



## EFFECTS OF GRADED LEVELS OF TOASTED SUNFLOWER SEED MEAL ON NUTRIENT DIGESTIBILITY AND CARCASS CHARACTERISTICS OF GROWING RABBITS

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### ABSTRACT

An eight-week feeding trial was conducted on the effects of a graded level of toasted sunflower seed meal on the carcass and nutrient digestibility of growing rabbits using forty-five rabbits crossbred (New Zealand X Dutch), ranging from five to six weeks of age, with an average weight of 650.34 g. The rabbits were randomly assigned to five dietary treatments, with 9 rabbits per treatment and 3 rabbits per replicate, in a Complete Randomized Design. Each treatment diet contained 0, 5, 10, 15, and 20% TSSM in diets 1, 2, 3, 4 and 5, respectively. The parameters measured include proximate composition of toasted sunflower seed initial body weight, body weight and final body weight, live weight, dressed weight, Others are nutrient digestibility, such as dry matter (DM), Crude protein (CP), Crude Fiber (CF), Ether Extract (EE), Ash and nitrogen-free extract (NFE). The results for carcass characteristics indicated that there were no significant ( $p < 0.05$ ) differences among the treatment groups in live weight, slaughter weight, dressed weight and dressing percentage the values obtained ranged from 1010.80 to 1103.67g, 920.80 to 1013.67, 486.87 to 535.83 g and 48.13 to 52.22g respectively. However, the results for nutrient digestibility showed a significant ( $p < 0.05$ ) difference among treatment groups for crude protein, crude fiber, ether extract, ash, and nitrogen-free extract. Conclusively, inclusion of 20% FSSM in the diet of rabbits gave better results on the nutrient digestibility, and carcass characteristics of growing rabbits without any adverse effect.

**Keywords.** Rabbit, Sunflower, Carcass, Nutrients, Digestibility

### INTRODUCTION

Protein supplementation is often important to improve livestock performance, and this needs to be done with respect to the requirement of the animals in addition to the balance of other nutrients available. Soya bean meal and fish meal have been widely and successfully used as conventional protein sources for livestock. However, the prices of these protein sources have been escalating continuously in recent times, whilst availability is often erratic. The problem has been worsened due to increased competition between humans and livestock for these protein ingredients as food. However, the feeding and nutrition of rabbits requires an adequate supply of feed in quantity and quality for optimal growth (Abonyi *et al.*, 2012). In most developing countries, rabbit production is based primarily on grasses and legumes whose availability and growth during the dry season cannot sustain rabbit production all year round (Abdullude. *et al.*, 2007). There is a need, therefore, to explore the use of non-conventional feed resources that have the capacity to yield the same output as conventional feeds, perhaps at a cheaper cost. Hence, any similar high protein ingredient which could partially or completely be use as a substitute for soya beans or fish meal is desirable. This strategy could help reduce the cost of production thereby making available the major crops for human consumption. Rabbits have been identified as a cheap source of high-quality protein that can substantially improve the level of animal protein production and consumption in developing countries (Wafar *et al.*, 2018)

One possible source of cheap protein is the *senna obtusifolia* seed meal of some tropical legume browse plants. Seed meal do not only provide protein source but also some essential vitamins such as A and C as well as minerals. The constraint to enhance the utilization of seed meal resides chiefly in factors such as fiber content, the presence of anti-nutritive compounds, and deficiencies in certain amino acids. *senna obtusifolia*, is a legume weed that belong to the family leguminosae and subfamily of caesalpiodeae.



**MATERIALS AND METHODS**

**Experimental Site**

The experiment was carried out at the Department of Animal Science, Livestock Teaching and Research Farm of the Federal College of Education (Technical) Gombe. The Gombe state capital is located between Latitude 10° 15' 00" N, 10° 19' 30" N and Longitude 11° 07' 15" E, 1° 13' 30" E., at an altitude of 352 m above sea level and has a land area of 52km<sup>2</sup> (Stephen *et al.*, 2023). The area has a semi-arid tropical climate with a wide seasonal range of temperature. The hottest months are March and April with a range between 18 and 40°C. There is long dry season of 6 to 7 months between the month of October to April. The first three months of dry season are characterised by the harmattan while the last 2 to 3 months of the dry season there is hot and diurnal temperatures and comparatively cooler nights. This is followed a wet season between the months of May and October. The average annual rainfall is about 850 mm The relative humidity range of about 30 to 45% in August and usually lower to about 5% in December and January (Saleh *et al.*, 2018)

**Experimental Animal and their Management**

A total of forty-five weaner rabbits of mixed breed (Dutch x and New Zealand white), sexes and age ranging from 4 to 6 weeks were purchased from rabbit keepers in Gombe Metropolis and were used for the experiment. They were randomly allocated to five treatment groups of nine rabbits each. The rabbits were housed individually in cages measuring 35 cm x 36 cm x 45 cm (width x length x height). The experimental diets (in mash form) and clean drinking water were provided ad- libitum throughout the experimental period.

**Experimental Diet**

The experimental diets were compounded using the following ingredients: maize soya bean, wheat offal, sunflower seed meal, bone meal and salt were used to formulate five experimental diet. Such that diet 1 (T<sub>1</sub>) contained 0% of sunflower seed meal which served as control. Fermented Sun flower seed meal was included at 5, 10, 15 and 20% inclusion levels diet of 2, 3,4 and 5 respectively as shown in Table 1

**Table 1:** Composition and Calculated Analyses of the Experimental Diets (%)

Ingredients	Treatments				
	T <sub>1</sub> (0%)	T <sub>2</sub> (5%)	T <sub>3</sub> (10%)	T <sub>4</sub> (15%)	T <sub>5</sub> (20%)
Maize	40.00	36.00	33.00	30.00	28.00
Soya bean meal	23.00	22.00	20.00	18.00	15.00
Fermented sunflower seed meal	0.00	5.00	10.00	15.00	20.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Groundnut haulms	15.95	15.95	15.95	15.95	15.95
Wheat offal	15.00	15.00	15.00	15.00	15.00
Salt (NaCl)	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25	0.25
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Calculated analyses</b>					
Crude protein (%)	17.49	18.52	18.86	18.85	18.71
Crude fibre (%)	9.24	9.73	11.14	12.56	12.96
Ash (%)	4.86	4.82	4.83	4.84	4.81
ME (Kcal/kg)	2706.35	2682.00	2519.98	2432.70	2358.70

**Experimental Design and Duration**

The five experimental treatments (diets) were assigned to the five groups in a Complete Randomized Design (CRD). Each treatment was replicated three times and there were three rabbits per replicate. The study lasted for 8 weeks.



### **Carcass Measurements**

At the end of the feeding trial, three (3) rabbits were selected from each treatment based on the average live weight for the group. These rabbits were weighed and starved overnight (12 hours) water was ad lib. The fasting weight was recorded in the morning prior to slaughter. Rabbits were weighed and slaughtered by cutting transversely across the trachea, oesophagus, large carotid arteries and jugular veins to ensure maximum bleeding. They were later opened and dressed. The dressed carcasses were split into retail cuts such as shoulder, forelegs, thighs/hind leg, rack and loin as described by (Blasco *et al.*, 1993).

### **Cut up parts**

Each carcass was divided into the following anatomical parts head, tail, pelts and feet. Then the weight of individual parts from each part was taken and weighed using electronic sensitive balance and were expressed as percentage (%) of slaughter. Seven (7) days to the termination of the feeding trial, three rabbits per treatment were moved to a metabolic cage, acclimatizes for three days before collection of the faecal sample and rabbits were fed known amount of feed. Faecal sample were collected, oven dried and weight. After that, faecal and the feed sample were analysed for proximate composition according to the standard procedure of (AOAC 2005). Nutrient weight in the diet and faeces were calculated using the weight of diet consume and faecal sample collected and their determined composition from which apparent digestibility coefficient were calculated as stated by (Aduku .2004).

### **Statistical Analysis**

Data collected were subjected to one-way analysis of variance (ANOVA) in a Complete Randomized Design (CRD) using statistix 9.0 software (Statistix 2013). Significance differences among the treatment means were compared using Least Significant differences (LSD).

## **RESULTS AND DISCUSSION**

### **Proximate Composition of Experimental Diet and Sunflower Seed Meal.**

The proximate composition of the experimental diet and sunflower seed were presented in Table 2. The results showed that sunflower seed contained 93.55% dry matter (DM), 22.10% crude protein (CP), 5.44% crude fiber (CF), 6.80% Ash, 30.73% nitrogen free extract (NFE) and ME 3040 Kcal/kg. These values were lower than the values (DM) 94.26%, (CP) 27.60%, (CF) 15.29% EE 8.50% (NFE) 39,% and ME 3104.20 Kcal/kg reported by Adetola *et al.*, (2019) who fed rabbits with toasted sunflower seed meal. However, the values obtained in this study were similar to the values (DM) 91.22%, (CP) 23.50%, (CF) 44.00% Ash 4.70% and (NFE) 44.10% opined by Duwa *et al* (2015) who fed weaner rabbits with roasted sunflower seed meal. The variation between this results and that of Adetola *et al* (2019) could be due to soil type and stages of the harvest, the results of the study also showed that sunflower seed contained the necessary ingredient that can support the performance of growing rabbits. The experimental diet had dry matter ranges from 91.56 to 93.11% crude protein (20.32 to 23.41%) crude fiber (14.60 to 17.34%) ether extract (7.09 to 8.24%) nitrogen free extract (40.05 to 50.28%) Ash (5.62 to 7.68%) and ME (kcal/kg) 2841 to 3194 (kcal/kg.) the dry matter and crude protein composition were close to the values 96.64 to 98.43% and 18.70 to 20.07 respectively obtained by Oseiko *et al.*, (2020) who reported raw and roaster sunflower seed meal. However, the DM and CP values were also lower than 90.00 to 91.00 and 19.11 to 20.21 as opined by Onazi *et al.*, (2020) who fed sunflower seed meal based- diet to growing rabbits. The crude fiber values obtained in the study is lower than 4.34 to 5.00 as revealed by Adetola *et al.*, (2019) who fed rabbits with toasted sunflower seed meal. However, the values were also higher than 8.73 to 10.34 reported by Duwa *et al.*, (2014) who revealed that raw and roasted sunflower seed meal and this variation could be as a result of difference in soil and variety of seed. Ether extract values were similar to 7.00 to 8.11 as revealed by Sani (2020) after feeding rabbits with three different energy sources to growing.



**Table 2.** Proximate Composition of Experimental Diet and Sunflower Seed Meal.

Nutrients (%)	Treatments					SSM
	T <sub>1</sub> (0%)	T <sub>2</sub> (5%)	T <sub>3</sub> (10%)	T <sub>4</sub> (15%)	T <sub>5</sub> (20%)	
Dry matter (DM)	93.11	91.56	92.34	93.04	91.62	93.55
Crude protein	20.32	23.41	22.52	21.32	23.26	22.00
Crude fibre (%)	17.34	15.61	14.68	15.36	15.21	5.44
Ether extract (%)	8.24	7.19	7.12	7.20	7.09	6.80
Nitrogen free extract (%)	40.05	49.89	50.28	45.61	48.64	30.73
Ash	5.62	7.68	6.76	7.46	6.96	6.80
ME (kcal/kg)	2841.10	3172.00	3194.20	2992.10	3161.01	3040.00

SSM-----Sunflower seed

### Nutrient Digestibility of Rabbits Fed Graded levels of Toasted Sunflower Seed Meal

The results for nutrients digestibility of rabbits fed toasted sunflower seed meal is presented on table 3. Dry matter (DM) digestibility showed no significant ( $P > 0.05$ ) differences among the treatment groups. The values were lower than 60.13 to 81.68% recorded by Duwa *et al.*, (2014) who fed roasted Sunflower seed meal to growing rabbits but the results were contrary to the values of 70.12 to 82.98% reported by Adetola *et al.*, (2019) who fed graded levels of toasted Sunflower seed meal to growing rabbits. The crude protein value obtained in this study fell between 45.15 to 63.41% which were lower than the ranged values of 44.58 to 57.56% reported by Mohammed *et al.* (2005) who offered goat rumen content to a growing rabbit. The results obtained from the study clearly indicates toasted Sunflower seed meal increases the levels of the crude protein digestion across the treatment group. There were no significant ( $P > 0.05$ ) differences among the treatment groups for crude fiber digestibility and the values obtained in this study compared favorably with Yunus (2015) who reported CF values (44.92 to 58.04) and fell within the ranged of 42.21 to 62.23% as it was reported by Saka *et al.*, (2019) who fed moringa oleifera leaf meal to growing rabbits. However, this values were similar to 42.34 to 54.62% reported by Patience and Adetutu (2018) who fed rabbits with graded levels of Sunflower seed meal. Ether extract (EE) and Ash were significantly ( $P < 0.05$ ) affected among the treatment groups. The ash digestibility recorded in this study was higher than the values of 45.25 to 56.77% reported by Yunus (2015) who fed boiled and fermented sorrel seed meal to growing rabbits and also in line with Salama *et al.*, (2019) who reported Ash digestibility values of 50.54 to 60.75% after feeding growing rabbits with feneal seed meal. Ether extract values recorded in this study was lower than 75.88 to 87.62% opined by Gulukun *et al.*, (2023) who fed rabbits with Kidney bean (*Phaseolus vulgaris*) seed to growing rabbits. Nitrogen free extract were significantly ( $p < 0.05$ ) affected across the treatment groups. The NFE values obtained in this study fell between the ranged of 42.47 to 67.36% as reported by Juji (2021) who fed rabbits with *Senna obtusifolia* seed meal. The digestibility of nutrients recorded in this study showed that the available nutrients in TSSM are highly digestible for the performance of rabbits across all the treatment groups.

**Table 3** Nutrient Digestibility of Rabbits Fed Toasted Sunflower Seed Meal (TSSM)

Parameters%	Treatments					SEM
	T <sub>1</sub> (0%)	T <sub>2</sub> (5%)	T <sub>3</sub> (10%)	T <sub>4</sub> (15%)	T <sub>5</sub> (20%)	
Dry matter (DM)	57.40	59.32	61.21	57.77	60.04	1.87 <sup>NS</sup>
Crude protein (CP)	45.15 <sup>d</sup>	57.66 <sup>c</sup>	63.41 <sup>a</sup>	58.60 <sup>ab</sup>	58.56 <sup>b</sup>	3.10 <sup>*</sup>
Crude Fibre (CF)	35.89	47.50	52.21	44.70	42.90	5.45 <sup>NS</sup>
Ether extract (EE)	58.23 <sup>d</sup>	63.11 <sup>c</sup>	70.23 <sup>a</sup>	60.66 <sup>b</sup>	65.60 <sup>ab</sup>	3.49 <sup>*</sup>
Ash	61.38 <sup>d</sup>	70.32 <sup>b</sup>	71.66 <sup>a</sup>	69.53 <sup>ab</sup>	66.16 <sup>c</sup>	2.72 <sup>*</sup>
Nitrogen free extract (NFE)	49.4 <sup>d</sup>	64.28 <sup>c</sup>	67.92 <sup>ab</sup>	67.26 <sup>b</sup>	70.51 <sup>a</sup>	2.72 <sup>*</sup>

**Key:** a, b, c = mean in the same row with different superscript differ significantly (P<0.05)

N = significant NS = not significant(P>0.05)

Carcass Characteristic of Growing Rabbits Fed Graded Levels of Toasted Sunflower Seed meal (TSSM).

The levels of insignificance in growth response of rabbits in this work goes in line with the findings of Adetola *et al.*, (2019) who also reported no significant(P>0.05) differences in rabbits fed toasted Sunflower diet but the values for the slaughter and dressed weights were lower than 1154.50 to 1378.30 g and 750.00 to 760.42 g reported by Bello *et al.*, (2021) who fed *Moringa oleifera* leaf meal to growing rabbits. The dressing percentage values were similar 48.14 to 51.21(g) reported by Ibitoye *et al.*, (2020) who fed rabbits with three different energy sources. The body component expressed as percentage of slaughter also showed no significant (P>0,05) differences among the treatment groups for head, skin and tail. The value for head is below the ranged value of 9 to 14% reported by Adetola *et al.*, (2019) who fed rabbits with graded levels of toasted Sunflower seed meal. The feet weight reported in this study was within the range of 2.98 to 3.62% reported by Sani (2021) who fed rabbits with different energy sources. The values for loin obtained in this study ranged from 7.50 to 10.80% is lower than 11.95 to 14.90% opined by Bello *et al.*, (2021) who fed rabbits with *Moringa oleifera* leaf meal. The value for internal organ weight showed no significant (P>0.05) differences for heart, liver, kidney, lungs, small and large intestine. The values of internal organs reported in this study were within the ranged reported for healthy rabbits of similar age (Duwa *et al.*, 2005, Yunus 2015, and Sani, 2020) respectively.

**Table 4.** Carcass Characteristics and Internal Organ Weight of Growing Rabbits Fed Toasted Sunflower Seed Meal (TSSM).

Treatments Parameters	T1 0%	T2 5%	T3 10%	T4 15%	T5 20%	SEM
Slaughter weight (g)	1010.80	1042.97	1103.67	1046.90	1031.80	66.4 <sup>ns</sup>
Dressed weight (g)	486.87	523.87	535.57	497.13	497.33	45.75 <sup>ns</sup>
Dressing percentage	48.68	52.38	53.56	49.70	49.73	4.57 <sup>ns</sup>
Weight organ/ body component express as percentage of slaughter Wight %						
slaughter Hind leg/thigh	18.60	16.61	15.63	17.13	19.81	2.56 <sup>ns</sup>
Rack	7.82	9.17	7.93	8.90	9.58	1.45 <sup>ns</sup>
Loin	8.08	10.80	9.04	7.50	8.26	1.45 <sup>ns</sup>
Shoulder	9.26	9.54	10.34	9.63	9.84	0.74 <sup>ns</sup>
Head	8.28	9.99	10.10	8.96	10.73	1.28 <sup>ns</sup>
Feet	2.91	2.84	3.42	2.86	2.53	0.81 <sup>ns</sup>
Skin	10.34	8.58	9.08	7.16	7.82	2.35 <sup>ns</sup>
Tail	0.58	0.66	0.71	0.61	0.66	0.14 <sup>ns</sup>
Heart	0.37	0.28	0.44	0.41	0.39	0.42 <sup>ns</sup>
Liver	2.53	2.71	3.24	2.84	2.83	0.83 <sup>ns</sup>
Lungs	0.59	0.55	0.58	0.66	0.60	0.07 <sup>ns</sup>
Fat	0.34	0.37	0.34	0.32	0.33	0.04 <sup>ns</sup>
Large intestine	1.75	1.87	2.01	1.58	2.12	0.31 <sup>ns</sup>
Small intestine	3.55	3.21	3.44	3.31	3.61	0.31 <sup>ns</sup>

**Key** T<sub>1</sub>.....0% Toasted Sunflower seed meal  
T<sub>2</sub>.....5% .Toasted Sunflower seed meal  
T<sub>3</sub>-----10% Toasted Sunflower seed meal  
T<sub>4</sub>-----15% Toasted Sunflower seed meal  
T<sub>5</sub>.....20%S Toasted Sunflower seed meal

## CONCLUSION AND RECOMMENDATION

The results of the study indicate that up to 20% of toasted sunflower seed meal (tSSM) could be incorporated in to the diets of growing rabbits without adverse effect on the performance of growing rabbits. However, further studies are needed to evaluate other methods of sunflower seed meal on the other classes of rabbits.

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