



PERFORMANCE OF WEANER RABBITS FED GRADED LEVELS OF UREA-TREATED COWPEA HUSKS DIETS

Soji, W. M., Yusuf, H. B., Edeh, I. E. and Yusuf, S. Z.

Department of Animal Science, Faculty of Agriculture, Modibbo Adama University, Yola

Corresponding Author's Email: sojiwandia@gmail.com, **GSM:** +234-7030054646,

hassanby2003@yahoo.com; +234-8036342466.

ABSTRACT

A fifty six (56) days feeding trial was conducted to evaluate the performance of weaner rabbits on graded levels of urea-treated cowpea husk diets. The husks were treated at 0, 2.5, 3, 3.5 and 4% levels of urea solution designated as T1, T2, T3, T4 and T5 respectively. Forty (40) unsexed mongrel weaner rabbits aged between 5-6 weeks were used for the experiment and were randomly allotted to treatments in a Completely Randomized Design. The treatments were replicated four times with two rabbits per replicate. The rabbits were given 50g of feed twice a day (8:00am and 4:00pm) and water ad-libitum. The results from proximate composition of urea-treated cowpea husk showed improvement in protein content (11.3- 15.23%) and also fibre fraction degradation (33.1- 18.07%) from treatment 1-5 respectively. The result of growth performance revealed that there were no significant ($P>0.05$) differences in final body weight (1457.80- 1540.10g), total weight gain (914.13- 990.50g) and FCR (3.79-4.58) across the treatment groups. Similarly, parameters evaluated for nutrient digestibility were similar ($P>0.05$) across the dietary treatments. Hence t2 fed Treated cowpea husk with 2.5% urea solution gave the least cost per kg gain (₦870.74) compared to others treated with higher levels of urea and is therefore recommended for weaner rabbits.

Key words: Performance, Nutrient, Digestibility, Mongrel, Urea

INTRODUCTION

Feed is a major constraint adversely affecting animal production. This has worsened in recent years as a result of ever increase in human population and cost of feed ingredients coupled with clash in consumption for available grains and legumes (Aufule, 2004) and this has affected supply of protein from animal origin. In light of the escalating global population, (FAO, 2012) reported that from year 2000-2020, the projected world requirement for protein would increase immensely and this would necessitate the imperative to explore other aspect and specie in livestock production to bridge the gap of protein intake from animal origin. Traditional animals such ruminant and monogastric (broiler and swine) had been found to be main source of meat but recently studies have shown that farming rabbits and other micro livestock species (grasscutter and snail) is emerging in many developing countries, Nigeria included as potential source of protein (Ozung *et al.*, 2017). However, the limiting factor for meat production from rabbits is mainly access to quality feed (Olugusi *et al.*, 2021). This premise has engendered the need to consider alternative feed resources such as agro by-products and agro industrial waste product that are readily available and underutilized (Ozung *et al.*, 2017).

Rabbits (*Oryctolagus cuniculus*) are micro livestock that can produce high quality animal protein. Nutritionally, rabbit meat has a higher protein (20-21%), low fat (10-11%) when compared with meats from other species. Rabbit meat has the cholesterol value of 169/100mg (dry matter basis) when compare with beef (200mg), chicken (220mg) and low sodium content (Janieri, 2003). In view of the salient benefit that could be derived from rabbit's production such as meat production, prolificacy, short generation interval and ability to subsist on plant feed resources/forages, it is imperative to explore other locally available feedstuff on it.

Cowpea husk is an alternative non-conventional feed resource not consumed by man. It is a farm waste or fibrous crop residue characterized by cellulose and hemicellulose lignification, low crude protein (12.9%), high crude fibre (33.1%) on dry matter, low soluble carbohydrate and minerals (Adebowale and Nakashima, 1992); (Van Hao and Ledin, 2001).



The search for cheap, safe and simple methods for improving nutritive value of farm wastes is imperative if straws and other related farm residues are to be utilized in rabbit diets. Urea fertilizer had been used as protein supplement and also in treatment of straws, stovers and agro-industrial by-products to improve their nutritive value basically of the nitrogen content contained in the fertilizer. Although responses to supplementation with urea have been variable, several workers have shown that intake of low quality diet roughages is increased when supplements of non-protein nitrogen (NPN) are given (King, 1971); (Oluokun, 2005). The presence of urea activity in the caecum of rabbit makes it capable of utilizing urea as a source of nitrogen (Fontenot *et al.*, 1977) similar to rumen in ruminant (Fontenot *et al.*, 1977); (Makkar and Singh, 1987). The use of urea in drinking water or sprayed on the stover has been suggested as a possible means of improving the nutritive value of crop residue (Jayasuriya and Perera, 1982). Information is lacking on chemical treatment of cowpea husk for rabbit feeding. Hence this study aimed at investigating the response of weaner rabbits to graded levels of urea-treated cowpea husk in diets.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at Teaching and Research Farms of Modibbo Adama University (MAUTECH) Yola, located in Girei Local Government Area Adamawa State. It lies between latitudes $9^{\circ}12'N$ – $9^{\circ}14'N$ and longitude $12^{\circ}15'E$ – $12^{\circ}17'E$. The climatic conditions of this area is fairly constant, the temperature of the area is high throughout the year, a maximum temperature of $33.9^{\circ}C$ and a minimum of $20.8^{\circ}C$ has been observed and covers an area of 54 hectares. The relative humidity is very low between January to March about (20-30%) which will start increasing from April and reaches its peak in August and late September with a mean annual rainfall of 956mm while the cool dry harmattan starts in November to February (Zemba *et al.*, 2020). The study area falls within the North Guinea Savannah vegetation zone, this one is characterized by high grass land with shrubs and fewer trees (Ezra *et al.*, 2016).

Experimental Animals and Management

Fourty (40) mongrel weaner rabbits between the ages of 5–6 weeks' old were procured from Gombe State. They were randomly allotted to five dietary treatments replicated four times with two rabbits per replicate in completely randomized design. Each replicate was housed in a cage measuring 150cm x100cm x120cm in a three tier hutch system raised 120cm above the floor. The cages were fitted with feeders and drinkers. The animals were given necessary treatment against parasites prior to the experiment.

Source of Cowpea Husk, Urea and Urea-Cowpea Husk Treatment

Cowpea husk was sourced from Jimeta By-Pass Market of Adamawa State while the urea was purchased from Yola fertilizer dealers. The cowpea husk was treated at 2.5%, 3%, 3.5% and 4% urea. Four kilogram of urea dissolved in 100 litres of water will give the 4% of urea solution. The cowpea husk was then soaked in the solution for 10 minutes, thereafter it was enclosed in an air tight condition for 3 days. Subsequently it was left under shade for some hours to dry. It was then ground to a considerable particle size, stored properly and used in the experiment.

Experimental Diets

Five experimental diets were formulated using untreated and treated cowpea husks. The cowpea husks were treated with 0, 2.5, 3, 3.5 and 4% urea solution and designated as diets 1, 2, 3, 4 and 5 respectively.

Table 1: Ingredients, Percentage Composition and Calculated Experimental Diets

Ingredients	Graded Urea Levels				
	T1 (0%)	T2 (2.5%)	T3 (3%)	T4 (3.5%)	T5 (4%)
Maize	45.00	47.00	48.00	48.00	49.00
Maize offal	18.00	18.00	18.00	18.00	18.00
Groundnut cake	23.00	21.00	20.00	20.00	19.00
UTCH	0	10.00	10.00	10.00	10.00
Untreated CP husk	10.00	0	0	0	0
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Calculated analysis	100	100	100	100	100
ME(Kcal/kg)	2750.50	2766.34	2774.26	2774.26	2782.18
Crude protein	17.67	17.26	17.10	17.30	17.14
Crude fibre	7.36	7.30	7.27	7.27	7.24
Calcium	1.16	1.16	1.16	1.16	1.15
Phosphorus	0.71	0.70	0.70	0.70	0.69
Lysine	1.01	0.96	0.94	0.94	0.91
Methionine	0.47	0.47	0.46	0.46	0.46

Vitamin-mineral premix will provide per kg the following: Vit. A 1500 IU; Vit.D₃ 3000 IU; Vit.E 30 IU; Vit.K 2.5 mg; ThiamineB₁ 3 mg; Riboflavin B₂ 6 mg; Pyrodoxine B₆ 4 mg; Niacin 40 mg; Vit. B₁₂ 0.02 mg; Pantothenic acid 10 mg; Folic acid 1mg; Biotin 0.08 mg; Chloride 0.125 mg; Mn 0.0956 g; Antioxidant 0.125 g; Fe 0.024 g; Cu 0.006 g; Se 0.24 g; Co 0.240 g. UTCH: Urea Treated Cowpea Husk; CP: Cowpea ME: Metabolizable Energy. *Metabolizable energy calculated according to formula of (Pauzenga, 1985)*

Data Collection

Data were collected on growth parameter and digestibility.

Growth parameter

Initial weight

At the beginning of the experiment, the experimental animals were weighed to obtain their initial body weights and thereafter on weekly basis. The weight of the rabbits per replicate was taken on weekly basis to determine the weekly body weight gain. The weight of the rabbits at the end of the experiment was the final weight gain. The weight gain was determined as:

$$\text{Weight gain} = \text{Final weight gain} - \text{Initial weight gain}$$

Feed intake

Feed was offered to each group of the experimental animal twice (morning and evening) daily. Water was giving *ad libitum*. The left over feed was collected the following day and weighed. The weight of the left over feed was subtracted from the weight of feed offered, the difference was recorded as feed intake.

$$\text{Feed intake} = \text{feed offered} - \text{feed left over}$$

Weight gain

The weight of rabbits per replicate was taken on weekly basis to determine the weekly body weight gain.

$$\text{Weight gain} = \text{weight of current week} - \text{weight of previous week}$$

Feed conversion ratio (FCR)

Feed conversion ratio was calculated as the ratio of feed intake per weight gain using the formula described by (Abubakar and Oni, 2000)



$$FCR = \frac{\text{feed intake}}{\text{weight gain}}$$

Mortality

Record of mortality in each treatment was taken throughout the duration of the experiment and expressed as the percentage of the total rabbits at the beginning of the experiment

Digestibility Study

At the 56th day of the experiment, a rabbit from each replicate was randomly selected and placed in metabolic cages. Faeces was collected for five days sun-dried and bulked. The fecal samples were milled before chemical analysis. The fecal samples were analyzed for dry matter, crude protein, crude fibre, Ash, ether extracts and nitrogen free extract.

The digestibility values were calculated as thus:

$$\text{Apparent Nutrient Digestibility} = \frac{\text{Nutrient intake} - \text{Nutrient excreted}}{\text{Nutrient intake}} \times 100$$

Chemical Analysis

Experimental diets, urea-treated cowpea husks and fecal samples were analyzed for proximate composition using the methods described by (AOAC, 2010).

Statistical Analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using completely randomized design as described by (Steel and Torrie 1980). Means were then separated using (Duncan, 1955) using JMP SAS, version 10.

Statistical model: $Y_i = U + F_i + E_i$

Where Y_i = Observations for dependent variable

U = Overall mean

F_i = Fixed Effects of the feed

E_i = Experimental error

Economics of Production

The cost/kg of each diet was calculated as the summation of the cost/kg of each ingredient multiplied by the level of inclusion.

- i. Cost/kg diet = $\sum (\text{Cost/kg ingredient} \times \text{kg inclusion in diet})$.
- ii. Cost of feeding was computed as a product of the cost of the diet and the amount of consumed during the period of study

Cost of feeding = $(\text{Cost/diet} \times \text{total feed intake})/100$.

iii. Feed cost/kg weight gain was calculated as cost of feeding divided by the total weight gain multiplied by 100

Feed cost/kg weight gain = $(\text{cost of feeding} / \text{total weight gain}) \times 100$.

RESULTS AND DISCUSSION

Proximate Composition of Untreated and Urea-Treated Cowpea Husk

The nutritive composition of untreated and urea-treated cowpea husk as shown in Table 2, revealed that the feedstuffs had comparable nutrient profile although the urea-treated cowpea husks had higher crude protein T2 (12.11%), T3 (14.02%), T4 (14.15%) T5 (15.03%) than the untreated T1 (11.3%). This suggests that treating cowpea husk using urea solution increases its crude protein content. The treatment of cowpea husk with urea increases its nitrogen content due to addition of non-protein nitrogen (Oluokun, 2005). This corroborates with other findings that urea ammoniation increases protein content of feed materials {(Yakubu *et al.*, 2007); (Ambaye, 2009); (Ubwah *et al.*, 2014)}. Dry matter values compared favourably with the values reported by (Mohammed and Jamala 2013). Furthermore, it was also observed that there was fibre fraction degradation from T1-T5 (33.1 - 18.07%) i.e. reduction in fibre levels. This also conforms with the findings of (Belew and Babalola, 2004) who found that chemical treatment of feeds with alkali and urea degrades fibre.



Table 2: Proximate Composition of Untreated and Urea-Treated Cowpea Husks

Parameters (%)	T1 (UNTC)	T2 (2.5% TCH)	T3 (3% TCH)	T4 (3.5% TCH)	T5 (4% TCH)
Dry matter	92.00	90.33	90.24	90.15	90.11
Crude protein	11.3	12.11	14.02	14.15	15.23
Crude fibre	33.1	22.01	20.86	20.41	18.07
Ether extract	3.40	3.35	3.33	3.30	3.31
Ash	8.66	8.31	8.50	8.52	8.11
NFE	27.77	22.84	22.52	22.45	22.8

NFE: Nitrogen Free Extract. UNTC: Untreated cowpea husk, TCH: Treated cowpea husk

Proximate Composition of Experimental Diets

The result obtained from the proximate composition of experimental diets showed that the dry matter (DM) contents of the feed materials were numerically higher than (90.24 – 91.00%) reported by (Ubua *et al.*, 2018) but compared favorably with (94.37 - 95.34%) reported by (Iliya *et al.*, 2006). The CP compared well with the range of (15.81 - 16.48% and 15.10 - 17.46) reported by (Iliya *et al.*, 2006) and (Ubua *et al.*, 2018) but lower than (24.21 - 38%) reported by (Isiekwen, 2013) who fed weaner rabbits with urea treated and fermented brewer dried grain. The crude fibre were within the range of (7.11 - 10.74%) reported by (Ubua *et al.*, 2018).

Several attempts had been made to utilize urea in improving the nutritive value of low protein straws, stovers and other agro-industrial by-products to feed ruminant and monogastric animals. In monogastric animals, (Oluokun, 2005), (Iliya *et al.*, 2006), (Mohammed and Jamala 2013) and (Ubua *et al.*, 2018) had utilized different feed materials such a rice milling waste, cowpea husk and brewer dried grain all treated with urea. The results showed effective improvement in the nutritive value of the materials treated with urea especially the protein content. From the table of the proximate in this study, it could thus be seen that the dry matter (DM) of the feed was utilized and is within the range of 5-7% reported by (Iliya *et al.*, 2006). The protein content however was high compared to control. Numerically the protein content of T5 was higher than T1 this can be attributed to the increase level of urea fertilizer which in turns supplemented more nitrogen compared to other treatments. Therefore, the comparable nutrient profile of the experimental diets may be attributed to the initial quality of treated feed material. It has been reported that the effect of urea treatment is more pronounced for materials whose initial quality is very poor compared to those with better original quality (Chesnost and Reiniger, 1995); (Yakubu *et al.*, 2007).

Table 3: Proximate Composition of Experimental Diets

Parameters	Graded Levels of Urea				
	T1	T2	T3	T4	T5
Dry matter	93.50	93.03	93.00	93.00	93.00
Crude protein	14.85	15.33	16.05	16.07	18.13
Crude fibre	8.50	8.44	8.45	8.50	9.00
Ether extract	4.50	5.10	5.70	5.72	6.20
Ash	5.92	5.05	5.95	6.40	6.40
NFE	66.23	66.08	63.85	63.34	60.27
ME (Kcal/kg)	3140.77	3326.15	3322.23	3305.42	3311.79

ME = Metabolizable Energy = $37 \times \% \text{CP} + 81 \times \% \text{EE} + 35.5 \times \% \text{NFE}$. Calculated according to the formula of (Pauzenga, 1985). NFE: Nitrogen free extracts

Growth Performance of Weaner Rabbits Fed Graded Level of Untreated and Urea-Treated Cowpea Husks.

Table 4 showed the result obtained from the growth performance of weaner rabbits on diets containing graded levels of untreated and urea-treated cowpea husk. The result revealed that the initial



body weight (539.35g) in T2 - (549.63g) in T1, final body weight (1457.80g in T4 – 1540.00g in T1), DWG T4 (16.32g) - in T1 (17.69g), total feed intake (3805.1 - 4229.9g) from T1-T5 and feed conversion ratio T1 (3.79) – (4.58) in T3 and T4 were statistically similar across the dietary treatments ($P>0.05$). However, no mortality was recorded throughout the experimental period.

The numerical low feed intake (TFI) observed in the treatments 1 and 2 can be attributed to the lower protein levels. However, statistically similar intakes observed in treatments 3, 4 and 5 was as a result of improved protein levels in the diets although higher intake was recorded in T5. This conforms with the report of (Ubua *et al.*, 2018) who stated that feed intake increases with increase protein level in experimental diets and decreases when the diet has low crude protein. Similarly, daily feed intake (DFI) increased with increase in levels of urea across the experimental treatments. The value obtained in the study are above (44.14 - 64.00g) reported by [(Iliya *et al.*, 2006); (Mohammed and Jamala, 2013)] but compared favorably with (63.22 - 70.34g) obtained by (Isiekwen, 2013).

There was no much effect of urea-treated cowpea husk on total weight gain (TWG) and daily weight gain (DWG). The values obtained for DWG falls within the range of (16.07 - 17.86g) reported by (Iliya *et al.*, 2006) and higher than (10.38 - 16.31g) reported by (Oluokun, 2005) who reported similar finding on weaner rabbits fed urea treated fermented cowpea husk. The similarity observed in parameters evaluated for growth in this study is in consonant with the earlier reports by (Cheeke and Amberg 1972); (Lebas and Collins 1973); (Iliya *et al.*, 2006) who stated that weaner rabbits showed no favorable response to low protein diets supplemented with urea. (Lang, 1981) had suggested that rabbits with more developed caecum and lower protein requirements (NRC, 1977) may be more responsive to urea supplementation compared to weanling rabbits

Table 4: Growth Performance of Weaner Rabbits Fed Graded level of Untreated and Urea-Treated Cowpea Husks

Parameters	T1 (0%)	T2 (2.5%)	T3 (3%)	T4 (3.5%)	T4 (4%)	S.E.M
Initial weight (g)	549.63	539.35	548.45	543.63	544.15	37.12 ^{ns}
Final weight (g)	1540.10	1494.50	1477.40	1457.80	1523.50	79.92 ^{ns}
Total weight gain (g)	990.50	955.15	928.93	914.13	979.35	68.19 ^{ns}
Daily weight gain (g)	17.69	17.06	16.59	16.32	17.49	1.22 ^{ns}
Total feed intake (g)	3805.10	3891.60	4122.30	4181.60	4229.90	292.9 ^{ns}
Daily feed intake (g)	67.95	69.49	73.61	74.67	75.54	5.22 ^{ns}
Feed conversion ratio (g)	3.79	4.07	4.58	4.58	4.32	0.36 ^{ns}

NS: Not significant ($P>0.05$)

Nutrient Digestibility of Weaner Rabbits Fed Graded Level of Untreated and Urea-Treated Cowpea Husks.

There was no significant difference ($P>0.05$) among the parameters evaluated for nutrient digestibility in this study which is contrary to the report of (Oluokun, 2005) who reported significant ($P<0.05$) difference in DM, CP, ADF and NDF as rabbits receiving urea-treated cowpea husk performed better than those fed untreated. The result tends to suggest that treating cowpea with urea fertilizer did not have any significant effect on the nutrient digestibility. Decrease in dry matter with increase in crude fibre observed in this study conforms with the findings of (Doma *et al.*, 1997); (Iliya *et al.*, 2006). The CP digestibility found in T4 is lower than the values observed on the other treatments (diets). However, the values obtained in this study were comparable with that of (Iliya *et al.*, 2006).



Table 5: Nutrient Digestibility of Weaner Rabbits Fed Graded Level of Untreated and Urea-Treated Cowpea Husks

Parameters	Graded Levels of Urea					SEM
	T1	T2	T3	T4	T5	
Dry matter (%)	83.26	87.13	77.74	75.59	78.50	1.87 ^{ns}
Crude protein (%)	67.60	64.65	62.14	50.53	54.11	2.44 ^{ns}
Crude Fibre (%)	60.57	58.81	65.63	66.51	71.20	2.98 ^{ns}
Ether extract (%)	60.00	58.2	52.56	52.54	55.65	1.54 ^{ns}
ASH (%)	57.00	49.50	50.38	50.73	58.21	1.56 ^{ns}

NS: Not significant

Economic Benefits of Feeding Weaner Rabbits with Untreated and Urea-Treated Cowpea Husks.

The variation observed in the cost of total feeding rabbits was a result of the differences recorded in total feed intake (3.80, 3.89, 4.12, 4.18, and 4.22kg) and feed cost/kg (162.45, 212.65, 222.75, 232.75, 242.85) in various dietary treatments. The higher weight gain and better feed efficiency are two major possible influences which resulted in cost of producing weaner rabbits fed diets. Many researchers had earlier reported positive economic response as a result of feeding non-conventional feedstuffs to weaner rabbits (Yisa *et al.*, 2009); (Kwari *et al.*, 2011). However, cost of feed/kg weight gain (623.54, 870.74, 997.53, 1069.11, 1056.52) was affected as a result of poor utilization of this feedstuffs which consequently affect the feed efficiency and weight gain of the animals.

Table 6: Economics Benefits of Feeding Weaner Rabbits with Graded Levels of Untreated and Urea-Treated Cowpea Husk

Parameters	Graded Levels of Urea					SEM
	T1	T2	T3	T4	T5	
Total feed intake (kg)	3.80	3.89	4.12	4.18	4.22	0.20
Feed cost/kg (₦)	162.45	212.65	222.75	232.75	242.85	
Cost of feeding (₦/)	617.31	827.20	917.73	972.89	1024.84	4.59
Total weight gain (Kg)	0.99	0.95	0.92	0.91	0.97	0.04
Feed cost/kg gain (₦/kg)	623.54	870.74	997.53	1069.11	1056.52	4.17

CONCLUSION AND RECOMMENDATION

1. The characterization of the crude fibre in the test ingredient revealed that cowpea husk did not interfere with nutrient and chemical absorption by rabbits which resulted to increase in protein contents from proximate composition of untreated and urea treated cowpea husk
2. The result of the performance revealed that feeding untreated and urea-treated cowpea husk produced similar result in terms of growth and digestibility.
3. Finally, rabbits can tolerate up to 4% urea solution in their diets without having any detrimental effect on their health status. However economically, it has been established that T2 (2.5%) gave the minimum least cost per kg gain as compared to others treated with higher levels

Based on the findings of this study, the following steps can be applied;

1. For optimum performance of rabbits, the treatment of cowpea husk with urea solution should not exceed 2.5% graded level



2. The days of bagging should be increase to about 7 days or more to help in further degradation of fibre in the husk
3. Pelletizing of cowpea husk for rabbits is also recommended maximum utilization of the husk

REFERENCES

- Abubakar, B. Y. and Oni, O. O. (2000). Practical breeding and selection methods. In a straining manual on national training workshop on poultry production in Nigeria. NAPRI/SHIKA ZARIA NIGERIA. 1-6 Sept. 2000 Pp 5.
- Adebowale, E. A, and Nakashima, Y. (1992). Rumen degradation of some leguminosae and Graminae roughages: Effect of chemical pretreatment with or without cellulose preparation on dry matter and cell wall disappearance. *Animal Feed Science and Technology*. 38: 219-235.
- Ambaye, T. D. (2009). On-farm evaluation of urea treated rice straw and rice bran supplementation on feed intake, milk yield and composition of forage cows, North Western Ethiopia. MSc. Thesis, Bashir Dar University, Bahir Dar. Pp. 6-10
- AOAC, (2010). Association of Analytical Chemist. Official Methods of Analysis 17th Edition AOAC Ic, Arlington, Virginia, USA.
- Aufule, B. D., Oluokun, J. A., and Olalokun, G. A. (2004). "Cassava leaves in the diet of rabbits" *Nigerian Journal of Animal Production*, Vol. 9, Pp. 30-31
- Belewu, M. A. and Babalola F. T. (2004). Nutrient Enrichment of Some Waste Agricultural Residues after Solid State Fermentation Using *Rhizopus Oligosporus*. *Journal of Applied Bioscience* 13:695-699
- Cheeke, P. R. and Amberg, J. W. (1972). Protein Nutrition of Rabbits. *Nutrition Reports inter*. 5: 259-266
- Chenost, M. and Reiniger, P. (1995). Ed., "Evaluation of straws in ruminant feeding". Elsevier Science Publishers L.T.D., Pp 182.
- Doma, U. D., Adegbola, T. A. and Gagami, V. G. (1997). Effects of crude protein and Forage levels on growth and Nutrient digestibility of Rabbits. *Applied Tropical Agriculture*, 2:36-39.
- Duncan, D. B. (1955). Multiple range and multiple F- test. *Biometrics*. 11:1-42
- Ezra, A., Umar, A., Joseph, I. and Kefas, A. H. (2016). Effects of climate on growth of rice (*Oryza Stiva*) in greater Yola. *Global Journal of Human Social Science*. Geography, Geo-science, environmental science and disaster management. 16 (5): 51-59 print ISSN: 0975-587x.
- FAO, (2012) Food and Agriculture Organisation. Food outlook: global market analysis. Publication of Food and Agriculture Organisation. Trades and Market Division, Rome. <http://www.fao.org/docrep/016/aI993e/aI993e00.pdf>. Accessed 23 May 2020
- Fontenot, J. P., Borard K. P., Otjen R. R., Rumsey T. S. and Priode B. M. (1977). Supplementation of apple pomace with non-protein nitrogen for gestating beef cows. 1. Feed intake and performance. *Journal of Animal Science*. 45(3): 513–522.
- Forsythe, S. J., and Parker, D. S. (1985). Nitrogen metabolism by the microbial floral of the rabbit cecum. *Journal of Applied Bacteriology* 58: 363–369.
- Iliya, D. S., Nafarnda, W. D., Sudi, I. Y., Kalla, D. J. U., Kubkomawa, I. H., Alahira, C. C., and Nesati, Y. I. (2006). Performance and nutrient digestibility of Rabbits fed urea treated cowpea husk. *Journal Animal Production Research Advance* 2 (4): 213-216.
- Isiekwen, J.O. (2013). Performance, Heamatology and serum chemistry of Weaner Rabbits Fed Urea-Treated and Fermented Brewers Dried Grains Groundnut Cake-Based Diets DOI: 10.2478
- Janieri, A. (2003). Nutritional quality of rabbit meat. *Italian R.V. Agriculture*, 24: 275.
- Jayasuriya, M. C. N. and Perera F.A. (1982). Ammonia treatment. In: Sundstol F, Owen E (Eds) *Straws and other by-products as feed*. Academic Press, London. p. 604.
- King, J. O. L. (1971). Urea as a protein supplement for growing rabbits. *British Veterinary Journal* 127: 523–528.
- Kwari, I. D., Igwebuike, J. U., Mohammed, I. D. and Diarra, S. S. (2011). Growth, Haemotology and serum chemistry of Broiler chickens fed raw and differently processed sorrel (*Hibiscus*



- sabdariffa*) seed meal in a Semi-Arid Environment. *International Journal of Science Nature* 2(1):22-27.
- Lang, A. (1981) Hasis [Hashish]. *Morphol Igazsagugyi Orv Sz.* Oct; 21 (4): 309-12. Hungarian
- Lebas, F. and Collin, M. (1973). Effect of Adding Urea to a Low Protein Diet for Growing Rabbits. *Annales de Zootechnie*. 23, 577.
- Makkar, H. P. S. and Singh, B. (1987). Enzymatic profile of rabbit cecum and the rumen. *Journal of Applied Rabbit Research*. 10: 172-174.
- Mohammed, M. and Jamala, G. Y. (2013). Performance and Nutrient Digestibility of Weaner Rabbit Fed Urea Treated Cowpea Husk. *IOSR Journal of Agriculture and Vet Science (IOSR-JAVS)*. E-ISSN: 2329-2372 Volume 5, Issue 2, Pp 34-37.
- NRC (National Research Council). (1977). Nutrient Requirements of Rabbits: Second Revised Edition, (1977). Washington, DC: The National Academies Press. <https://doi.org/10.17226/35>
- Olugosi, O. A., Ogunribido, T., Ayeni A. O. (2021). Effect of biologically upgraded cocoa pod husk meal on growth, serum and antioxidant properties of two rabbit breeds. *Bulletin of the National Research Centre* **45**, Article number: 11
- Oluokun, J.A. 2005. Intake, digestion and nitrogen balance of diets blended with urea treated and untreated cowpea husk by growing rabbit. *African Journal of Biotechnology*, 4 (10): 1203-1208
- Ozung, P. O., Kennedy, O. O., Agiang, E. A., Eburu, P. O., Evan, E. I, Ewas C. E. (2017). Growth performance and apparent digestibility coefficient of weaned rabbits fed diet containing different forms of cocoa pod husk meal. *Agriculture Food Science Research* 4 (1): 8-19
- Pauzenga, U. (1985). Feeding Parent Stock. *Zootech Characteristics of Weanling Rabbits fed Graded Levels. International*, (34) 22-25
- Steel, R. G. D. and Torrie, J. H. (1980). Principles and Procedures of Statistics. A biometrical approach. 2nd Edition. McGraw-Hill, New York USA, Pp 20-90
- Ubua, J. A., Peter, C., Istifanus, E. F., and Inuwa, I. (2018). Growth Performance of Weaner Rabbits (*Oryctolagus cuniculus*) Fed Dietary Levels of Urea Treated Rice Offal. *Journal Animal Production Research* 30 (2):41-47.
- Ubwa, S. T., James, A., Barnabas A. O. and Esther, O. (2014). Studies of urea treated rice milling waste and its application as animal feed. *African Journal of Pure and Applied Chemistry*. Vol. 8 (8). Pp 23-31.
- Van Hao, N. and Ledin I. (2001). Performance of growing goats fed *Gliricidia maculata*, *Small Ruminant Research*. 39: 113–119.
- Yakubu, B., Adegbola T. A., Bogoro, S. and Yusuf, H. B. (2007). Effect of urea treated and untreated rice offal on the performance of broilers: growth performance and economy of production. *Journal of Sustainable Development Agriculture and Environment*. 3:7-13
- Yisa, A. G., Olaiya, O. D., Akanni, K. N and Akinyela, A. (2009). Growth Performance of Cockrel Chicks Feed Graded Levels of Boiled Pigeon Pea (*Cajanus cajan*); *proceeding of 14th Annual Conference of Animal Science Association of Nigeria (ASAN) LAUTECH, Ogbomosho, Nigeria*. Pp. 398 -399.
- Zemba, A. A., Tukur, A. L., and Ezra, A. (2020). Basic Geographic Information on Local Government Area in Adebayo A. A., Tukur A. L. and Zemba A. A (Eds) Adamawa state in Maps (Second Edition). Geography Department in cooperation with *paraclate publishers* Yola (Page 3-17).