protein	16.00	16.00	16.00	16.00		
Energy (Kcal/kg)	2689	2752	2830	2908		
Lysine (%)	0.66	0.65	0.61	0.60		
Methionine + cystine (%)	0.50	0.53	0.55	0.58		
Calcium (%)	1.20	1.22	1.23	1.24		
Phosphorus (%)	0.77	0.79	0.80	0.82		
Chemical Analyses						
Dry matter	95.43	95.91	95.29	96.13	Raw	Roasted
Crude protein	16.12	16.12	16.10	15.68	90.00	98.40
Crude fibre	8.73	8.96	9.25	10.34	23.50	29.10
Crude fat	5.09	6.73	7.59	8.82	22.10	30.74
Ash	7.54	8.79	8.63	9.01	44.00	39.00
					4.70	10.50

* Premix (Agricare-mix®) supplied per kg of diet; Vitamin A 20,000IU; Vitamin D 4,000IU; Vitamin E 39.96IU; Vitamin K 5.99 mg; Riboflavin 12 mg; Vitamin B₁₂ 0.1 mg; Pyridoxine HCl 7 mg; Cal-D-Panthenate 30 mg Nicotinic acid 70 mg; Folic acid 2 mg; Biotin 0.2 mg; Potassium 0.41 %; Sodium 0.30 %; Copper 24 mg; Manganese 110 mg; Zinc 100 mg; Iron 110 mg; Selenium 0.3 mg; Calcium 0.22 mg; Iodine 3 mg; Choline 1000 mg; Butylated hydroxytoluene (BHT) 140 mg and Zeolox 50 mg.

Table 2 - Performance of rabbit fed graded levels of sunflower seed meal

Parameters	Treatment	T ₁ (control)	T ₂ 10%	T ₃ 20%	T ₄ 30%	SEM
Initial body weight (g)		478.82	474.10	477.30	475.40	0.200
Final body weight (g)		1150.00 ^b	1200.11 ^b	1500.15 ^a	1625.19 ^a	123.500*
Total weight gain (g)		671.18 ^d	726.01 ^c	1022.85 ^b	1149.79 ^a	104.830*
Daily weight gain (g)		10.65 ^c	11.52 ^c	16.34 ^b	18.25 ^a	1.820*
Daily feed intake (g)		46.70 ^c	47.34 ^c	54.48 ^b	58.95 ^a	0.40*
Feed conversion ratio		4.38 ^a	4.17 ^a	3.33 ^b	2.79 ^c	0.013*
Mortality		0.00	0.00	0.00	0.00	--
Feed cost (₦/kg)		64.30 ^a	61.10 ^a	57.90 ^c	54.10 ^c	6.340*
Total feed cost (₦)		196.13 ^a	196.13 ^a	189.17 ^b	172.66 ^c	10.130*
Feed cost/kg gain		167.50 ^c	184.51 ^b	188.08 ^b	237.95 ^a	11.460*

^{a,b,c,d} Mean within the same row with different superscripts significantly ($P < 0.05$) different; * = significant ($P < 0.05$) different; SEM = Standard Error of Means



Nutrient digestibility

The result of the nutrient digestibility is shown in Table 3. There were high significant ($P<0.05$) differences among treatments for dry matter digestibility (DMD), crude protein digestibility (CPD), crude fibre digestibility (CFD) and ether extract digestibility (EED). The dry matter of T₁ (control) is significantly ($P<0.05$) inferior to groups on roasted sunflower seed meal based diets while the highest was recorded in T₄ in all parameters. The effects of fat on digestibility of the diet are equivocal.

Benjamin (1986) reported that the addition of vegetable oil to a ration did not have any effect on digestion of dry matter, ether extract and crude protein. On the contrary, a decrease in digestibility of dry matter, organic matter and energy was reported by Lebas (1975) on addition of oil. The crude fibre digestibility (CFD) range between (52.33 – 59.32 %). The treatment groups on roasted sunflower seed meal diet perform better than the T₁ (control) group, though the crude fibre digestibility was not adversely affected. The crude fibre digestibility shows slight depression than the other nutrient digestibility except for ash. Variations exist in the coefficient for the most commonly used feedstuffs. Variation in fibre digestibility is especially wide, making interpretation difficult (Pairet *et al.*, 1986). A possible explanation in the discrepancies may lie in the failure to include the composition of soft faeces in the calculation. In germ free rabbits, which do not practice coprophagy, digestibility coefficient of fat and protein are increased and carbohydrate and fibre decrease (De-Blas and Gidenne, 1998). This could be the possible explanation observed in the decrease of the crude fibre digestibility. The crude protein digestibility (CPD) were significantly higher ($P<0.05$) in all the treatment groups with the highest in T₄ (84.39 %) and lowest in T₁ (76.32 %). The digestibility of crude protein increases as the dietary crude protein level rises, but becomes markedly depressed by an increase in crude fibre content of a diet (Lang, 1981). It shows that crude fibre (CF) content of the feed (Table 1) was higher, that might be the possible cause of depression in crude protein digestibility (CPU) of T₁ (control). Lang (1981) also reported that the digestibility of most nutrients has been shown to increase as protein level rises. The result of the ether extract digestibility (EED) shows that the ether extract digestibility (EED) increases with increase in the level of roasted sunflower seed meal. The ether extract digestibility (EED) ranges from (62.86 – 81.23 %) with the highest in T₄ (30 %) roasted sunflower seed meal inclusion. Sirato-Yasumoto *et al.* (2001) suggested that the presence of saponified fat which is not detected by ether extraction may have resulted in seriously high nutrient digestibility of fat been quoted in many experiments. The ash digestibility ranges from (32.00 – 73.33 %) with the highest value in T₄ (73.33 %) and lowest in T₁ (32.00 %). The ash digestibility (AD) is shown to increase with increase in the levels of roasted sunflower seed meal.

Table 3 - Nutrient Digestibility of Rabbits fed Graded Levels of Sunflower Seed Meal

Nutrient (%)	T ₁ (control)	T ₂ 10%	T ₃ 20%	T ₄ 30%	SEM
Dry matter (DM)	60.13 ^c	66.17 ^b	63.42 ^b	81.68 ^a	1.210*
Crude protein (CP)	76.32 ^d	78.32 ^c	80.13 ^b	84.39 ^a	0.030*
Ether Extract (EE)	62.86 ^b	71.72 ^b	78.63 ^a	81.23 ^a	1.140*
Crude fibre (CF)	52.33 ^c	55.23 ^b	56.72 ^b	59.32 ^a	0.310*
Ash	32.00 ^d	52.50 ^c	67.57 ^a	73.33 ^b	2.410*

^{a,b,c,d} Mean within the same row with different superscripts significantly ($P<0.05$) different; * = significant ($P<0.05$) different; SEM = Standard Error of Means

Carcass characteristics

The results of carcass measurement are shown in Table 4. There were high significant ($P<0.05$) treatment effects on slaughter weight, carcass weight and dressing percentage, the highest mean values were revealed in rabbits fed T₄ containing 30% roasted sunflower seed meal and the lowest in T₁ (control). The higher dressing percentage range from 43.28 – 70.78 % obtained may be related to the higher fat content recorded with carcass. This is similar to the report of Fielding (1991) who reported dressing percentage of 50 – 56 % and tends to be greater if the rabbits are fully grown. This was also observed in this study where T₄ having the highest percentage (70.78%) also had highest abdominal fat (11.25%), while T₁ (control) having the lowest (43.28%) dressing percentage had the lowest abdominal fat (7.35%). The study revealed that there was a relationship between dressing percentage and abdominal fat of carcass. Significant ($P<0.05$) difference in T₄ with 30% roasted sunflower seed meal were however observed for some of the organs which include liver, kidney, back and caecum while lungs, heart, small and large intestine, spleen and stomach indicated no significant ($P>0.05$) difference among the treatment groups.

The finding in this study concur with the report of Epo *et al.* (2009) and Alliceek *et al.* (2005) who fed cassava tuber meals and 20% sunflower seed meal to rabbits but did not showed any significant ($P<0.05$) difference among treatments for heart, lungs, spleen, liver and stomach. It is a common practice in feeding trials to use weights of some internal organs like liver and kidneys as indicators of toxicity. Bone (1979) reported that if there is any toxic elements in the feed, abnormalities in weights of liver and kidney would be observed. The abnormalities arise because of increased metabolic rate of the organ in attempt to reduce these toxic elements or anti-nutritional factors to non-toxic metabolites. The observations in this study suggest that the test diets did not contain any appreciable toxin.



Table 2 - Carcass Characteristics of Rabbits fed Graded Levels of Sunflower Seed Meal

Parameters	T ₁ (control)	T ₂ 10%	T ₃ 20%	T ₄ 30%	SEM
Slaughter weight	1000.04 ^b	1033.11 ^b	1234.62 ^a	1318.22 ^a	123.500*
Carcass weight	497.70 ^b	509.85 ^b	689.35 ^a	727.65 ^a	164.890*
Dressing percentage	43.28 ^c	45.49 ^c	57.96 ^b	70.78 ^a	12.470*
Liver	40.35 ^d	45.10 ^c	44.70 ^b	57.05 ^a	9.750*
Lungs	10.35	10.48	11.24	10.22	1.010
Heart	3.00	2.95	3.16	3.99	1.620
Kidney	8.30 ^b	8.50 ^b	10.70 ^a	10.90 ^a	2.670*
Back	77.01 ^c	93.76 ^b	95.21 ^b	105.72 ^a	18.001*
Small intestine	89.60	87.25	90.80	88.80	3.280
Large intestine	105.55	103.45	107.95	108.91	5.390
Caecum	24.70 ^c	24.90 ^c	20.50 ^b	30.50 ^a	4.676*
Spleen	1.10	1.45	1.00	1.80	1.340
Stomach	90.75	92.35	91.20	90.65	2.440
Abdominal fat	7.35 ^b	8.89 ^b	10.85 ^a	11.25 ^a	1.340*

^{a,b,c,d} Mean within the same row with different superscripts significantly (P<0.05) different; * = significant (P<0.05) different; SEM = Standard Error of Means

CONCLUSION

Based on the results obtained, it appears that the inclusion of roasted sunflower seed meal into the diets of rabbits up to 30% has no negative effect on the performance, nutrient digestibility and carcass characteristics of weaner rabbits.

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