

Growth response, nutrient digestibility and carcass analysis of weaned rabbit fed graded levels of toasted sunflower (*Helianthus annuus*) based diets

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Target audience: Animal Scientist, Nutritionist, Researcher, Rabbit farmers.

Abstract

Graded levels of toasted Sunflower seed meal on growth response, nutrient digestibility and carcass yield of six weeks old weaned rabbits were investigated for 56 days with thirty-six (36) unsexed mixed breed rabbits of average weight 0.50kg. The rabbits were randomly assigned to four treatments with nine (9) rabbits per treatment and replicated thrice in a Completely Randomized Design. Four diets were formulated containing TSSM at 0%, 25%, 50% and 75% as Diet 1(control), 2, 3 and 4 respectively. Parameters measured include feed intake, growth rate, feed conversion ratio and nutrient digestibility while a rabbit/ replicate were selected and severe for carcass evaluation. Results obtained showed no significant ($P>0.05$) difference in all growth parameters measured. Nutrient Digestibility of diet showed significant ($P<0.05$) differences in crude protein, ash content and nitrogen free extract across the dietary treatments. The crude protein (59.62-86.91%), ash (36.76-73.87%), nitrogen free extract (81.48-96.18%) values obtained ranged significantly across the dietary treatments with rabbits on D_3 recording the highest values. Carcass and organ weight showed significant ($P<0.05$) difference in skin, liver, heart and lungs among all parameters evaluated. Conclusively, inclusions of TSSM at 50% in rabbit's diet presented a better result on growth, digestibility and carcass yield.

Keywords: Sunflower seed meal, Weaner rabbit, Digestibility, Performance, Muscle cuts.

Description of Problem

Animal protein is very essential for the growth, development and maintenance of human life as it contains all the essential amino acids needed for this purpose. Unfortunately, poultry and pigs require food sources that are in direct competition with man, unlike rabbits that can be raised on forages and feed materials that freely abound in the tropics (1). Rabbits have been recognized to play an important role in the supply of animal protein especially in the rural and peri-urban areas. They are fast converters of feed to meat and can utilize up to 30% crude fibre as against

10% by most poultry species (2). Rabbits have high growth rate, very high prolificacy and fecundity levels, quicker return on investment, short gestation period with high quality and nutritious meat, and as well as simple management techniques (3). Advocacy has been made by (4) for the development of alternative feeding materials that would be relatively cheaper when compared with commercial feeds or conventional feedstuffs. (5) 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. Non-conventional feed ingredient could be processed into a high quality feedstuff that can favourably supplement. Sunflower is grown in many semi-arid regions of the world. It is tolerant to both low and high temperature (6). Sunflower is one of the most important oil crops of major economic importance and ranks second to soybean among all oil seeds globally as a source of vegetable oil. 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 (7). According to (8) full-fat sunflower seed has 17% crude protein, 26.1% crude fat, 29.1% crude fibre, 3.1% ash, 18.8% nitrogen free extract, 0.17% calcium and 0.53% phosphorus. Sunflower seeds are the best natural and whole food source of

vitamin E which is alpha-tocopherol in its biologically active form (9). Several authors have reported the use of sunflowers seeds in livestock diets. Sunflower seed meal has been incorporated in rations of poultry (10), rabbits (11) and swine (7). Hence, this study was conducted to evaluate the effect of feeding graded levels of toasted sunflower seed meal on growth response, digestibility and carcass yield of growing rabbits.

Materials and Method

Experimental site

The experiment was carried out in the Rabbitry unit of the Institute of Agricultural Research & Training, Moor Plantation, Ibadan, Oyo state which lies between 7.38° N and 3.84°E in the humid zone of the rain forest belt of South Western Nigeria.

Table 1: Gross Composition of Experimental Diet (%)

Ingredients	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)
Maize	45.00	45.00	45.00	45.00
Rice bran	14.00	14.00	14.00	14.00
Soyabean meal	19.30	14.47	9.65	4.83
TSSM	0.00	4.83	9.65	14.48
Wheat offal	18.00	18.00	18.00	18.00
Bone meal	3.00	3.00	3.00	3.00
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
M.E (kcal/kg)	2609.34	2492.45	2375.81	2258.92
Crude protein (%)	17.38	16.28	15.19	14.10
Crude fibre (%)	5.68	5.76	5.84	5.93
Calcium	1.50	1.41	1.31	1.21
Phosphorus	1.02	0.99	0.96	0.93
Ash	3.14	2.88	2.62	2.36

M.E- Metabolizable Energy

TSSM –Toasted Sunflower Seed Meal

Sourcing and Processing of Test Ingredient

The Sunflower seed used for this experiment was obtained from National Association of Sunflower Seed Farmers, Abuja. The sunflower seed was toasted in order to reduce the anti-nutritional factor and make the nutrients available to the animals according to the procedure of (12). A wide aluminum frying pan pre-heated to about 90^{0c} after which the seed was poured and constantly stirred using a wooden spoon to prevent burning purposely to enhance even distribution of heat. The toasting lasted for 5 minutes after which the seed was allowed to cool and then milled using a milling machine before incorporated into the diet.

Experimental animals and management

A total of thirty- six (36) unsexed weaned mixed breed rabbit aged between 5-6 weeks

with an average weight of 450-500g were used for this study for a period of 56 days. The rabbits were acclimatized for two weeks in order to get accustomed to the feed and confinement. During this period, prophylactic treatments were administered to the rabbits in order to stabilize them before the study commenced. The rabbits were equalized in weight before they were assigned to the various diets. Feed and water were supplied twice per day on daily basis, forages were served in the morning and concentrate in the evening. Routine medication were administered as at when due. The experimental rabbits were housed in a wooden hutch with a wire mesh floor (so that faeces and urine can drop) and window for ventilation. The hutches and its surroundings were cleaned twice per week. The experimental animals were managed well for optimum performance.

Table 2: Proximate composition of Experimental Diet

Parameters	TSSM	D ₁ (0%)	D ₂ (25%)	D ₃ (50%)	D ₄ (75%)
Dry Matter	95.10	89.90	91.10	90.80	92.00
Crude Protein	21.35	15.40	15.05	13.64	10.15
Crude Fibre	08.20	3.80	5.90	6.00	6.60
Ash	06.20	6.20	8.40	4.30	6.00
Ether extract	39.50	13.80	27.90	27.90	33.00
NFE	25.45	50.7	48.15	49.36	51.95

TSSM- Toasted Sunflower Seed Meal NFE- Nitrogen Free Extract

Table 3: Growth Response of Growing Rabbits Fed Toasted Sunflower Seed Meal

PARAMETERS	TSSM inclusion				SEM±
	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	
Initial weight (g)	495.33	497.67	500.00	496.67	2.86
Final weight (g)	1517.20	1628.30	1871.70	1526.70	66.43
Weight gain (g)	1021.90	1130.70	1371.70	1030.00	66.66
ADWG(g/rabbit/day)	18.25	20.19	24.50	18.39	1.19
Feed intake (g/day)	5431.60	6181.50	5057.70	4872.9	304.84
ADFI (g/rabbit/day)	96.99	110.38	90.32	87.02	5.44
FCR	5.32	5.44	3.92	4.79	0.44

ADWG: Average Daily Weight Gain, ADFI: Average Daily Feed Intake, FCR: Feed Conversion Ratio, TSSM: Toasted Sunflower Seed Meal, SEM: Standard Error of Mean.

Experimental diets and design

Four diets were formulated such that toasted sunflower seed meal was incorporated into the experimental diets at varying levels of 0, 25, 50 and 75% inclusion to connote D₁ (control), D₂, D₃ and D₄ respectively in Completely Randomized Design. The rabbits were randomly allotted into dietary treatments and each treatment was replicated three times with a total of nine (9) rabbits per treatment.

Data Collection**Growth performance**

The rabbits were weighed individually at the beginning of the experiment and subsequently on a weekly basis using a 10kg sensitive weighing scale (Camry brand) prior to feeding in the morning. The initial live weight was subtracted from the final live weight to determine the weight gained by each animal. Feeds offered and remnants were weighed on a daily basis to determine the actual feed intake per animal. Feed conversion ratio (FCR) was calculated from feed intake and weight gain values. Weight gain = Final weight (g) - Initial weight (g), Feed intake = Feed offered - Feed refusal (g) as described by (13).

Feed Conversion ratio (FCR) =

Feed intake (g)

Weight gain (g)

Digestibility Trials

Seven (7) days to the end of the feeding trial, three rabbits per treatment were transferred to a metabolic cage, acclimatized for two days before collection of sample and fed known amount of feed. Feecal samples were collected, oven dried and weighed. Urine samples were also collected into a universal bottle with drop of conc. HCL in order to trap the ammonia. After that, the feecal and feed samples were analyzed for proximate composition according to the standard procedure of (14). Nutrients weight in diets and feaces were calculated using the weights of diets consumed and feecal samples collected and their determined composition from which apparent digestibility coefficient were calculated as stated by (15).

Carcass Analysis

At the end of feeding trial, one rabbit per replicate was randomly selected making three rabbits per treatment were starved overnight, weighed, stunned and slaughtered by severing the jugular vein and soft tissues of the neck and then flayed and dressed. The weight of the carcasses and organs were recorded.

Table 4: Nutrient Digestibility of Growing Rabbits fed Sunflower Seed Meal

PARAMETERS (%)	TSSM		Inclusion		SEM±
	D1 (0%)	D2 (25%)	D3 (50%)	D4 (75%)	
Dry Matter	75.79	79.20	82.98	70.12	2.52
Crude Protein	64.53 ^b	84.19 ^a	86.91 ^a	59.62 ^b	4.24
Crude Fiber	87.89	84.31	89.43	86.56	1.43
Ether Extract	60.35	65.59	76.46	60.45	3.74
Ash	44.93 ^{ab}	67.57 ^a	73.87 ^a	36.76 ^b	6.03
N. F. E	81.48 ^b	88.93 ^a	96.18 ^a	91.44 ^a	1.87

^{a,b} means along the same row with different superscripts are significantly different (p<0.05).

N.F.E: Nitrogen Free Extract, TSSM: Toasted Sunflower Seed Meal, SEM: Standard Error of Mean.

Table 5: Carcass and organs weight of rabbits fed toasted sunflower seed meal

Live weight (g)	1773.30	1766.70	1833.30	1710.00	68.48
Slaughter weight (%)	96.67	96.55	95.17	95.97	0.71
De-skinned	86.21	88.91	85.83	84.82	0.98
Skin weight	10.85 ^a	8.52 ^b	9.92 ^{ab}	9.01 ^{ab}	0.36
Eviscerated weight	62.24	47.25	64.72	63.45	4.91
Dressed weight	77.74	51.41	80.92	76.81	6.61
Hind limb	40.83	35.43	36.43	36.17	1.22
Loin	20.23	22.28	21.51	34.61	3.36
Fore limb	17.81	15.43	15.14	17.22	0.74
Back	16.63	13.37	15.67	16.68	0.82
Head	14.66	9.30	13.79	14.15	1.24
Neck	4.12	1.91	2.72	2.83	0.36
Organ weight					
GIT	29.56	18.73	24.40	26.75	2.76
Liver	6.41 ^{ab}	5.49 ^b	5.49 ^b	7.57 ^a	0.32
Heart	0.54 ^b	0.45 ^b	0.49 ^b	0.68 ^a	0.03
Lung	1.36 ^a	0.84 ^b	0.98 ^b	1.04 ^{ab}	0.07
Kidney	1.29	1.30	1.12	1.24	0.04
Spleen	0.12	0.15	0.24	0.12	0.03

^{a, b} means along the same row with different superscript are significantly difference (P < 0.05)

Statistical Analysis

All data collected were subjected to one-way Analysis of Variance (ANOVA) and the significant means among variables were separated using Duncan's Multiple Range test (16).

Result

The proximate composition of Toasted Sunflower seed meal and experimental diets fed to rabbits as presented on Table II showed the crude protein of toasted sunflower seed to be (21.35%), crude fibre (8.20%), ether extract (39.50%) and high dry matter content (95.10%). The dry matter content of the diet ranged from 89.90-92.00% with D₄ (75% TSSM) having the highest and D₁ (0% control) the least value. The crude protein content ranged from 10.15-15.40 and was an inverse of the dry matter values across the treatments. The crude fiber values increased as the level of inclusion of TSSM increases. The Ash content in the diet range 4.30-8.40% with the least on 50% and highest on 25% TSSM respectively.

The value obtained for Ether extract ranged from 13.60 – 17.50% which increases as the inclusion levels of TSSM increases. Presented on Table III is the result of the growth response of rabbit fed experimental diets. There were no significant (P>0.05) difference in all parameters evaluated across the treatments. However, differences were observed in the numeric value obtained for final weight in which at D₃ (50% TSSM) recorded the highest value (1871.70g) as compared to control and other diets. Similarly, for feed intake, rabbits on D₃ had a better consumption rate with increased weight gain. This is evident in the feed conversion ratio (FCR), as rabbits on the same diet efficiently converted feed consumed to muscle. The nutrient digestibility of the diets as shown on Table IV presented a significant (P<0.05) differences in the Crude protein, Ash Content and Nitrogen Free Extract among all parameters evaluated. For crude protein digestibility, highest significant (P<0.05) values were obtained on D₂ (84.19) and D₃

(86.91) while least values on D₁ (64.53) and D₄ (59.62) but for Ash content, D₂ (67.57) and D₃ (73.87) had the highest ($P < 0.05$) values followed by D₁ (44.93) and D₄ (36.76) had the least. Nitrogen Free Extract values ranges from (81.48 – 96.18) with the highest ($P < 0.05$) values on D₂, D₃ and D₄ respectively and D₁ having the least. Presented on Table V is the carcass and organ weight of growing rabbits fed toasted Sunflower Seed Meal. Significant ($P < 0.05$) differences were obtained in skin weight as well as some organ weight such as liver, heart and lung among parameters evaluated. Highest significant ($P < 0.05$) value for skin was recorded on D₁ followed by D₃ and D₄ while D₂ had the least. Both liver and heart showed highest ($P < 0.05$) values in D₄ and the least were in the other treatments but for lungs, D₁ recorded the highest ($P < 0.05$) value followed by D₄ and the lowest values on D₂ and D₃ respectively.

Discussion

Sunflower seeds are rich sources of protein, minerals such as calcium and phosphorus (17). The proximate value of toasted sunflower seed in this study is contrary to the values reported by the (18) and (19). However, (20) found that chemical composition of decorticated sunflower meal as 41.6% CP, 14.7% EE, 8.9% CF and 7.1% crude Ash while (13) reported 90.00% DM, 23.50% CP, 22.10% CF, 44.00% CFat and 4.70% Ash for raw seed and 98.40% DM, 29.10% CP, 30.74% CF, 39.00% CFat and 10.50% Ash for roasted seed respectively which differs from the report of this study. Variations in chemical composition of sunflower meal might be attributed to location, micro and macro environmental factors or to the different processing methods, which determine the composition of this ingredient used as feedstuff. The proximate composition of the experimental diets showed

that the diets had high dry matter (DM) contents that ranged from 89.90% in D₁ to 92.00% in D₄. This indicated that the diets can be stored for longer period of time without spoilage. These values recorded for DM differs slightly from the ranges of 95.29%-96.13% DM reported by (13). The crude protein content ranges from D₄ (10.15) - D₁ (15.40) which reduces as the inclusion level of TSSM increases but fell within the ranges of 9.0 - 29.7% as reported by (21) for growing rabbits in the tropical environment. Although the values are slightly lower than the report of (13). The diets had low crude fibre content which is quite lower than the ranges of 8.73-10.34% reported by the same author, 4.54-12.70% by (22) and 10-20% recommended for optimum performance of rabbits by (23) but had higher value for ether extract 33.00% (D₄) as compared to 13.80% (D₁) but contradicts the ranges of 5.09-8.82% reported by (13). This difference can be attributed to the fact that the seed has high oil content and the method of processing. The Ash content ranges from 4.30% - 8.40% which is lower than the ranges of 7.54-9.02% reported by (13) and 3.10-15.70% reported by (22) when rabbits are fed with wild sunflower inclusion in their diet. The high content of NFE in the experimental diets is an indication that the seed has higher energy content because NFE consists of mainly sugars and starch among other components. The range of values for Nitrogen Free Extract (NFE) fell within the range reported by (22). The level of insignificance in growth response of rabbits in this present study agreed with the findings of (24) who also reported no significant difference in rabbits fed with Mango Fruit Reject Meal but the values obtained for final and weight gain were higher than 1431.25g - 1718.75g and 13.93g- 17.95g recorded by the same author and also higher than that reported by (25). However, this is contrary to the findings of (13) who reported significant ($P <$

0.05) difference in performance of rabbits fed roasted sunflower seed meal. Although, the values recorded for final weight, weight gain, feed intake and FCR are significant but they are lower than the values reported in this study. Feed conversion ratio (FCR) is an important index of performance, which is a direct indication of how best feed offered to animals was utilized for meat production. As reported by (13), rabbits on 30% inclusion of sunflower seed meal gained more weight and perform better than other treatments but in this study, 50% inclusion of TSSM present the best result in terms of weight gain, feed intake and FCR. The FCR ranges from 3.92- 5.44g across the treatments and is higher than 2.79-4.38g reported by (13) but lower than 6.91 –7.30g reported by (26). The differences observed in the feed conversion ratio (FCR) may be attributed to the composition of the diet. As shown in the digestibility study, the mechanisms directing the growth responses observed in the rabbits appear to be related to nutrient digestibility. The dry matter digestibility values (70.12- 82.98%) obtained in this study is higher than (60.13-81.68%) reported by (13) but contrary to the values (61.16-87.03%) reported by (27) who fed rabbits with diets containing varying levels of groundnut haulms and cowpea shell. Moreso, the DM values is similar to the range of 62.35-82.03% observed by (28) and much lower than the report of 88.07-90.06% by (22) who fed rabbit with wild Sunflower inclusion. Crude protein digestibility value observed in this study is between 59.62- 86.91% which fell within the range of 76.32-84.36% reported by (13) but higher than the range of 55.34-74.83% by (22). Although, this result is contrary to the values (42.21- 62.23%) reported by (28). The crude fibre digestibility value ranges from 84.31-89.43% as reported in this study which is quite higher than the values reported by (22), (13) and (28) respectively. Ash digestibility

content as observed in the study is in agreement with the values reported by (13). Ether extract digestibility and Nitrogen free extract does not follow any trend but highest values were obtained on 25% and 50% inclusion of TSSM respectively.

The insignificance in the carcass parameters evaluated in the study disagreed with the findings of (13) and (22) but in line with the finding of (29) and (17). Significant differences were recorded in some of the organs such as liver, heart and lungs. This contradict the report of (30) and (31) who fed cassava tuber meals and 20% sunflower seed meal to rabbits. It is a common practice in feeding trials to use weights of some internal organs like liver and kidneys as indicators of toxicity. (13) reported that if there is any toxic elements in the feed, abnormalities in weights of liver and kidney would be observed.

Conclusions and Applications

Based on the results of this study, it can be concluded that:

1. Toasted sunflower seed meal is a potential source of protein and contains valuable nutrient that can be utilized in diets of weaned rabbit and can be used to partially replace Soybean meal (SBM).
2. Inclusion of Toasted Sunflower seed meal at 50% in the diet of weaned rabbits has no adverse effect on their growth response and it is effective for proper nutrient intake and digestibility.
3. In view of optimum performance and nutrient digestibility, supplementing Toasted Sunflower seed meal in the diets of weaned rabbit at 50% inclusion levels is hereby recommended for rabbit farmers.

References

1. Biobaku, W.O. (1993).Effect of cooking raw and cooked (*belonix regia*) seed

- beans on the performance of rabbits. *Journal of Agricultural Technology*. Maiden Edition, 56-60.
2. Egbo, M. L., Doma, U. D. and Lacadaks, A. B. (2001). Management in Bauchi metropolis. Proceedings of the 26th Annual Conference on Nigerian Society for Animal Production (NSAP), March 18-21, 2001, ABU Zaria, Nigeria, Pp: 160-162.
 3. Hassan, H.E., Elamin, K.M., Yusuf, I.A., Musa, A.M. and Elkhairy, M.A (2012): Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. *Journal of Animal Science Advances*. 2(4): 407-415.
 4. Alawa, J. P., Botoye, D. T. K., Ndukwe, F. O. and Berepubo, N. A. (1990). Effect of varying proportions of brewer's dried grains on the growth performance of young rabbits. *J. Applied Rabbit Res.*, 12:252-255.
 5. Agunbiade, J. A, Adeyemi O. A, Fasina, O. E and Bagbe, S. A. (2000). Fortification of cassava peel in balanced diets for rabbits. *Journal of Animal Production*. 28 (2):167-173.
 6. Putnam, D. H., Oplinger, E. S., Hicks, D. R., Durgan, B. R. and Noetzel, D. M. (1990). Sunflower: Alternative Field Crops Manual. Co-op Extension Service, Wisconsin, Madison, USA.
 7. Putt, E. (1998). History and Present World Status. In: Sunflower Science and Technology, Carter, J.F. (Ed.). *American Society of Agronomy, Madison, Rabbits*. *J. Applied Rabbit Res.*, 9: 25-30 Pp: 1-25
 8. Relf, D. (1997). Sunflower, the Virginia Gardener. Newsletter 8(8):1-2.
 9. Olomu, J. M. (1995). Monogastric Animal Nutrition-Principles and Practice. Jachem Publications, Benin City Nigeria.
 10. Tsuzuki, E. T., Garcia, E. R., Murakami, A. E. and Galli, J. R. (2003). Utilization of sunflower seed in laying hen rations. *Rev. Bras. Cienc. Avic.*,5: 179-182.
 11. Adeniji, C. A. and Ogunmodede, B. K. (2006). Growth, nutrient retention and serum metabolites of broiler chickens fed high fibre hulled sunflower seed cake. *Nigerian Journal of Animal Production*, 33 (2): 222 - 229.
 12. Akande, K. E., Abubakar, M. M., Adegbola, T. A., Bogoro, S. E. and Doma, U. D. (2009). Effect of feeding graded levels of roasted sunflower meal on the performance, nutrient digestibility and carcass characteristics of rabbits. *Continental J. Anim. Vet. Res.*1: 31-37.
 13. Duwa, H., Girgiri, A.Y., Dauda, A. and Igwebuike, J.U. (2014). The effect of feeding graded levels of roasted sunflower (*Helianthus Annuus* L.) seed meal on weaner rabbits. *Online J. Anim. Feed Res.*, 4 (5): 107-112.
 14. A.O. A. C. (2005). Association of Official Analytical Chemists. Official methods of Analysis, 15th edition. A.O.A.C. Washington D.C. Pp69-88.
 15. Aduku, A.O (2004). *Animal Nutrition in the tropics: Feeds and Management, Monogastric and Ruminant Nutrition*. Davcon Computers & Business Bureau, Zaria, Nigeria. Pp 5-143.
 16. SAS, (2004). Statistical Analysis System. Proprietary software release 8.1 SAS institute Inc, Cary, North Carolina USA..
 17. Salunkhe D. K., Chavan J. K., Adsule R.N. and Kadam S. S. (1991). World oilseed: chemistry, Technology and utilization Pp 554. New York Van Nostrand Reinhold .
 18. Syda A. M. Ali, Hayder O. Abdalla and Abasaid M. A. 2011. Sunflower meal as an alternative protein source to groundnut meal in laying hens ration. *Egypt Poult. Sci.* Vol. (31) (IV): 745-753

- 19 Fagbenro, O. R. ; E. O. Adeparusi and W. A. Jimoh, (2010). Effect of processing on the nutrients and anti-nutrients composition of sunflower seed meals, *International Journal chem.* Vol. 20, No.3,1 (2010) 165- 170.
- 20 Mohammed, E. Ahmed, Nivin M. El faki and Talha E. Abbas, (2013). The effect of decorticated sunflower meal as a substitute for groundnut meal in broiler diet. 2nd International Conference on Environment, Agriculture and Food Sciences (ICEAFS' 2013) May 6-7,2013 Kuala Lumpur (Malaysia).
- 21 Duncan, D.B.(1955). Multiple Range Test and F-test. *Biometrics*.11: 1-42.
- 22 Fakorade, O.P and Adetutu, A.A (2018). Performance and carcass characteristics of weaner rabbits fed wild sunflower (*Tithonia diversifolia*) inclusion in their diet. *International Journal of Development and Sustainability* . Volume 7 No 8: Pp 2216-2226.
- 23 Bello, K.M. (2003). Chemical composition of some plants used as feed for rabbits in Bauchi metropolis. *Nigerian Journal Animal Production*, 30(1): 32-36.
- 24 Orayaga, K.T. (2016): Effect of composite Mango (*Manifera indica*) Fruit Reject Meal on Growth Performance, Digestibility and Economics of Production of Rabbits. *Nigerian .J. Anim Sci* (1): 65-75.
- 25 Onifade A.A. and Tewe O.O. (1993). Alternative tropical energy feed resources in rabbit diet. Growth performance, Diets digestibility and Blood composition, *World Rabbits Science* 1(1):17-24.
- 26 Abu O.A and Ekpeyoung T.E (1993) Utilization of dried palm oil mill effluent by young growing rabbit. *World Rabbit Science* 1(1):11-15.
- 27 Bawa, G.S., Abu, E A. and Adegbulu, M T. (2007). Effects of duration of cooking whole or crushed African Locust Bean (*Parkia Filicoidea*, Welw) seeds on the levels of some anti – nutritional factors and growth performance of young rabbit. *Nigerian Journal of Animal Production*, 34 (2):208-219.
- 28 Saka, R. O., Anurudu, N. F., Adebisi, A. O. Adetoro, B. O., Adetola, O. O, Bolarinwa, M. O. Adewumi, M. O., Balogun, I. O. and Saka, A. A (2019). Performance characteristics, nutrient digestibility and blood profile of rabbits fed diets containing graded levels of *Moringa oleifera* seed powder. *Nigerian J. Anim. Sci.*, 21 (2): 202-213
- 29 Adama, T.Z. and H. Haruna, (2002). Effect of dietary source of fibre on feed intake, growth performance, nutrient digestibility and carcass characteristics of growing rabbits. *J. Sustain. Trop. Agric. Res.*, 4: 67-71.
- 30 Ekpo, J. S, Solomon, I.P, Isaac I.J, Ekpo, K.O. and Leo, O.O. (2009). Carcass characteristics and economic benefits of weaner rabbits fed cassava tuber meals. *Asian Journal of Animal and Veterinary Advances*. 4(4):214-218
- 31 Alciceek, A, Bozkurt, M and Cabuk, M. (2005). The effect of essential oil combination derived from selected herbs growing wild in Turkey on broiler performance. *South African Journal of Animal Science*. 33:89-94.