*Nigerian J. Anim. Sci. 2020 Vol 22 (3): 199-208 (ISSN:1119-4308)*


# Locally-processed cowpea husk improved body weight gain of on-farm raised rabbits in Northeastern Nigeria

**Isaac Oluseun Adejumo*, Badmus K.A., Maidala A., Makinde O.J., Maina A.D., Mohammed I.C. and Abubakar Bomoi**

*Department of Animal Science, Fedeeral University, Gashua, Nigeria*
**smogisaac@gmail.com*

## Abstract

*Nigeria as an agricultural country generates a large tons of crop residues. Crop residues and by-products could result in environmental burden or pollution if not recycled or consumed by livestock. Efforts are being geared towards harnessing crop residues or by-products into animal feed. An on-farm experiment was conducted to investigate if fermentation and/or enzyme supplementation would improve the growth response of locally-reared rabbits. The weaner rabbits of similar age were sourced locally and were randomly distributed to groups. The animals were fed ad libitum with commercial basal diet but each treatment group was daily supplemented with 20 g of wheat bran, fermented wheat bran, fermented and enzyme-treated wheat bran, fermented wheat bran and fermented and enzyme-treated cowpea husk accordingly in a completely randomized design. Specific contrasts were also performed. Fermented cowpea husk improved (P<0.05) body weight (day 21) and body weight gain of experimental animals compared with the control group. Other treatments were statistically similar to the control group. The fermentation process improved body weight of experimental animals fed wheat bran diets. The fermentation process enhanced feed intake of experimental rabbits fed wheat bran over the animals fed unfermented wheat bran. Enzyme supplementation improved feed intake of the animals fed wheat bran-based diets. The small intestine of rabbits fed control diet showed normal mucosal layer with normal glands without inflammation (slender arrow), the villi appeared normal (white arrow). The small intestinal photomicrographs of rabbits fed fermented wheat bran-based diet showed mild necrosis and glandular degeneration (black arrow), and the circular muscle layer was normal (grey arrow). The photomicrographs of rabbits fed a fermented cowpea husk-based diet showed normal central venules. The study concluded that fermented cowpea husk could boost rabbit production.*

***Keywords:*** *crop residue, nutrition, rabbit, sub-Saharan Africa*

## Description of Problem

Nigeria as an agricultural country generates a large tons of crop residues. Crop residues and by-products could result in environmental burden or pollution if not recycled or consumed by livestock. Efforts are being geared towards harnessing crop residues or by-products into animal feed (1, 2, 3). Rabbit production in Gashua, Northeastern Nigeria is still at the household levels. The agro-pastoral area is one of the poor areas in Northeastern Nigeria, ravaged by the incidence of insurgency and malnutrition. Rabbit production could boost the income of the farmers and could help improve human nutrition in the areas. However, the cost of feeding is an important constraint. Gashua lies at 339 m above sea level and considered to have a desert climate. The average annual temperature is 26.7 °C and rainfall is 404 mm (4). The climate conditions in Gashua could only support the growth of a few crops such as corn, millet, peanut, and cowpea (5).

Kabir *et al* (6) earlier reported that New Zealand White had improved litter size (at birth and weaning) while Chinchilla breed had advantage of individual weight at birth, weaning, milk yield and mothering capacity. The authors however, concluded that cross breeding between Chinchilla and New Zealand White, regarding the use of sire and dam breed to exploit non-additive genetic variance.

However, the present study was mainly designed for finding non-conventional feed ingredient for rabbit in an on-farm situation, in order to reduce cost animal protein production, especially rabbit which is one of the best meat globally (7,8,9).

Rabbits can be fed grain-free diet or forages (10). Studies have been conducted to seek alternative feed ingredients mainly to reduce the cost of production for rabbits. Adedeji *et al.* (11) fed different levels of *Leucaena leucocephala* leaf meal to rabbit to assess its effect on their growth performance and observed that increase in the level of inclusion beyond 10% depressed feed intake, feed conversion efficiency, final body weight as well as the average body weight gain. Koura *et al*. (12) observed that good performance can be obtained for growing rabbit fed diets containing 10% legumes pod shells. The authors further reported that diet with cowpea pod shells showed good performances of rabbits in terms of growth performance (dry matter nutrient and intake, digestibility and body weight gain.

The importance of cowpea shells also include the possibility of being stored during the period of scarcity or off-season. In addition, the use of cowpea husks and other straws, by-products and agriculture wastes could be fed to animals to reduce their cost of production (13, 14) as well as reduce hazards of environmental pollution arising from indiscriminate burning or dumping of such straws, by-products or agricultural wastes. Literature is not informative about the use of processed cowpea husk ((*Vigna unguiculata* L.Walp) on the growth performance of rabbits in Gashua, Northeastern Nigeria. It was therefore hypothesized that replacing wheat bran with indigenously processed cowpea husk could reduce the cost of rabbit production without any adverse effect on growth performance, health and intestinal integrity of rabbits.

## Materials and Methods

The protocol was as approved by Institutional Animal Care and Use Ethics of the Federal University, Gashua, Nigeria in accordance with Animal Care and Welfare Guidelines. An on-farm experiment was conducted to investigate if fermentation and/or enzyme supplementation would improve the growth response of locally-reared rabbits. Thirty cross bred (Chinchilla x New Zealand White) weaner rabbits of similar age (6 weeks old) were sourced locally from two sources and their ages were determined from the farmers' record. They were randomly distributed to groups. Rabbits were housed as a group. There were nine animals per pen with three replicates per treatment. The animals were fed *ad libitum* with commercial basal diet but each treatment group was daily supplemented with 20 g of wheat bran, fermented wheat bran, fermented and enzyme-treated wheat bran, fermented wheat bran and fermented and enzyme-treated cowpea husk accordingly. The flow chart for the traditional fermentation of wheat bran and cowpea husk is shown below:

Wheat bran/cowpea husk

↓

Sorted to remove stones and other dirt

↓

Soaked for 48 hours under air-tight plastic containers

↓

Air-dried under room temperature

↓

Fermented wheat bran/cowpea husk

One hundred grams of the readily available commercial enzyme used in this experiment contained 10 g of *Pueraria tuberose,* 5 g of *Hemidesmus indicus,* 10 g of *Phyllanthus* *niruri*, 10 g of *Aegle mermolos*, 10 g of *Woodfordia fructicosa*, 10 g of *Terminalia chebula*, 15 g of *Andrographis paniculata*, 4 g of *Trachyspermum ammi*, 4 g of *Pimpinella anisum*, 2 g of *Zingiber officinale*, 5 g of *Boerhaavia diffusa*, and 5 g of *Eclipta alba*, fortified with lipase, protease, xylanase and *actobacillus acidophilus*. The experimental layout is:

Diet 1 = wheat bran-based diet
Diet 2 = fermented wheat bran-based diet
Diet 3 = fermented and enzyme-treated wheat bran-based diet
Diet 4 = fermented cowpea husk-based diet
Diet 5= fermented and enzyme-treated cowpea husk-based diet

The body weight gain and feed efficiency were determined from the weekly body weight and feed intake. Rabbits in each group were sacrificed and livers and intestines were excised separately according to the group for histological study. Each liver and intestine according to group was preserved in universal bottles and fixed in 10% buffered formalin solution until they were analyzed for histology. The tissues were observed and cut into small pieces of about 4 mm. The tissues were processed with tissue processor (Leica TP 1020) and dehydrated by passing them through different reagents. The tissues were eventually placed in wax baths. Having sectioned the tissue appropriately, labelled, dried and stained accordingly (15, 16). Blood samples were harvested and taken to the General Hospital, Gashua for laboratory analyses. The blood samples were analyzed for glucose, total protein, albumin ALP, total bilirubin, conjugated bilirubin and creatinine. The design of the experiment was completely randomized. Data were analyzed in a one-way analysis of variance using the general linear model of SAS and specific contrasts. Where significant differences existed, Tukey's test was used to separate the means.

**Results and Discussion**

Fermented cowpea husk significantly improved ($P<0.05$) BW (d21) and BWG of experimental animals compared with the control group (Table 2). Other treatments were statistically similar to the control group. Rabbits on Diets 3 and 4 had improved ($P<0.05$) feed intake compared with the control group. Feed efficiency was significantly higher ($P<0.05$) for the experimental animals on Diet 4. The fermentation process significantly improved BW of experimental animals fed wheat bran diets. However, enzyme treatment did not complement BW in experimental animals fed wheat bran diets. Fermented cowpea husk significantly enhanced BW and BWG of experimental animals compared with fermented and enzyme-treated wheat bran. The addition of enzyme did not significantly improve BW and BWG of cowpea husk-fed animals. The fermentation process enhanced feed intake of experimental rabbits fed wheat bran over the animals fed unfermented wheat bran. Enzyme supplementation significantly improved feed intake of the animals fed wheat bran-based diets. However, enzyme supplementation reduced feed intake of rabbits fed cowpea husk-based diets. Feed efficiency was higher ($P<0.05$) for rabbits fed fermented cowpea husk compared with those fed fermented and enzyme-treated wheat bran. Feed efficiency was significantly better for rabbits fed fermented and enzyme-treated cowpea husk compared with fermented cowpea husk.

No significant difference was observed for glucose, total protein, albumin ALP, total bilirubin and creatinine among the treatments (Table 3). Fermented wheat bran and fermented cowpea husk and fermented and enzyme-treated cowpea husk depressed ($P<0.05$) urea content of the experimental animals. When compared with the control group, fermented and enzyme-treated cowpea husk reduced ($P<0.05$) conjugated bilirubin of the experimental animals.

Figure 1 shows the photomicrographs of livers of weaner rabbits fed processed wheat offal and cowpea husk-based diets. The photomicrograph of the liver from the wheat offal-based diet (control diet) showed normal central venules without congestion (white arrow). The photomicrographs of rabbits fed fermented wheat bran-based diet (b) showed normal central venules without congestion (white arrow) and the sinusoids appeared normal and not infiltrated. The photomicrographs of rabbits fed fermented and enzyme-treated wheat bran-based diet (c) showed mild congestion of the portal vein (white arrow). The photomicrographs of rabbits fed a fermented cowpea husk-based diet (d) showed normal central venules without congestion (white arrow), and the sinusoids appeared normal and not infiltrated. The photomicrographs of rabbits fed fermented and enzyme-treated cowpea husk-based diet (e) showed fatty degeneration, normal central venules without congestion (white arrow), the sinusoids appeared normal and not infiltrated (slender arrow).

The intestinal photomicrographs of rabbits fed wheat offal-based diet (a), fermented wheat bran-based diet (b), fermented and enzyme-treated wheat bran-based diet (c), fermented cowpea husk-based diet (d) and fermented and enzyme-treated cowpea husk-based diet (e) are presented in Figure 2. The small intestine of rabbits fed control diet showed normal mucosal layer with normal glands without inflammation (slender arrow), the villi appeared normal (white arrow). The small intestinal photomicrographs of rabbits fed fermented wheat bran-based diet showed mild necrosis and glandular degeneration (black arrow), and the circular muscle layer was normal (grey arrow). The intestine of rabbits on fermented and enzyme-treated wheat bran-based diet indicated glands with moderate necrosis and degeneration (red arrow), the submucosal layer was moderately infiltrated by inflammatory cells. Rabbits on fermented cowpea husk-based diet revealed the submucosal layer was moderately infiltrated by inflammatory cells (blue arrow) and the circular muscle layer was normal (red arrow). The experimental rabbits on fermented and enzyme-treated cowpea husk-based diet showed a normal mucosal layer with normal glands without inflammation (slender arrow), the villi appeared normal (white arrow), the submucosal layer was moderately infiltrated by inflammatory cells (blue arrow) and the circular muscle layer was normal (red arrow).

Tekle and Gebru (17) reported a higher intake of organic matter, crude protein and acid detergent fibre of cowpea haulms than in groundnut haulm. However, body weight and body weight gain were similar between goats supplemented in both groups but were higher than the control group. Oduguwa *et al*. (18) earlier reported on the cowpea husk fermented with either *Rhodotorula oligosporus* or *Saccharomyces cerevisae.* Adeloye (19) reported that cowpea husk was well received by goats and thus improved their growth performance. Pagrut *et al* (20) also reported that fermented cowpea husk improved final and body weight gain of weaner rabbits, although the fermentation process adopted in the present study is different from the method adopted by Pagrut *et al* (20). However, there seem to be none or little research on the influence of cowpea husk on liver and intestinal histology of weaner rabbits, hence, the present study seems to suffer comparison with prior findings in this regards. It can be said that the serum biochemical results indicated a normal nutritional status for healthy rabbits which agrees with the previous findings of Pagrut *et al* (20).

**Table 1:** Ingredient composition of the experimental diet

| **Ingredients** | **Proportion (g/kg)** |
|---|---|
| Corn | 520.3 |
| Soybean | 210.2 |
| Premix[1] | 2.5 |
| Salt | 5.0 |
| Limestone[2] | 10 |
| Bone meal | 12.5 |
| Wheat offal* | 237.0 |
| Methionine | 2.5 |
| *Analyzed nutrients* | |
| Metabolizable energy | 2600 Kcal/Kg |
| Crude protein (%) | 16.82 |
| Ether extract (%) | 7.56 |
| Crude fibre (%) | 13.01 |
| Calcium (%) | 1 |
| Available phosphorus (%) | 0.4 |

[1]Vitamin-mineral premix was formulated to supply the following at 2.5 grams per kilogram of diet: 11 025 IU of vitamin A; 3528 IU of vitamin D; 33 IU of vitamin E; 0.91 mg of vitamin K; 2.21 mg of thiamin; 7.72 mg of riboflavin; 55 mg of niacin; 18 mg of pantothenate; 5 mg of vitamin B-6; 0.22 mg d-biotin; 1.10 mg of folic acid; 478 mg of choline; 0.03 of vitamin B-12; 75 mg of Zn; 40 mg of Fe; 64 mg of Mn; 10 mg of Cu; 1.85 mg of I; and 0.30 mg of Se

[2]Contained 22% calcium and 18.7% phosphorus

*Diet 1 = wheat bran-based diet; Diet 2 = fermented wheat bran-based diet; Diet 3 = fermented and enzyme-treated wheat bran-based diet; Diet 4 = fermented cowpea husk-based diet; Diet 5= fermented and enzyme-treated cowpea husk-based diet

**Table 2:** Effect of wheat bran-based diets and fermented cowpea husk-based diets on growth performance of rabbits

| Parameters | Treatments | | | | | | | Probability | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Diet 1 | Diet 2 | Diet 3 | Diet 4 | Diet 5 | Pooled SD[1] | Treatment | Diet 1 vs. Diet 2[2] | Diet 2 vs. Diet 3[3] | Diet 3 vs. Diet 4[4] | Diet 4 vs. Diet 5[5] |
| BW (d7), kg | 350.00 | 335.00 | 400.00 | 310.00 | 470.00 | 40.620 | 0.056 | 0.727 | 0.178 | 0.078 | 0.011 |
| BW (d21), kg | 460.00[a] | 610.00[ab] | 550.00[a] | 750.00[b] | 600.00[ab] | 45.607 | 0.012 | 0.022 | 0.245 | 0.007 | 0.022 |
| BWG, kg | 230.00[a] | 225.00[a] | 150.00[a] | 430.00[b] | 215.00[a] | 48.785 | 0.015 | 0.922 | 0.185 | 0.002 | 0.007 |
| Feed intake, kg | 525.00[a] | 630.00[ab] | 740.00[c] | 715.00[bc] | 580.00[a] | 26.458 | 0.002 | 0.011 | 0.009 | 0.388 | 0.004 |
| Feed efficiency, g/kg | 258.34[a] | 335.01[a] | 196.54[a] | 590.58[b] | 223.96[a] | 67.612 | 0.011 | 0.308 | 0.096 | 0.002 | 0.003 |

abc Means with different superscripts within the same rows are significantly different.
Diet 1 = wheat bran -based diet; Diet 2 = fermented wheat bran -based diet; Diet 3 = fermented and enzyme -treated wheat bran-based diet; Diet 4 = fermented cowpea
husk-based diet; Diet 5= fermented and enzyme-treated cowpea husk-based diet
Means with different superscripts within the same column are significantly (P<0.05) different.
1SD = standard deviation
2Contrast between T1 and T2; 3Contrast between T2 and T3; 4Contrast between T3 and T4; 5Contrast between T4 and T5
BW = body weight; BWG = body weight gain

**Table 3:** Effect of wheat bran-based diets and fermented cowpea husk-based diets on biochemistry parameters of rabbits

| Parameters | Treatments | | | | | | Probability | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Diet 1 | Diet 2 | Diet 3 | Diet 4 | Diet 5 | Pooled SD[1] | Treatment | Diet 1 vs. Diet 2[2] | Diet 2 vs. Diet 3[3] | Diet 3 vs. Diet 4[4] | Diet 4 vs. Diet 5[5] |
| Glucose | 1.70 | 2.90 | 1.95 | 2.73 | 3.08 | 0.646 | 0.479 | 0.227 | 0.316 | 0.400 | 0.626 |
| Total protein | 48.25 | 54.00 | 52.50 | 54.25 | 56.50 | 4.006 | 0.423 | 0.211 | 0.723 | 0.681 | 0.599 |
| Albumin | 30.75 | 34.00 | 31.50 | 33.50 | 34.25 | 2.013 | 0.406 | 0.167 | 0.269 | 0.366 | 0.725 |
| ALP | 48.50 | 74.50 | 74.00 | 64.50 | 39.75 | 21.14 | 0.454 | 0.274 | 0.982 | 0.672 | 0.295 |
| Urea | $8.65^{a}$ | $3.33^{b}$ | $8.05^{a}$ | $3.55^{b}$ | $3.75^{b}$ | 0.860 | 0.010 | 0.004 | 0.011 | 0.013 | 0.828 |
| Total bilirubin | 11.65 | 6.08 | 11.80 | 8.40 | 9.90 | 3.082 | 0.477 | 0.145 | 0.204 | 0.419 | 0.652 |
| Conjugated bilirubin | $9.09^{a}$ | $3.10^{ab}$ | $6.05^{ab}$ | $4.05^{ab}$ | $2.75^{b}$ | 1.008 | 0.045 | 0.018 | 0.130 | 0.184 | 0.253 |
| Creatinine | 50.25 | 40.75 | 43.00 | 48.50 | 44.50 | 2.617 | 0.066 | 0.015 | 0.429 | 0.090 | 0.187 |

abc Means with different superscripts within the same rows are significantly different.
Diet 1 = wheat bran-based diet; Diet 2 = fermented wheat bran-based diet; Diet 3 = fermented and enzyme-treated wheat bran-based diet; Diet 4 = fermented cowpea husk-based diet; Diet 5= fermented and enzyme-treated cowpea husk-based diet
Means with different superscripts within the same column are significantly ($P<0.05$) different.
1SD = standard deviation
2Contrast between T1 and T2; 3Contrast between T2 and T3; 4Contrast between T3 and T4; 5Contrast between T4 and T5

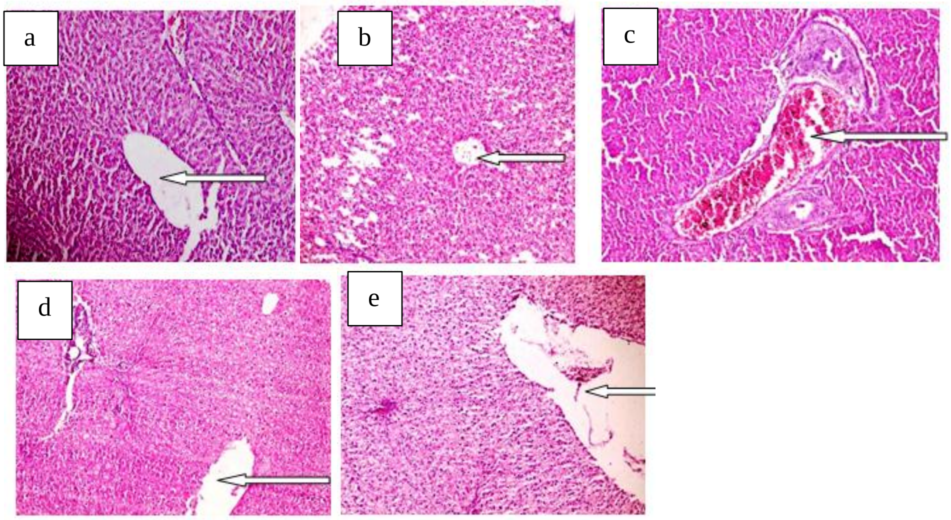


**Figure 1**: Liver photomicrographs of weaner rabbits fed wheat offal-based diet (a), fermented wheat bran-based diet (b), fermented and enzyme-treated wheat bran-based diet (c), fermented cowpea husk-based diet (d) and fermented and enzyme-treated cowpea husk-based diet (e), mg x100

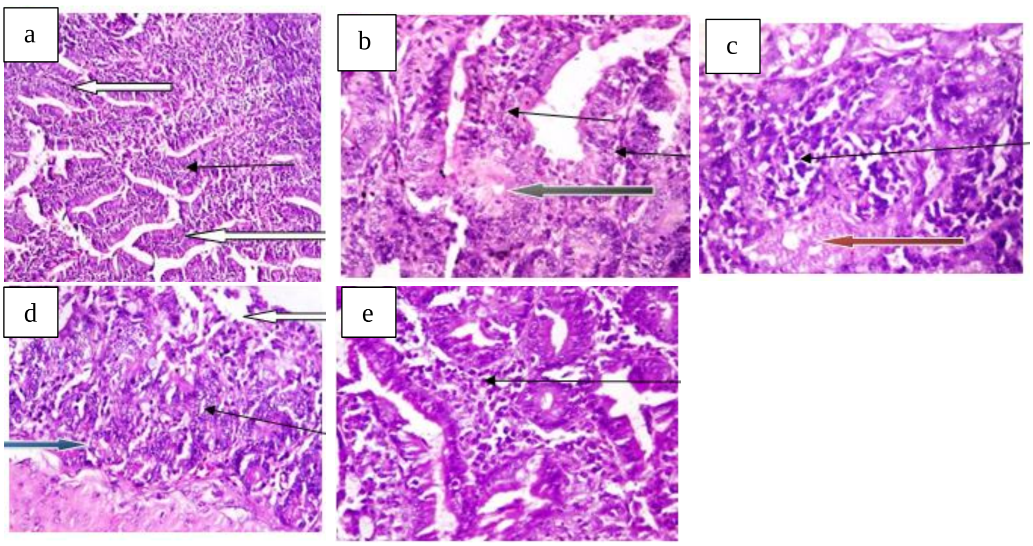


**Figure 2:** Intestinal photomicrographs of weaner rabbits fed wheat offal-based diet (a), fermented wheat bran-based diet (b), fermented and enzyme-treated wheat bran-based diet (c), fermented cowpea husk-based diet (d) and fermented and enzyme-treated cowpea husk-based diet (e), mg x400

**Conclusion and Applications**

1. The serum biochemistry data obtained in the present study suggest that the test ingredient were not deleterious to the experimental animals, having shown a normal nutritional status for healthy rabbits.
2. The liver and intestinal architecture of the experimental animals fed fermented and enzyme-treated cowpea husk was normal.
3. Fermented cowpea husk was well received by the animals, having shown not negative impact on blood chemistry, histology and performance.
4. Fermentation and addition of enzyme improved feed efficiency of the experimental animals.

**Acknowledgement**

The support of Nigeria Institutional-based TEFfund grant towards this study is acknowledged.

**References**

1. Adejumo, I.O., Adetunji, C.O. and Adeyemi, O.S. (2017). Influence of UV light exposure on mineral composition and biomass production of *mycomeat* produced from different agricultural substrates. *Journal of Agricultural Sciences*, 62(1):51-59, DOI: 10.2298/ JAS1701051A
2. Adetunji, C.O. and Adejumo, I.O. (2017). Nutritional assessment of *mycomeat* produced from different agricultural substrates using wild and mutant strains from *Pleurotus sajor-caju* during solid state fermentation. *Animal Feed Science and Technology*, 224:14-19
3. Adetunji, C.O. and Adejumo, I.O. (2018). Potency of agricultural wastes in mushroom (*Pleurotus sajor-caju*) biotechnology for feeding broiler chicks (Arbor acre). *International Journal of Recycling of Organic Waste in Agriculture*, 8:37-49
4. Climate data.org. Visited February 14, 2020, from https://en.climate-data.org/africa/nigeria/yobe/gashua-362873/
5. McKenna, A. Retrieved February 12, 2020, from https:// www. britannica. com/place/Yobe
6. Kabir M., Akpa G.N., Nwagu B.I. and Adeyinka I.A. (2012). Litter traits in a diallel crossing of three rabbit breeds in Northern Guinea Savannah zone of Nigeria. World Rabbit Science Association Proceedings 10$^{th}$ World Rabbit Congress – September 3 - 6, 2012– Sharm El- Sheikh –Egypt, 69- 74
7. Combes S. (2004). Valeur nutritionnelle de la viande de lapin. *INRA Productions Animales*, 17(5):373–383.
8. Hermida M., Gonzalez M., Miranda M., Rodríguez-Otero J.L. (2006). Mineral analysis in rabbit meat from Galicia (NW Spain). *Meat Sc*ience, 73:635–639
9. Nistor E., Bampidis V. A., Păcală N., Pentea M., Tozer J. and Prundeanu H. (2013). Nutrient content of rabbit meat as compared to chicken, beef and pork meat. *Journal of Animal Production Advances*, 3(4):172-176
10. Aduku, A.O. and Olukosi, J.O. (1990). Rabbit Management in the Tropics: Production, Processing, Utilization, Marketing, Economics, Practical training, Research and Future Prospects, Living Book Services, G.U. Publications, Nigeria.
11. Adedeji O.S., Amao S.R., Ameen S.A., Adedeji T.A., and Ayandiran T.A. (2013). Effects of varying levels of *Leucaena Leucocephala* leaf meal diet on the growth performance of weaner rabbit. *Journal of Environmental Issues and Agriculture in Developing Countries*, 5(1):5-9

12. Koura B.I., Houndonougbo F. and Houinato M. (2015). Effect of incorporation of cowpea and soybean pods in diets on feed intake, digestibility and weight gain performances of rabbit. *Sciences de la vie, de la terre et agronomie*, 3(2):32-36
13. Omer H.A.A., Tawila M.A. and Gad Sawsan M. (2012). Feed and water consumptions, digestion coefficients, nitrogen balance and some rumen fluid parameters of Ossimi sheep fed diets containing different sources of roughages. *Life Science Journal*, 9(3):805–816
14. Omer H.A.A. and Badr A.M.M. (2013). Growth performance of New Zealand White rabbits fed diets containing different levels of pea straw. *Life Science Journal*, 2(10):1815–1822
15. Galighor, A.E. and Koziff, E.N. (1976) Essentials of Practical Microtechnique (2nd edn). Lea and Febriger, New York
16. Avwioro, O.G. (2010). Histochemistry and Tissue Pathology, Principle and Techniques. Claverianum Press, Nigeria
17. Tekle, D. and Gebru, G. (2018). The effect of haulms of groundnut and cowpea supplementations on growth performance of Abergelle goats. *Livestock Research for Rural Development*, 30, Article #50. Visited February 14, 2020, from http:// www. lrrd. org/ lrrd30/3/dest30050.html
18. Oduguwa, O.O., Edema, M.O. and Ayeni, A.O. (2008). Physico-chemical and microbiological analyses of fermented corncob, rice bran and cowpea husk for use in composite rabbit feed. *Bioresource Technology*, 99:1816–1820
19. Adeloye, A.A. (1995). The value of cowpea husk to the goat. Bioresource Technology, 52:281-282
20. Pagrut, N., Ganguly, S. and Yadav, P. (2018). Haematology of weaner rabbits fed diets containing culture fermented cowpea husk. *International Journal of Veterinary Sciences and Animal Husbandry*, 3(3):01-03.