ANIMAL PRODUCTION

Journal of Applied Agricultural Research 2022, 10(1): 141-150
ISSN 2006-750X.

TRADITIONAL BREEDING PRACTICES AND TRAIT PREFERENCES OF RABBIT FARMERS IN NASARAWA STATE, NORTH CENTRAL NIGERIA.

Yakubu[1*], L.M. Liman[1,2], O.M. Akinsola[3] and D.S. Bunjah Umar[4]
[1]Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus, P.M.B. 135, Lafia, 950101, Nigeria.
[2]Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria
[3]Department of Theriogenology and Production, University of Jos, Plateau State, Nigeria
[4]Livestock Department, Agricultural Research Council of Nigeria, Nigeria.
[*]Corresponding author's email address: abdulmojyak@gmail.com; abdulkubu@nsuk.edu.ng

ABSTRACT.

The current study was embarked upon to determine the influence of gender on livestock breeding practices and trait preferences of rabbit farmers in Nasarawa State, Nigeria. A total of 120 rabbit keepers were randomly sampled in the three agricultural zones of the State. Primary data were collected through individual semi-structured questionnaire administration. Categorical and continuous variables including breeding traits were statistically tested based on gender (using information from 105 farmers). Educational status ($P<0.01$), primary occupation ($P<0.05$) and access to credit ($P<0.01$) were significantly different between the male and female farmers. Both sexes ranked equally ($P>0.05$) meat consumption, income, fur and pet as the reasons for keeping rabbits. Access to veterinary services was lower ($P<0.05$) among female farmers. However, average birth interval was better in female flocks (84.54±2.42 versus 91.37±1.31) compared to their male counterparts. Body size, body conformation, mothering ability, survivability, heat tolerance, disease resistance, birth interval and coat colour were important breeding traits, which did not differ between gender ($P>0.05$). The present findings could guide interventions aimed at improving rabbit production in the study area.

Keywords: Breeding, traits, rabbit, farmers.

INTRODUCTION.

Animal husbandry combines the art and science of raising animals by blending time-honored practices and modern scientific knowledge onto a system that provides for safe and efficient management and handling of animals. Most of the world's human population is fed on food produced on small farms which have continued to get smaller as the human population pressure increases (Fróna *et al*., 2019; IFAD, 2021). This coupled with mounting pressures on natural resources and climate change (FAO, 2017) has led to the need to search for alternative protein sources that are cheap, readily

available and pose minimal competition to man in their food demand (Akinmutimi, 2007). Based on these facts, rabbits' high prolificacy, fast growth rate, high genetic selection potential, high feed conversion efficiency and economic utilization of space (Hassan *et al*., 2012) make them a viable option. Rabbit breeds are distinctively identified phenotypically by body size, shape and the coat colour (Marai *et al*., 2002; Fontanesi, 2021) including adaptation (Xiao *et al*., 2019).

The advantage of rabbit in Nigeria as a source of animal protein has been identified (Amaefule *et al.,* 2005; Yakubu and Adua, 2010; Momoh *et al*., 2015). Domestic rabbit is raised as a cheap source of meat for reason of its economic values for human consumption and high prolificacy and small body size that make it suitable for backyard rearing and easy consumption by family (Oseni and Lukefahr, 2014). Rabbit could be produced using intensive and renewable resource such as garden, "waste" and by-product of grains. Rabbits are able to thrive on non-conventional feedstuff (Akinmoladun *et al*., 2018; Oloruntola *et al*., 2018).

Despite the importance of rabbits in Nigeria, their productivity is still very low. This may be explained on genetic grounds by the original introduction of small, low-productivity stock; natural selection; and the absence of artificial selection for increased productivity. Therefore, simultaneous genetic improvement for both local adaptation and production-characteristics could be set as the primary goal for rabbit farms. To achieve this, indigenous knowledge of the farmers is imperative; and when such put into consideration the perceptions of both male and female farmers makes the breeding programme more viable. According to Lukefahr and Cheeke (I991), "Increased awareness of the high potential of meat rabbit production in making a positive impact on the lives of the majority of subsistence, limited-resource rural and peri-urban populations has contributed to the recent development of numerous national rabbit programmes. While this trend is encouraging, it is imperative that the rabbit project complements the traditional and/or sociological values of the local population and that it be properly introduced with careful planning and design". In this context, Nicola *et al*. (2015) suggested the integration of gender analysis into research, and follow this through project design which attempts to promote enhanced productivity in livelihoods by focusing on extending, and enhancing, women's role in production. Similarly, breeding practices and breeding objectives of men and women pastoralists for keeping different types of livestock have been reported in Marshall *et al*. (2014); and when such breeding strategies take into account gender, there is probability of achieving better results (Marshall *et al*., 2016).

In Nasarawa State, north central of Nigeria, there is death of information on gender differentiated traditional breeding practices and trait preferences of rabbit farmers for the selection of animals for breeding purpose. The present study aimed at assessing the management practices being embarked upon separately by male and female rabbit producers in Nasarawa State, north central Nigeria. This was to pave way for better comprehension of the prevailing production systems and breeding programmes along gender line, thereby facilitating rational decisions towards increased farm outputs.

MATERIALS AND METHODS.

Description of study area.

The study was carried out in Nasarawa State, north central Nigeria. The State is located within the southern guinea savannah agro-ecological zone and is found between latitudes 7° 52′ N and 8° 56′ N and longitudes 7° 25′ E and 9° 37′ E, respectively. A detailed

description of the zone has been reported in an earlier study (Yakubu *et al*., 2019).

Sampling Procedure.

A total of 120 rabbit keepers were randomly sampled in the study area covering the three Senatorial districts of Nasarawa South (20 males and 20 females), Nasarawa North (20 males and 20 females) and Nasarawa West (20 males and 20 females) using random number generator. Rabbit keepers were selected from the study area based on rabbit production potential and willingness of the farmers to participate in this research. In the conduct of the research, there was be strict adherence to the International Ethical Guidelines for Biomedical Research (CIOMS, 2002) involving Human Subjects and the Global code of conduct for research in resource-poor settings following Convention on Biological Diversity and Declaration of Helsinki.

Data Collection Procedure.

Information was obtained on the socio-economic characteristics of the farmers, ownership of livestock, size and structure of the flock, feeding strategies, health and other routine management practices as well as productivity performance. The rabbit farmers (of both sexes) were asked separately to list the production objectives (reasons for rearing rabbits) and rank them using the following criteria: 1, least important; 2, important; 3, more important and 4, most important. They were also asked to list the selection criteria separately for breeding traits and rank them as follows: Ratings of 1 for less preferred, 2 preferred, 3 more preferred and 4 most preferred. The semi-structured questionnaires were pre-tested on ten (10) rabbit farmers in each location to ensure that the questions were adapted to the prevailing local conditions following the description of Dossa *et al*. (2015) and adopted by Yakubu and Achapu (2017).

Statistical Analysis.

During the period of the analysis, only information from a total of 105 rabbit keepers was available. Within and between gender comparisons of the categorical variables were done using Chi square ($\chi 2$) statistics. Arithmetic means (± S.E.) of the continuous variables between sexes (gender) was subjected to T- Test. Mean ranks were calculated for between-gender comparison of the breeding traits using the Kruskal–Wallis test followed by the Mann–Whitney U test for separation of mean ranks as described by Dossa *et al*. (2015) and Yakubu *et al*. (2019). SPSS (2015) statistical package was employed in all analyses.

RESULTS.

The socio-economic characteristics of farmers keeping rabbits in Nasarawa State are shown in Table 1. Of all the socio-economic parameters, significant differences between males and females were found in educational qualification ($P<0.01$), primary occupation ($P<0.05$), and personal savings ($P<0.01$). Male rabbit keepers appeared to be more literate and also had higher access to financial credit than their female counterparts.

The average flock size was 30.12±1.70 and 27.74±2.70 for male and female rabbit producers, which was not statistically significant ($P>0.05$). Similarly, average number of bucks, does, male growers, female growers, male kits and female kits were not influenced ($P>0.05$) by the gender of farmers (Table 2).

The primary objectives of keeping rabbits did not differ ($P>0.05$) between male and female farmers as shown in Table 3. This is in respect of using rabbits as a source of meat, income, fur and pet.

The Management systems employed in keeping rabbits in Nasarawa State are shown in Table 4. of all the variables, only access to veterinary services was significantly

(P<0.05) influenced by the gender of the farmers. Here, the male farmers had better access than their female counterparts.

The productivity parameters (Mean±S.E.) of rabbits kept in Nasarawa State are shown in Table 5. Average age of doe at first birth, life span, of male kits/doe/year, no of female kits/doe/year and no of kits/birth were not significantly (P>0.05) different. However, gender affected birth interval (days) which was lesser in flocks maintained by female farmers.

Male and female rabbit keepers did not significantly (P>0.05) differ in the ranking of body size, body conformation, mothering ability, survivability, heat tolerance, disease resistance, birth interval and coat colour as choice of breeding stock (Table 6).

DISCUSSION.

Rabbit production is becoming important in Nigeria as an economic undertaking. This may be due to decreasing per capita landholdings as a result of increasing human population density. Understanding gender differences in livestock management and production and reflecting them into livestock project and policies is critical (Distefano and de Haan, 2018). Due to the role of gender relations in poverty alleviation, various reports have reiterated the need for further investigations on the implications of dynamic livestock production system on gender relations among farming communities (Mutsami and Karl, 2020; EFSA AHAW Panel *et al*., 2020; Izquierdo *et al*., 2021). Male farmers were more educated and had access to veterinary services than their female counterparts in the current study. However, it is possible that if more women are well educated, have ability to control mating to some extent with access to veterinary services, they will be able to boost production. It has been reported that men are given more equitable conditions than women (Boogaard *et al*., 2015). The higher access to credit by male rabbit keepers is an indication that they stand in a better position to increase their business capacity which may eventually lead to more production and income. Therefore, there is need for interventions and approaches to facilitate credit for their female counterparts to guarantee sustainable rabbit production. The lower average birth interval in female flocks is also an indication that given every necessary assistance, female rabbit producers could turn things around.

Equal ranking of meat by male and female farmers as a reason for keeping rabbits was observed in the current study. In a related study in Kenya, Mailu *et al*. (2017) reported that rabbit meat consumption was not affected by gender. However, Szendrő *et al*. (2020) found gender difference as regards rabbit meat consumption or its preference. It was established that meat was perceived more negatively by females than by males, which could be attributed to emotions and moral reason.

Stated preference valuation methods have been used to value livestock traits in African continent (Mailu *et al*., 2014; Yakubu and Joshua, 2019; Yakubu *et al*., 2019a and b). These may be exploited in the development of rational and sustainable breeding plans for rabbit production putting into consideration environments and production systems. According to Krupová *et al*. (2020), traits of economic importance can be used for the development of breeding objectives and selection indices for rabbit breeding. The equal preference by male and female rabbit producers for body size, body conformation, mothering ability, survivability, heat tolerance, disease resistance, birth interval and coat colour is an indication of the importance both sexes attached to these productive and adaptive traits. Similar trait preferences have been reported by earlier workers (Oseni *et al*., 2008; Mailafia *et al*., 2010; Mailu *et al*., 2014).

CONCLUSION.

This study revealed that male farmers were more literate, had access to veterinary services and credit facilities compared to the female rabbit producers. However, average birth interval in female flocks was lesser than that of their male counterparts. There was equal preference by male and female rabbit producers for body size, body conformation, mothering ability, survivability, heat tolerance, disease resistance, birth interval and coat colour. It is, therefore, recommended that governments and non-governmental organizations should devise means to boost rabbit production in the study area considering gender peculiarities.

Table 1. Socio-economic characteristics of rabbits' keepers in Nasarawa State.

	Gender			
	Male	**Female**		
Characteristics	**No (%)**	**No (%)**	**Chi-square**	**P-value**
Categorical variables				
Marital Status				
Single	61 (70.9)	25 (29.1)		
Married	13 (68.4)	6 (31.6)		
Widowed	0 (0.0)	0 (0.0)	0.047	0.828^{ns}
Education				
None	5 (29.4)	12 (70.6)		
Primary	9 (69.2)	4 (30.8)		
Secondary	23 (74.2)	8 (25.8)		
Tertiary	37 (84.1)	7 (15.9)	17.913	0.01**
Primary Occupation				
Crop farming	17 (81.0)	4 (19.0)		
Trading	18 (60.0)	12 (40.0)		
Artisan	8 (61.5)	5 (38.5)		
Civil Service	8 (9.0)	10 (32.3)	13.842	0.02*
Others	20 (95.2)	1 (4.8)		
Access to Credit				
No	23 (92.0)	2 (0.0)		
Yes	51 (63.7)	29 (36.3)	7.306	0.01**
Personal savings				
No	47 (74.6)	16 (25.4)		
Yes	27 (64.3)	15 (35.7)	1.289	0.256^{ns}
Type of landholding				
Individual ownership	52 (73.2)	19 (26.8)		
Communal farming system	12 (85.7)	2 (14.3)		
Rent	5 (62.5)	3 (37.5)		
Free occupation	5 (41.7)	7 (58.3)	6.854	0.077^{ns}
Continuous variables				
	Mean	Mean	Standard error	P-value
Age of Respondent	41.22	37.61	1.23	0.183^{ns}
Household size	9.96	7.74	0.86	0.243^{ns}
Farm size (hectares)	0.54	0.48	0.03	0.474^{ns}
Experience in rabbit keeping (years)	3.00	2.58	0.18	0.290^{ns}

*, ** Significant at $P \leq 0.05$ and $P \leq 0.01$, respectively. ^{ns} Not significant

Table 2. Flock structure (Mean±S.E.) of rabbits kept in Nasarawa State

	Gender		
Parameters	Male	Female	P-value
Flock size (head)	30.12±1.70	27.74±2.70	0.452^{ns}
Average no of buck (head)	2.47±0.17	2.06±0.17	0.163^{ns}
Average no of does(head)	4.15±0.29	4.00±0.39	0.774^{ns}
No of Male growers (head)	5.68±0.36	5.97±0.66	0.676^{ns}
No Female growers (head)	5.36±0.36	4.71±0.66	0.353^{ns}
No of male kits	6.61±0.40	5.42±0.70	0.124^{ns}
No of female kits	5.63±0.44	5.52±0.62	0.880^{ns}

S.E. = standard error. ^{ns} Not Significant

Table 3. Mean ranks of reasons for keeping rabbits obtained from Kruskall- Wallis test

	Gender			
	Male	Female		
Traits	Mean rank	Mean rank	Kruskall-Wallis test	Asymptotic significance
Meat	52.36	54.52	0.153	0.696^{ns}
Income	52.29	54.69	0.192	0.661^{ns}
Fur	55.28	47.56	1.607	0.205^{ns}
Pet	54.31	49.87	0.528	0.467^{ns}

Means in rows with similar superscripts are not different (P > 0.05).
The higher the rank mean, the more important the trait.
^{ns}Not significant

Table 4: Management systems of rabbits kept in Nasarawa State

	Gender			
	Male	**Female**		
Characteristics	**No (%)**	**No (%)**	**Chi-square**	**P-value**
Categorical variables				
Source of Foundation Stock				
Inherited	6 (75.0)	2 (25.0)		
Purchase from market	34 (70.8)	14 (29.2)		
Purchase from neighbor	24 (68.6)	11 (31.4)		
Borrowed	8 (72.7)	3 (27.3)		
Others	2 (66.7)	1 (33.3)	0.190	0.996^{ns}
Management system				
Semi-intensive	33 (66.0)	17 (34.0)		
Intensive	41 (74.5)	14 (25.5)	0.919	0.338^{ns}
Commercial feed				
Yes	60 (69.8)	26 (30.2)		
No	14 (73.7)	5 (26.3)	0.115	0.735^{ns}
Breeding Control				
Yes	16 (72.7)	6 (27.3)		
No	58 (69.9)	25 (3.2)	0.068	0.795^{ns}
Provision of nest boxes				
Yes	47 (71.2)	19 (28.8)		
No	27 (69.2)	12 (30.8)	0.046	0.830^{ns}
Access to Vet				
Yes	67 (75.3)	22 (24.7)		
No	7 (43.8)	9 (56.3)	6.480	0.05*
Use of herbs				
Yes	13 (76.5)	4 (23.5)		
No	61 (69.3)	27 (30.7)	0.350	0.554^{ns}
Continuous variable				
	Mean ±S.E.	Mean ±S.E.	T-value	P-value
No of foundation stock	5.26±0.31	4.81±0.50	0.778	0.428^{ns}

* = significant at P<0.05
^{ns} = not significant
S.E.= standard error

Table 5: Productivity indices (Mean±S.E.) of rabbits kept in Nasarawa State

	Gender		
Parameters	Male	Female	P-value
Average age of Doe at first birth (months)	4.47±0.14	4.65±0.20	0.506^{ns}
Average life span (years)	4.81±0.36	4.77±0.47	0.954^{ns}
Average no of male kits/doe/year	22.2±1.20	21.41±1.23	0.665^{ns}
Average no of female kits/doe/year	18.12±1.07	16.65±1.09	0.415^{ns}
Average birth interval (days)	91.37±1.31	84.54±2.42	0.01^{**}
Average no of kits/birth	8.09±0.19	8.64±0.39	0.157^{ns}

S.E. = standard error
** = significant at P<0.01, respectively.

Table 6: Mean ranks of traits preferred in the choice of breeding stock of rabbits obtained from Kruskall-Wallis test

	Gender			
	Male	Female		
Traits	Mean rank	Mean rank	Kruskall-Wallis test	Asymptotic significance
Body size	53.72	51.29	0.190	0.663^{ns}
Body conformation	51.24	57.19	0.978	0.323^{ns}
Mothering ability	54.60	49.18	0.933	0.334^{ns}
Survivability	52.73	53.65	0.024	0.878^{ns}
Heat tolerance	50.73	58.42	1.516	0.218^{ns}
Disease resistance	50.84	58.15	1.343	0.246^{ns}
Birth interval	54.15	50.26	0.402	0.526^{ns}
Coat colour	52.64	53.87	0.039	0.844^{ns}

Means in rows with similar superscripts are not different (P >0.05).
The higher the rank mean, the more important the trait
^{ns}Not significant.

REFERENCES.

Akinmoladun, O.F. Adejoro, V. and Jimoh, A. 2018. Performance and carcass characteristics of rabbits fed diets with total or partial replacement of *Tridax procumbens* by Bamboo (*Bambusa arundinancea*) Leaves. *Journal of Experimental Agriculture International*, 27(1): 1-10.

Akinmutimi, A.H. 2007. Effects of cooking periods on the nutrient composition of velvet beans (mucuna pruscens). *Proceedings of the 32nd Annual conference of the Nigerian Society for Animal Production*, March 18-21, 2007, Calabar Nigeria.

Boogaard, B.K., Waithanji, E., Poole, E.J. and Cadilhon, J-J. 2015. Smallholder goat production and marketing: a gendered baseline study from Inhassoro District Mozambique. *NJAS – Wag. J. Life Sci*., 74–75: 51–63.

CIOMS. 2002. International Ethical Guidelines for Biomedical Research Involving Human Subjects Prepared by the Council for International Organizations of Medical Sciences (CIOMS) in collaboration

with the World Health Organization (WHO), Geneva. 62pp.

Distefano, F. and de Haan, N. 2018. Gender analysis in livestock management and interventions in East Africa. An FAO training Report, 28-30 May, 2018. 43pp.

Dossa, L.H., Sangaré, M., Buerkert, A. and Schlecht, E. 2015. Production objectives and breeding practices of urban goat and sheep keepers in West Africa: regional analysis and implications for the development of supportive breeding programs. *SpringerPlus*, 4: 281. DOI: 10.1186/s40064-015-1075-7

EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare) *et al*. 2020. Scientific Opinion on the health and welfare of rabbits farmed in different production systems. *EFSA Journal*, 18(1):5944. 96 pp. https://doi.org/10.2903/j.efsa.2020.5944

FAO. 2017. The future of food and agriculture – Trends and challenges. Rome. 180pp.

Fontanesi, L. 2021. Rabbit genetic resources can provide several animal models to explain at the genetic level the diversity of morphological and physiological relevant traits. *Appl. Sci.*, 11: 373. https://doi.org/10.3390/app11010373

Fróna, D., Szenderák, J. and Harangi-Rákos, M. 2019. The Challenge of Feeding the World. *Sustainability*, 11, 5816. https://doi.org/10.3390/su11205816

Hassan, H.E., Elamin, K.M., Yousif, I.A., Musa, A.M. and Elkhairey, 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.

IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

IFAD. 2021. Transforming food systems for rural prosperity. International Fund For Agricultural Development (IFAD) Rural Development Report 2021. 316pp.

Izquierdo, A.V., García, J.A.E. and Romero, F.A. 2021. Type and characterization of rabbit farmers in Mexico's central states. *Rev. Mex. Cienc. Pecu*., 12 (2): 469-486. https://doi.org/10.22319/rmcp.v12i2.5811.

Krupová, Z.,Wolfová, M., Krupa, E. and Volek, Z. 2020. Economic values of rabbit traits in different production systems. *Animal*, 14, (9): 1943-1951. https://doi.org/10.1017/S1751731120000683.

Lukefahr, S.D., and P.R. Cheeke. 1991. Rabbit project development strategies in subsistence farming systems. 1. Practical considerations. *World Animal Review*, 68 (3): *60-70*.

Mailafia, S., Onakpa M.M. and Owoleke O.E. 2010. Problems and prospects of rabbit production in Nigeria - A review. *Bayero Journal of Pure and Applied Science*, 3 (2): 20-25.

Mailu S.K., Wanyoike, M., Muhammad, L. and Mwanza, R.N. 2017. The Frequency and Some Correlates of Rabbit Meat Consumption in Kenya. *Tanzania Journal of Agricultural Sciences*, 16 (2): 62-71.

Mailu, S.K., Wanyoike, M., Serem, J.K. and Gachuiri, C.K. 2014. Rabbit (*Oryctolagus cuniculus*) breed characteristics, farmer objectives and preferences in Kenya: A correspondence analysis. *Discourse Journal of Agriculture and Food Sciences*, 2 (4): 118-125.

Marai, I.F.M., Habeeb, A.A.M and Gad, A.E. 2002. Rabbits' productive, reproductive and physiological performance traits as affected by heat stress: A review. *Livestock Production Science*, 78 (2): 71-90.

Marshall, K., Mtimet, N., Wanyoike, F., Ndiwa, N., Ghebremariam, H., Mugunieri, L. and Costagli, R. 2016. Traditional livestock breeding practices of men and women Somali pastoralists: trait preferences and selection of breeding animals. *J. Anim. Breed. Genet*. 133: 534–547.

Marshall, K., Mtimet, N., Wanyoike, F. and Ndiwa N. 2014. The complex and gender differentiated objectives of livestock keeping for Somali pastoralists. In: *Proceedings of the 10th World Congress of Genetics Applied to Livestock Production*. Vancouver (Canada), 17-22, 2014.

Momoh, O.M., Unung, H.U. and Attah, S. (2015). Growth performance of two crossbred rabbit genotypes fed two levels of dietary protein. *East African Agricultural and Forestry Journal*, 81: 51-57.

Mutsami, S. and Karl S. 2020. Commercial rabbit farming and poverty in urban and peri-urban Kenya. *Frontiers in Veterinary Science*, 7: 353. https://www.frontiersin.org/article/10.3389/fvets.2020.00353.

Naff, K.A. and Craig, S. 2012. The Domestic Rabbit, *Oryctolagus Cuniculus*: Origins and History. In: *The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents*. American College of Laboratory Animal Medicine, 2012. Pp. 157-163

Oloruntola, O.D., Ayodele, S.O., Adeyeye, S.A., Ogunsipe, M.H., Daramola, O.T. and Ayedun, E.S. 2018. *The Journal of Basic and Applied Zoology*, 79: 26. https://doi.org/10.1186/s41936-018-0039-1.

Oseni S.O. and Lukefahr, S.D. 2014. Rabbit production in low-input systems in Africa: Situation, Knowledge and Perspectives – A review. *World Rabbit Sci*., 22: 147-160.

Oseni, S.O., Ajay,i B.A., Komolafe, S.O., Siyanbola, O., Ishola, M. and Madamidola, G. 2008. Smallholder Rabbit Production in Southwestern Nigeria: Current Status, Emerging Issues and Ways Forward. *9th World Rabbit Congress* – June 10-13, 2008 – Verona – Italy

Szendrő, K., Szabó-Szentgróti, E. and Szigeti, O. 2020. Consumers' attitude to consumption of rabbit meat in eight countries depending on the production method and its purchase form. *Foods (Basel, Switzerland)*, *9*(5), 654. https://doi.org/10.3390/foods9050654

Xiao, N., Li, H., Shafique, L., Zhao, S., Su, X., Zhang, Y., Cui K., Liu Q. and Shi D. 2019. A Novel Pale-Yellow Coat Color of Rabbits Generated viaMC1R Mutation With CRISPR/Cas9 System. *Frontiers in Genetics*, 10: 875. https://www.frontiersin.org/article/10.3389/fgene.2019.00875

Yakubu, A., Bamidele, O., Hassan, W.A., Ajayi, F.O., Ogundu, U.E., Alabi, O., Sonaiya, E.B., and Adebambo, O.A. 2019. Farmers' choice of genotypes and trait preferences in tropically-adapted chickens in five agro-ecological zones in Nigeria. *Tropical Animal Health and Production*, 52: 95-107. https://doi.org/10.1007/s11250-019-01993-0.

Yakubu, A., Dahloum, L. and Gimba, E.G. 2019. Smallholder cattle farmers' breeding practices and trait preferences in a tropical guinea savanna agro-ecological zone. *Tropical Animal Health and Production*, 51(6): 1497-1506. DOI: 10.1007/s11250-019-01836-y.

Yakubu, A and Joshua, M.K. 2019. Breeding practices and traits of preference for selection of pigs by male and female smallholder farmers in Nigeria. *Tropical and Subtropical Agroecosystems*, 23 (1).

Yakubu, A. and Achapu, M.M. (2017). Assessment of production objective and breeding practices of rural goat keepers and implications for a breeding programme in north central Nigeria. *Nigerian Journal of Animal Production*, 44: 50-61.

Yakubu, A. and Adua, M.M. (2010). Effect of stocking density on growth performance, carcass qualities and cost-benefit of weaned rabbits in the savanna zone of Nigeria. 5 (3): 106-109.

Journal of Applied Agricultural Research 2022, 10(1): 151-159
ISSN 2006-750X.

CARCASS CHARACTERISTICS AND BLOOD PROFILE OF BROILER CHICKENS FED VERYING LEVELS OF DOUM PALM (*Hyphaene thabaica*) PULP MEAL

AbdulSalam Ibrahim [1] and Bah Sani Usman [2]
Department of Agricultural Technology Federal Polytechnic Damaturu, Yobe State [1]
Desert Research Monitoring and Control Centre Yobe State University Damaturu, Yobe State [2]
Department of Animal Science and Range Management Modibbo Adama University of Technology, Adamawa State Nigeria.
Corresponding Author: Email add: saniusmanbah@gmail.com, Tel. 08065499083

ABSTRACT.

The research was carried out to investigate the effects of dietary supplementation of doum palm pulp meal (DPPM) on carcass characteristics and blood profile of broiler chickens. The study was conducted at Modibbo Adama University of Technology, Adamawa State Nigeria. Adamawa state is located within the guinea Savannah zone of Nigeria between latitude 7^0N and 11^0N and longitude 11 and 14^0E. Two hundred (200) unsexed Anack 2000® strain day old chick broilers were randomly allotted in to five dietary treatments and replicated four times (10 birds per replicate) in a completely randomized design (CRD). The birds at starter and finisher phases were fed five different diets containing different levels of doum palm pulp meal at 0, 5, 7.5, 10 and 12.5% in treatments 1, 2, 3, 4, and 5 respectively for seven (7) weeks on deep litter system. The birds were vaccinated strictly based on the vaccination schedule recommended for the North-Eastern Nigeria. A vaccine against Gumboro and Newcastle diseases were administered on first, second and third weeks to maintain them in a good health condition. All vaccines were administered in clean drinking water and proper sanitation was maintained throughout the study period. Feed and water were provided *ad libitum*. Data collected on carcass characteristics, hematology and biochemical indices were subjected to analyses of variance (ANOVA) procedure for CRD and where significant difference exist among the treatment means, Duncan multiple range test was used to separate the means. The results of carcass and internal organs characteristics showed non-significant difference in all the parameters measured except in lungs ($P<0.01$), kidney ($P<0.05$), caecal length ($P<0.001$), caecal weight ($P<0.01$) and small intestine weight ($P<0.05$). No significant ($P>0.05$) difference were observed in all the hematological parameters measured except in MCV ($P<0.01$). It is same in biochemical indices were no-significant difference exist except in total cholesterol ($P<0.001$). Most of the values reported in the study fall within recommended range of poultry heamatology and biochemical indices. Therefore, doum palm pulp meal could be a potential energy source for broiler chickens production and up to 12.5% of DPPM can be included in the diets of broiler chickens without negative effect on carcass characteristics, haematology and biochemical indices.

Key words: Doum palm; Carcass characteristics; Haematology; Biochemistry, Broiler chicken.

INTRODUCTION.

In Africa, feeding livestock particularly poultry has always posed challenges to the farmer. By implication this challenge subsequently leads to high cost of production which by extension leads to high cost of protein from poultry as a result of expensiveness of major conventional feed ingredients Ironkwe and Bamgbose (2012). However, the use of conventional feed ingredients like grains for feeding poultry when human needs have not been met raises questions of economic and moral justification. But, the importance of poultry to the national economy cannot be overemphasized, as it has become popular industry for the small holders that have great contribution to the economy of' the country (Adebayo and Adeola, 2005).

However, in spite of enormous potentials of broiler production in many tropical and sub-tropical countries, its production is affected by scarcity and high cost of conventional feed ingredients Esonu et al., (2001). In view of the above, several plants materials were used in poultry production as non-conventional feeds in order to reduce cost of production; doum palm (*Hyphaene thebaica*) is one of them.

Doum fruit (*Hyphaene thebaica*) is a good source of essential minerals such as potassium, sodium, calcium, magnesium and phosphorous. Furthermore, doum fruit has been shown to provide essential B-complex vitamins, carbohydrate and fibres essential for good nutrition. Doum fruit possess good functional properties which can be used for various important applications in food industry (Waleed *et at.,* 2014). Doum palm ((*Hyphaene thebaica*) is a desert palm native to Egypt, sub-Saharan Africa and West India, it is known in Egypt as the doum or ginger bread palm, while in Nigeria is known as 'Goruba'. It grows to a height of 6 or 9 m and usually has forked of stems with fan shaped leaves, 65 to 75 cm long. It is listed as one of the useful plants of world (Fletcher, 1997). The trunk of the palm is used for construction, and the leaves used to make mats. Covering of the fruit is edible and can either be pounded to form a powder or cut off in slices; the powder is often dried then added to food as a flavouring agent (Orwa *et al.*, 2009).

However, there is little information on how to use doum palm pulp meal as a source of energy in the diets of broiler chickens. Therefore, this study aimed at investigating the effects of dietary supplementation of doum palm pulp meal (DPPM) on carcass characteristics and blood parameters of broiler chickens.

MATERIALS AND METHODS

Study Area.

The research was carried out at the Research and Teaching Farm, Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Nigeria. The location lies within the guinea Savannah zone of Nigeria between latitude 7^0N and 11^0N and longitude 11 and 14^0E it has a tropical climate with distinct wet and dry seasons. The rains commence in April and end in October. It has annual rainfall of 700 to 1600mm and average minimum temperature of 15.2^0C and maximum of 39^0C (Adebayo and Tukur 1997). The dominant features of the rainfall are its seasonal character, its variability from year to year and the intensively of the rainfall, while the dry season lasts from November to March.

Experimental Design and Treatment

The experimental birds were obtained from Agrited Farm Mayo Belwa, Adamawa State, Nigeria at day-old. Two hundred (200) broiler chicks were used. They were raised on

deep litter system. The broiler chickens were divided into 5 treatments: T1, T2, T3, T4, and T5 in a completely randomized design (CRD). Each treatment consisted four of (4) replicates and each replicate contained 10 birds. Allocation was done after one week of brooding. Doum palm pulp meal (DPPM) was included as a source of energy at 0%, 5%, 7.5%, 10% and 12.5% levels to replace maize T1, T2, T3, T4 and T5 respectively.

Formulation of Experimental Diets.

Tables 1 and 2 contained the composition of the experimental broiler diets at the starter and finisher phases respectively. The experimental diets were formulated using maize, wheat offal, Soya bean meal, doum palm pulp, fish meal, bone meal, limestone, lysine, methionine, salt, palm oil and premix. The protein and energy (ME) values are within recommended range by NRC, 2014 for broiler starter and finisher diets of 23 – 24% and 12 and 20 % protein and 2800 – 3000Kcal/kg and 3200 – 33000 kcal/kg (ME) respectively.

Table 1: Composition of the Experimental Starter Diets.

	Levels of doum palm pulp meal				
Ingredients (%)	T1 (0%)	T2 (5%)	T3 (7.5%)	T 4(10%)	T5 (12.5%)
Maize	52.50	46.50	43.00	40.00	37.00
Soya bean meal	10.00	10.00	10.00	10.00	10.00
Groundnut cake	18.00	19.00	20.00	20.50	20.50
Doumpalm pulp	0.00	5.00	7.50	10.00	12.50
Wheat offal	5.70	5.70	5.70	5.70	5.70
Palm oil	3.00	3.00	3.00	3.00	3.00
Fish meal	7.00	7.00	7.00	7.00	7.00
Limestone	0.75	0.75	0.75	0.75	0.75
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.30	0.30	0.30	0.30	0.35
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude protein	23.00	23.00	23.00	23.00	23.00
Crude fibre	4.10	4.77	5.11	4.81	5.43
Calcium	1.29	1.29	1.29	1.29	1.29
Phosphorus	0.34	0.34	0.34	0.34	0.34
Lysine	1.00	1.00	1.00	1.00	1.00
Methionine	0.86	0.86	0.86	0.86	0.86
ME (Kcal/kg)	3120.33	3053.54	2948.10	2987.29	2940.70

Vit./Minerals premix each contains; Vitamin A500iu Vitamin D_3, 888000iu Vitamin E, 12,000mg, Vitamin k_3, 15,000mg, Vitamin B_1, 1000mg, Vitamin B6, 1500mg, Niacin, 12000mg, Pantorthenic acid, 2000mg, Biotin, Vitamin B_{12}, 300mg, Folic acid, 1500mg, Choline Chloride, 60,000mg Manganese, 10,000mg, Iron 1500mg, Zinc, 800mg, Copper 400mg, Iodine, 80mg, Cobalt 40mg, Selenium, 8000mg.

Table 2: Composition of the Experimental Broiler Finisher Diets.

	Levels of doum palm pulp meal				
Ingredients (%)	T1 (0%)	T2 (5%)	T3 (7.5%)	T4 (10%)	T5 (12.5%)
Maize	52.50	46.50	43.00	40.00	37.00
Soya bean meal	10.00	10.00	10.00	10.00	10.00
Groundnut cake	18.00	19.00	20.00	20.50	20.50
Doum palm pulp	0.00	5.00	7.50	10.00	12.50
Wheat offal	12.20	12.20	12.20	12.20	12.20
Palm oil	3.50	3.50	3.50	3.50	4.00
Limestone	0.75	0.75	0.75	0.75	0.75
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.35	0.35	0.35	0.35	0.35
Premix	0.20	0.20	0.20	0.20	0.20
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude protein	20.00	20.00	20.00	20.00	20.00
Crude fibre	4.28	4.98	5.27	5.59	5.93
Calcium	1.29	1.29	1.29	1.29	1.29
Phosphorus	0.34	0.34	0.34	0.34	0.34
Lysine	1.00	1.00	1.00	1.00	1.00
Methionine	0.75	0.75	0.75	0.75	0.75
ME (Kcal/kg)	3040.20	2973.41	2940.46	2907.16	2900.60

Vit./Minerals premix each contains; Vitamin A500iu Vitamin D_3, 888000iu Vitamin E, 12,000mg, Vitamin k_3, 15,000mg, Vitamin B_1, 1000mg, Vitamin B_6, 1500mg, Niacin, 12000mg, Pantorthenic acid, 2000mg, Biotin, Vitamin B_{12}, 300mg, Folic acid, 1500mg, Choline Chloride, 60,000mg Manganese, 10,000mg, Iron 1500mg, Zinc, 800mg, Copper 400mg, Iodine, 80mg, Cobalt 40mg, Selenium, 8000mg.

Management of Experimental Birds.

A total of two hundred (200) unsexed strains of Agrited one day old broiler chicks were purchased from agrited farm hatchery mayo belwa, Adamawa State Nigeria. Before arrival of the chicks, the room was thoroughly swept, washed with detergent and then disinfected with Izal so as to eliminate disease-causing organisms present that may be a source of infection to the chicks. After three days of drying the room, wood shavings was spread on the cemented floor to a depth of about six centimeters (6 cm) to serve as an insulator and also absorb moisture, from droppings. All brooding equipment were cleaned, washed and disinfected. Blue-flamed heating kerosene stoves were used as a source of heat. Flat trays and plastic drinkers were provided in each replicate for the chicks in the brooding room. On arrival, chicks were given water containing anti-stress to relieve them of transit stress. All necessary brooding management practices were duly observed.

The birds were vaccinated strictly based on the vaccination programmed recommended for the North-East Zone. At the first week of age, they were starved of drinking water over night before vaccination, which enable them drink water containing the vaccine. A vaccine against Gumboro and Newcastle Disease were administered on first, second and third week to maintain them in a good health. All vaccines were administered in clean drinking

water and proper sanitation was maintained throughout the study period.

Data Collection.

During the study, data were collected on, Carcass yield, internal organ characteristics (expressed as a percentage of live weight), haematological and serum biochemical indices.

Statistical Analysis.

Data that were collected in respect of carcass characteristics and haematological indices these was subjected to analysis of variance (ANOVA) procedure for CRD as described by Steel and Torries (1980). Where significance difference was found among the treatment means, Duncan multiple range test (DMRT) was used to separate the means (Duncan, 1955).

Results and Discussion.

The proximate composition of doum palm pulp meal was presented in Table 3. The results of the analysis showed that; doum palm pulp meal contained high amount of metaboliserble energy (ME) of 2254.5Kcal/kg and less crude protein (2.92%). This showed that doum palm is good source of energy and can be used for partial replacement of maize in compounding poultry feed.

The carcass characteristic of the broiler fed the various levels of the doum palm pump meal is presented in Table 4. The effect of graded levels of doum palm pulp meal on carcass yield and internal organs showed no significant ($P>0.05$) difference among the treatment groups with regards to live weight, plucked weight and eviscerated weight. The result agrees with the report of Kwado et al., (2014) who observed no significant difference ($P>0.05$) in parameters tested such as live weight. However, the dressing percentage reported in the present study (table 4) was in line with the report of (Olajide, 2012) who reported dressing percentage of (71.05%). Dressing percentage observed in the current study (table 4) was higher than (61.25 to 68.81%) reported by Emmanuel et al., (2014). The result in the present study on live weight, plucked weight, eviscerated weight and dressing percentage were not significant ($P>0.05$) which disagreed with the result of (Olajide, 2012) who reported significant effect ($P<0.05$) by dietary treatments. The highest eviscerated weight (72.91%) reported by (Olajide, 2012) is less than the result in the present study. Similarly the dressed weight of 54.78 % reported also by (Olajide, 2012) is less than the report in the current study of (76.35%) which was recorded as the highest value.

There was a significant difference ($P<0.05$) among the treatment diets with regards to the some internal organs (lungs, kidney, caecal length, caecal weight and small intestinal weight) in this study (table 4) which is in accordance with the study of (Olajide, 2012) who reported that some organs (kidney, liver and gizzard were significantly ($P<0.05$) affected by dietary treatment. The result in the present study agree with the report of Kwado et al., (2014) who reported that Parkia pulp had a little or no negative effect on these parameters and organs parts. The report of Emmanuel et al., (2014) showed that, there were no significant differences ($P>0.05$) in organ weights such as heart, gizzard and intestine length across dietary treatments indicating that there were no abnormalities or pathological lesions in these organs. This report also agrees with the result in the present study which also indicated no abnormality in the organs as a result of feeding the graded levels of doum palm pulp meal to broiler chickens. The result in the present study on abdominal fat also showed no significant ($P>0.05$) difference among all the treatments.

Haematology and biochemical indices of broiler chickens fed doum palm pulp meal are presented in Table 5. The effects of graded levels of doum palm pulp meal on haematological indices of broiler chickens showed no significant (P>0.05) effect among all the parameters except in means corpuscular volume (MCV) where significant (P<0.01) effect was observed. The result in the present study is similar to the report of Agbabiaka et al., (2013) who reported no significant (P>0.05) effect among the blood parameters recorded except in red blood cell. Kwado et al., (2014) reported that the haematological parameters in their study did not show any significant difference (P>0.05) except for the red blood cells; this is also similar to the result in the current study. The packed cell volume (PCV) which fell within the normal range (22.0 – 35.0 %) in broiler chickens as cited by Aeangwanich et al., (2004) is in accordance with the result in the present study which recorded PCV values of 30.68 – 34.08 %. According to Papadoyannus et al., (1997) a reduction in the concentration of PCV in the blood is an indicative of the presence of a toxic factor which has deleterious effect on blood formation. This shows that doum palm pulp meal has no deleterious effect on the PCV of broiler chickens even at inclusion level of 12.5%. The values for hemoglobin recorded ranged between 9.99 - 11.08 mmol/L in which the values affirmed the assertion made by Chukulu et al., (2013) of the Hb inhibitory property of tiger nut. This result is in accordance with the result in the present study.

The Biochemical indices (table 5) showed no significant (P>0.05) difference among the treatment groups in the protein, albumin, globulin and urea levels except in cholesterol. The significant difference (P<0.05) in cholesterol levels across the treatments which is decreasing with addition of doum palm is in contrast with the report of (Olajide, 2012) who indicated that decrease in cholesterol level across the dietary treatments is an indication that doum palm may have cholesterol reducing ability. Low level of total protein in this study is an indication of some alteration in protein metabolism since serum protein and albumin synthesis are related to the amount of protein in the diets (Esonu *et al.,* 2001). However total protein did not show significant different across the dietary treatments but was lower than the standard value of 30.31 to 39.95 mg/dl reported by Mitruka and Rawnsley (1977). The result in the present study is in accordance with the report of Olajide (2012) who reported no significant (P>0.05) difference across the various dietary treatments in total protein, albumin, globulin and glucose.

CONCLUSION.

From the result obtained in this study, it is evident that doum palm pulp meal (DPPM) possessed good dietary energy quality for optimal growth of broiler chickens. Thus, doum palm pulp meal could be included up to 12.5% in the diets of broiler chickens without negative effect on carcass characteristics, internal organ components and blood parameters of broiler chickens. Further studies could be conducted by including doum palm pulp meal beyond 12.5% level of inclusion which will ultimately reduce the cost of feed in broiler production.

Table 3: Proximate composition of test material (Doum palm pulp meal)

Component	Composition (%)
Moisture	10.42
Fat	0.49
Calcium	0.15
Protein	2.92
Ash	7.37
Crude fiber	15.14
ME(Kcal/kg)	2254.5

ME=Metabolizable energy

Table 4: Carcass characteristics and internal organ parameters of broiler chicken fed DPPM

	Level of doum palm pulp meal in the diets					
Parameter	1(0%)	2 (5%)	3 (7.5%)	4(10%)	5 (12.5%)	SEM
Live weight (g)	1750.0	1780.0	1867.0	1702.5	1850.0	113.4^{NS}
Plucked weight (g)	1517.0	1682.5	1707.5	1582.5	1672.5	97.98^{NS}
Eviscerated weight (g)	1305.0	1432.5	1435.0	1422.5	1382.5	90.76^{NS}
Carcass weight (g)	1220.0	1320.0	130.0	1300	1270.0	85.76^{NS}
Dressing %	69.71	74.16	69.89	76.35	68.65	2.01^{NS}
Body components as % live weight						
Head	3.50	3.25	3.00	3.00	2.75	0.46^{NS}
Legs	4.00	4.25	4.75	4.50	4.25	0.23^{NS}
Liver	1.75	1.75	2.00	2.00	2.00	0.16^{NS}
Lungs	0.37^{b}	0.63^{ab}	0.46^{b}	0.93^{a}	0.88^{a}	0.11**
Kidney	0.25^{bc}	0.38^{ab}	0.24^{c}	0.19^{c}	0.39^{a}	0.04*
Gizzard	2.25	2.50	2.75	3.00	2.50	0.24^{NS}
Heart	0.49	0.52	0.48	0.45	0.37	0.04^{NS}
Pancreas	0.24	0.24	0.24	0.72	0.27	0.03^{NS}
Caecal length cm	19.25^{b}	15.50^{c}	19.50^{b}	30.75^{a}	19.25^{b}	1.17***
Caecal weight (g)	0.69^{bc}	0.49^{d}	0.55^{c}	0.73^{b}	0.97^{a}	0.08**
Small intestine weight (g)	3.43^{a}	2.87^{b}	2.85^{b}	0.19^{c}	0.39^{a}	0.04*
Small intestine length (cm)	196.5	178.75	204.75	185.25	188.75	9.83^{NS}
Large intestine length (cm)	13.00	10.25	12.75	10.50	11.00	1.11^{NS}
Large intestine weight (g)	0.37	0.29	0.46	0.30	036	0.06^{NS}
Abdominal fat%	1.64	1.50	1.07	2.39	1.99	0.41^{NS}
Spleen%	0.13	0.14	0.12	0.22	0.13	0.03^{NS}

Abc-means on the same row with different superscript are significantly different (P<0.05)*, (P>0.01)**.,(P<0.001)***, NS=Non-significant, SEM=Standard error of mean.

Table 5: Haematological and serum biochemical indices of broiler chickens fed (DPPM)

	Level of doum palm pulp meal in the diets					
Parameters	1(0%)	2(5%)	3(7.5%)	4(10%)	5(12.5%)	SEM
PCV (%)	32.80	33.83	30.68	34.08	32.15	1.41^{NS}
Hb (mmol/L)	8.55	9.13	8.65	8.98	8.55	0.54^{NS}
RBC (10^{12}/L)	1.97	2.13	1.91	2.17	2.05	0.08^{NS}
WBC (10^{9}/L)	24.58	23.57	22.75	24.47	23.16	6.10^{NS}
Plateletes (10^{9}/L)	19.00	17.75	20.75	16.50	15.75	3.56^{NS}
MCHC (mmol/L)	25.90	26.75	27.60	26.43	26.20	0.83^{NS}
MCH (pg)	43.20	42.55	47.63	41.35	41.20	1.85^{NS}
MCV (fl)	166.65^{a}	158.85^{b}	167.18^{a}	156.93^{b}	157.23^{b}	2.33^{**}
Serum Biochemical indices						
Total cholesterol	2.45^{bc}	3.73^{a}	3.43^{ab}	1.83^{cd}	1.35^{d}	0.24***
Total protein (g/L)	24.13	24.93	23.20	24.95	22.85	2.01^{NS}
Albumen (g/L)	14.13	13.65	12.60	13.55	14.60	0.81^{NS}
Globulin (g/L)	9.35	11.28	12.03	11.40	13.70	1.18^{NS}
Urea (mmol/L)	7.60	8.88	7.28	8.73	5.80	1.01^{NS}
Creatinine (mmol/L)	96.05	96.42	83.55	105.77	82.60	6.72^{NS}
Glucose (mmol/L)	6.90	6.20	4.78	6.70	5.73	1.22^{NS}

Abcd-means on the same row with different superscript are significantly different
(P<0.05)*,(P>0.01)**.,(P<0.001)** ,SEM=Standard error of means, NS=Not significant, PCV=Packed cell volume, RBC=Red blood cell, HB=Haemoglobin concentration,WBC=White blood cell, MCHC=Means corpuscular haemoglobin concentration, MCV=Means corpuscular volume

REFERENCES.

Adebayo, A. A. and Tukur (1997). Adamawa State in Maps. Paraclete Publishers, Yola, Nigeria Pp.112

Adebayo, O.O. and Adeola, R.G. (2005). Socio-economic Factors Affecting Poultry Farmers in Ejigbo Local Government Area of Osun State. *Journal Human Ecology* 18: *39-41.*

Aduku, A.O. (1992). Practical Livestock Feeds Production in the Tropics. Asekome and Co. Publishers, Samaru –Zaria, pp. 44-49.

Aeangwanich W, Simarakas S and Chinrasri O, (2004). Hematological Erythrocytes and Serum biochemical Value of the Thaii Indigenous Chicken (*Gallus domesticus*) In North-Eastern Thailand. *Songkalanakarian Journal of Science and Technology*, 26(3): 425-430.

Agbabiaka, L.A Machubuike, F.N Ekeyem U and Esonu B, O. (2013). Effect of Tiger nut Based diets on heaematoloy and serum biochemistry of Broiler Finisher. *Agriculture and Biology Journal of North America, 4(3): (86-191)*

Chukulu, M.O, Ibiam OFA and Okoi A, (2013). Studies on the Fungi and Physiochemical and proximate composition of dry and fresh tiger nuts (*Cyperus escuslentus*). *International Research Journal of Biotechnology, (ISN: 2141-5153) Vol. 4(1) PP. 11-14.*

Emmanuel, A Ibe, John, O. Makide, Sanson O.O, Samuel D, Sola E. B, and Isaac S. (2014).Growth Performance and Carcass Characteristics of Broiler Fed Two Varieties each of Guinea Corn and Millet as

Replacement for Dietary Maize. *Journal of life science, and Medical Research 2014, 3(2):46*

Esonu, B.O., Emenelom, O.O., Udedibbie, Anyanwu, A.B., Herbert, U.,Ekpor, C.F., Okoli, I.C and Iheukwumere F.C (2001). Performance and blood chemistry of weaner pigs fed raw mucuna (Velvet bean) meal. *Tropical Animal Production investigation, 4:49-54.*

Esonu, B.O., Emenelom, O.O., Udedibbie, Anyanwu, A.B., Herbert, U.,Ekpor, C.F., Okoli, I.C and Iheukwumere F.C (2001). Performance and blood chemistry of weaner pigs fed raw mucuna (Velvet bean) meal. *Tropical Animal Production investigation, 4:49-54.*

Fletcher, R. (1997). Listing of useful plants of the world. Australian New crops http://www.newcrops.uq.edu.au/listining/hyphaene *thebaica Retrieved 2016.*
Ironkwe, M.O. and Bamgbose, A.M. (2012). Effect of Replacing Maize with Brewer's Dreid Grain in Broiler Finisher Diets. Bulleting of Environment, Pharmacology and Life Sciences 1 (6) PP 17 – 18.

Kwadwo, O., Atuahene C.C, Attonkotoku,Y. and Adjei M.B. (2014). The Growth performace, carcass and haematological characterestics of broiler chickens fed alkaline-treated tiger nut (cyperus esculentus) residue meal. *Journal of animal Science Advances, 14(10):1068-1081*

Mitruka, B.N, and Rawnsley, H.N. (1997). Clinical Biochemical and Haematological reference value in normal experimental animals Masson New York.

NRC (1994). Nutrient Requirements for Poultry Vii, Revised Edition.National Research Council. National Academic press. Washington D.C. U.S.A. .Pp3-5.

Olajide, R. (2012) Growth Performance, Carcass, Haematology and Serum Anti-nutritional of Broilers as Affected by Contents of Anti-Nutritional Factors in Soaked Wild Cocoyam (*Coloxasia esculanta* (L) Schott) Corn- based Diets. *Asian Journal of Animal Sciences, 6:23-32.*

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A. (2009). "Agroforestry database: a tree reference and selection guide version 4.0" Url:http://www.Worldagroforestry .org/af/treedb/ Retrieved 2016

Papadoyannis, I. N., Tsioni, G. K., and Samanidou, V. F. (1997). Simultaneous determination of water and fat soluble vitamins after SPE separation and RP-HPLC analysis in pharmaceutical preparations and biological fluids. *Journal of Liquid Chromatography & Related Technologies, 20 (19), 3203-3231.*

Steel, R.G.D. and Torrie, J.H. (1980). *Principles and procedures of statistics. A biometrical approach,* second edition. McGraw Hill Books Co. New York. U.S.A

Waleed, A., Zangh L., Mohammed, D., Mohammed, Abubakar M., Elshareif, O. and Malik, T. (2014). Physiochemical, Nutrition and functional properties of the Epicarp, Flesh and Pited sample of Doum palm fruit (*Hyphaene thebaica*). *Journal of Food and Nutrition Research* 24: 180-186.

Journal of Applied Agricultural Research 2022, 10(1): 160-168
ISSN 2006-750X.

CATTLE TEMPERAMENT: AN APPROACH TO REDUCED FARMERS- HERDERS CONFLICT

[1]Sunday, H. L., [1]Adedibu, I.I, [2]Iyiola-Tunji, A. O. [3]Egberuare, A. T.
Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
[1,] Animal Science Department, Ahmadu Bello University, Zaria
[2]National Agricultural Extension Research and Liaisons Services (NAERLS), Zaira
[3]Livestock Department, Agricultural Research Council of Nigeria (ARCN), Mabushi, Abuja.
*Corresponding editor: sundaylot5@gmail.com +2347038501030

ABSTRACT.

The study was carried out to assess the knowledge and perception of cattle handlers in relation to temperament traits of *Bunaji* cattle in Kajuru, Giwa and Sabon Gari Local Government Areas of Kaduna State, Nigeria. A multi-stage sampling technique was employed for the study using structured questionnaire in a standardized paper and pencil procedure for collection of primary data. The total sample size was 101 from the population of 696 cattle handlers. The analytical tools were Descriptive Statistics (Frequency distribution, Percentage and Likert scale). The socio-economic characteristics showed that about 47% (majority) of the respondents were pastoralists, 23% were animal scientist and veterinary doctors, 15% were cattle traders, and 13.5% were village cattle keepers. Fewer (11.50%) females were involved in handling. Majority of the handlers were literate (56%), and been involved in rearing of *Bunaji* for more than ten (10) years (57%) period and on a herd size of above 50 cattle. About 60% mostly pastoralists and village cattle rearers have had contact only on temporary facilities like ropes and curds. The perception by majority of handlers revealed that *Bunaji* cattle are moderately temperamental (32.29%), while others viewed it to be calm (27.08%), nervous (25%), and very nervous (13.5%). Handlers of *Bunaji* cattle identified bulls and cows were more temperamental than the calves. The respondents also believed that temperament can be selected against. The study concludes that nervous cows are very reactive and difficult to control or managed. It thus recommends that the production of cattle that are gentle to human, easy to manage should be encouraged by cattle owners; rearing cattle in a smaller herd-size of less than 50 during grazing could increase productivity, handling safety and reduced farmers- herders' crises over limited resources. The study also recommends an empirical study to ascertain the views of the cattle handlers on Bunaji cattle temperament for further research.

Key words: *Bunaji*, Temperament trait, Handling, workability.

INTRODUCTION.

Cattle temperament also known as personality or disposition is the individual behavioural and physiological differences in response to an environmental challenge that is consistent over time (Louise and Hanne, 2015). Cattle generally because of their size, strength and potential for high speed has given rise to growing interest in temperament traits study by dairy and beef producers over the years as human- cattle contact cannot be

avoided (Adedibu and Musa, 2017). It is no doubt that the agricultural sector is the single largest employer of labour forces accounting for 42.4 percent and contributing to 36.69% of Kaduna State GDP (KASS, 2017) and mainly from Crops (33.67%), Livestock (2.65%), Fisheries (0.24%) and Forestry (0.11%). Cattle farming are the third largest livestock sub-sector accounting for 13.3% after poultry and goats with 31.2% and 28.5% respectively (KASS, 2017). Despite its economic value the high demand for grazing resource areas resulting from high population density, and increased crop farming had consequentially resulted to and un-resolved farmers-herders conflict in recent time in Nigeria as a whole. The worse of it is when the animals are very sensitive or reactive (poor temperament) in response to husbandry and handlings and especially those of the *Bos indicus* breed such as Bunaji cattle and their crosses (Handling cattle- NSW, 2017). The Bunaji cattle breed also known as the White Fulani cattle is the most populous cattle breed in Nigeria with over 89% of its total population concentrated in the Northern part of the country (Kubkomawa, 2017). In view of this the study was conducted in a bid to provide an alternative to reduced farmers-herders conflict through adequate sensitization policy.

The specific objectives were to assess: the socio-economic characteristics of the cattle handlers in the study areas; test the knowledge of cattle handlers to temperament traits of Bunaji cattle; and perception of cattle handlers to temperament trait of Bunaji cattle.

METHODOLOGY.

Study Area Description

The survey was carried out in Kajuru, Giwa and Sabon-Gari Local Government Areas of Kaduna State respectively. The global location of the State lies between longitude 30^0 East of the Greenwich Meridian and Latitude $9^0 11^0$, 30^1 North of the equator. The State which comprises of 23 Local Government Areas occupied an area of 48,473.2Km^2 has an estimated population of 8,252,400 as at March 21, 2016 (Census, 2006). The State shares common borders with Zamfara, Katsina, Niger, Kano, Bauchi, Plateau and Abuja States. The area belongs to the northern Guinea savannah zone based on vegetation classification. The state extends from Tropical grass land (Guinea Savannah) to the Sudan Savannah. The grass land is a vast region covering the southern part of the State about Latitude 11^0 00᾽ North of the equator. Kaduna State is marked by two seasons; the dry windy season and the wet or rainy season. The wet season is usually from April through October with great variations as one move northwards. The prevailing vegetation of tall grasses and big trees are of economic importance during both the rainy and dry seasons (Kaduna State Government, 2008) makes the area conducive for cattle production.

Method of Data Collection.

Both primary and secondary data were used in this study. Primary data were obtained through survey method by administering structured questionnaires to handlers with formal education while personal interview method was used to administer questionnaire to handlers without formal education. The secondary data were collected from relevant literatures. The questionnaires were developed by providing questions that led to answering the research questions in the form of data which when analysed enables the researcher to proffer solution based on the specific objective.

Sampling Procedure, Analytical Tools and Techniques.

A multi stage sampling technique was employed for this study. In the first stage, Kaduna State (a northern State) was purposively selected for its vital position in cattle production as the larger numbers of cattle are found in the northern part of Nigeria (Tawa and Rege, 1996; Kubkomawa, 2017). In the second stage, Kajuru, Giwa and Sabon-Gari Local Government Areas (L.G.A) were randomly selected (with replacement) from the 23 Local Government Areas that made up the State. In the third stage, four villages (Table 1) were purposively selected from each local government area based on their high involvement in Bunaji cattle handling. The estimated population of 40, 989.006 (3.1%) families were into livestock farming in the State; of which 13.8% (5,656.48) families were into cattle production (Kaduna State Agricultural Structure Survey, 2017). The proportion of the three L.G.A of the State which constituted a total of 12.30% (696) farming families who were into cattle production: Kajuru- 4.00% (227), Giwa- 4.60% (260) and Sabon-Gari- 3.70% (209) respectively.

The total of 101 questionnaires constituting 14.50% of its total cattle handlers were randomly administered to respondents of 12 villages in the three LGAs of the State (Table 1). The questionnaires were administered to respondents whose purpose of handling include beef and/or milk production, health, research, trading and draught in individual households, village major markets, veterinary clinics, abattoirs and farms.

All primary data obtained were coded and analysed using IBM SPSS statistics (Version 25) predictive analysis software at 5% level of significance. The objectives were analysed using simple descriptive statistics such as frequency, means, percentage as well as Likert scale.

Table 1: Distribution of Cattle Handlers in the three Local Government Areas of Kaduna State by the Kaduna State Agricultural Structure Survey (2016).

S/no	Local government areas (LGA)	Farm families involved in cattle production	14.50 % of cattle handlers by their LGA	Villages surveyed per LGA	Number of question-naires issued	Number of questionnaires retrieved
1	Kajuru	227	33	Kamshi-Iburu,	9	9 (9.38)
				Kasuwan-Magani	8	8 (8.33)
				Kufana	8	8 (8.33)
				Doka	8	8 (8.33)
2	Giwa	260	38	Shika,	9	9 (9.38)
				Guga,	9	8 (8.33)
				Biye	9	9 (9.38)
				Tsibiri (Janbaba)	10	10 (10.42)
3	Sabon- Gari	209	30	Zango,	8	8 (8.33)
				Bomo	7	3 (3.13)
				Milgoma-Tsakiya	7	7 (7.29)
				Samaru	8	8 (8.33)
	Total	696	101	12	101	96 (100)

Values in parenthesis represent percentages (%), Farm families involvement in cattle production (Kaduna State Agricultural Structure Survey, 2016)

RESULTS AND DISCUSSION.

Socio-Economic background of the respondents.

The socio-economic characteristics of the respondents used in this study are presented in Table 2. The results of the analysis showed that about 47% (majority) of the respondents were pastoralists, 23% were Animal Scientist and Veterinary doctors, 15% were cattle traders, and 13.5% were village cattle rearers. The high number of pastoralist agrees with Tawa and Rege, 1996 that most cattle are in the hands of pastoralist. Fewer (11.50%) females were involved in handling especially in situation were capable men were not available. The high involvement of male gender means that male predominates in cattle handling within the study areas. The predominance could be attached to cattle size, strength, speed and potential for aggression which requires a thoughtful and confident handling (Handling cattle-NSW, 2017). Majority (56%) were learned whereas those who have not had the opportunity of obtaining a formal education were mostly herders (39.58%). The poor involvement of pastoralist (herders) in formal learning places them at the extreme end of which better understanding of cattle temperament and other issues of life among them could be difficult despite their high level of handling experience (over 10 years) as majority (57%) of the handlers grow with the hobby from childhood (as expressed by the respondents).

Thirty three percent (33%) of the respondents mainly veterinary doctors and herders who worked on research farms and some herders have had contact with Bunaji cattle on a large herd size above fifty (50), about 30% mostly herders have had contact on a herd size between eleven to fifty (11-50). Smaller herd sizes were easy to control and manage whereas handlers on large herd size do so because of accessibility to ranching (as expressed by the respondents). The 12.5% of the respondents without herd were mainly those who worked in the abattoirs, these include animal scientist, veterinary doctors and cattle traders. About twenty percent (19. 79 %) that have a herd size of less than six were majorly village cattle owners who purposely use Bunaji bulls for draught and beef.

The majority (60%) of handlers have had contact only on temporary facilities like ropes and curds these are mostly pastoralists and village cattle owners. Twenty eight percent (28%) of those respondents that have had contact with Bunaji cattle on both permanent handling facilities like chute, weighing crate, crush, forcing pen, dispersal pens, race, and automated milking machine, and on temporary facilities were mostly animal scientist, veterinary doctors and cattle traders.

Test of knowledge to temperament trait of Bunaji cattle by handlers.

Table 3 shows the distribution of respondents based on the test of their knowledge to temperament traits of Bunaji cattle. The result revealed that the perceived temperament of Bunaji cattle varied among their handlers. Majority of the respondents (56.25%) have at one time culled out highly temperamental cattle as over 51% of the respondents' perceived offspring of the cows seems to exhibits the same character with their parents. This agrees with the report of Grandin (2015) that cattle keepers have been indirectly selecting cattle by breeding only cattle which are calm when in contact with humans by culling the highly temperamental animals (Maffei *et al*., 2018) which may have safety implications (Grandin, 1993; Breuer, *et al*. 2000; Haskell, *et al*. 2014). It was also observed that most aggressions on the farm are caused by bulls and cows (65%) and the high (46.88%) incidence of aggression

occurs when the Buanji cattle are to be restrained for routine management operations other than for aggression associated with resource based. This is in agreement with handling cattle- NSW (2017)*;* especially when carrying out health related activities ((Turner *et al.*, 2013; Adedibu and Musa, 2017).

Table 2: Socio- Economic Background of Bunaji Cattle Handlers.

	Parameter	Anim. Scientist	Vet. Doctors	Cattle Traders	Pasto-ralist	Village rearers	Total	(%)
a	**Local Government**							
	Kajuru	0.00	0.00	0.00	29 (30.20)	4 (4.17)	33	34.38
	Giwa	6 (6.25)	6 (6.25)	7 (7.29)	9 (9.37)	9 (9.37)	37	38.54
	Sabon Gari	7 (7.29)	3 (3.12)	8 (8.33)	8 (8.33)	0.00	26	27.08
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**100.00**
b.	**Sex**							
	Male	11(11.45)	8 (8.33)	14 (14.58)	41 (42.70)	11 (11.45)	85	88.58
	Female	2 (2.08)	1 (1.04)	1 (1.04)	5 (5.21)	2 (2.08)	11	11.46
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
c	**Age (years):**							
	1 - 10.	0.00	0.00	0.00	3 (3.13)	0.00	3	3.13
	11-20.	0.00	0.00	0.00	4 (4.17)	0.00	4	4.17
	21-30.	8 (8.33)	9 (9.37)	6 (6.25)	16 (16.67)	5 (5.21)	44	45.83
	> 30	5 (5.21)	0.00	9 (9.38)	23 (23.96)	8 (8.33)	45	46.88
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
d	**Academic qualification**							
	Non formal	0.00	0.00	3 (3.13)	38 (39.58)	1 (1.04)	42	43.75
	Primary	0.00	0.00	3 (3.13)	4 (4.17)	3 (3.13)	10	10.42
	Secondary	0.00	0.00	3 (3.125)	3 (3.125)	**6 (6.25)**	12	12.50
	Tertiary	13(13.54)	9 (9.37)	6 (6.25)	1 (1.04)	3 (3.12)	32	33.33
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
e.	**Experience (years)**							
	< 1	1 (1.04)	0.00	1 (1.04)	1 (1.04)	3 (3.13)	6	6.25
	1—5.	4 (4.17)	8 (8.33)	2 (2.08)	2 92.08)	4 (4.17)	20	20.83
	6 –10.	5 (5.21)	1(1.04)	4 (4.17)	3 (3.13)	2 (2.08)	15	15.63
	➢ 10	3 (3.12)	0.00	8 (8.33)	40 (41.67)	4 (4.17)	55	57.29
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
f	**Herd size**							
	Nil	3 (3.12)	4 (4.17)	4 (4.17)	1 (1.04)	0.00	12	12.50
	1—5	1 (1.04)	0.00	5 (5.21)	0.00	13 (13.54)	19	19.79
	6—10	1 (1.04)	0.00	1(1.04)	2 (2.08)	0.00	4	4.17
	11—50	4 (4.17)	0.00	4 (4.17)	21 (21.88)	0.00	29	30.21
	51-100.	0.00	1 (1.04)	1 (1.04)	13 (13.49)	0.00	15	15.63
	➢ 100	4 (4.17)	4 (4.17)	0.00	9 (9.38)	0.00	17	17.71
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
g	**Handling facilities**							
	Permanent	1 (1.04)	4 (4.17)	4 (4.17)	0.00	2 (2.08)	11	(11.46)
	Temporary	3 (3.13)	0.00	0.00	42 (43.75)	13 (13.54)	58	(60.42)
	Both	9 (9.38)	5 (5.21)	11 (11.46)	2 (2.08)	0.00	27	(28.13)
	Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**

Values in parenthesis ( ) stands for values in percentages

Table 3: Test of Knowledge and Perception of Handlers to Temperament Traits in Bunaji Cattle

Parameter	Anim. Scientist	Vet. Doctors	Cattle Traders	Pasto-ralist	Crop farmers	Total	(%)
Temperament perception							
Very calm	0.00	0.00	0.00	**1 (**1.04)	0.00	**1**	1.04
Calm	1 (1.04)	0.00	2 (2.08)	18 (18.75)	5 (5.21)	**26**	27.08
Moderate	7 (7.29)	5 (5.20)	6 (6.25)	9 (9.37)	4 (4.17)	**31**	32.29
Nervous	5 (5.21)	4 (4.17)	2 (2.08)	11 (11.46)	2 (2.08)	**24**	25.00
Very nervous	0.00	0.00	4 (4.17)	7 (7.29)	2 (2.08)	**13**	13.54
no response	0.00	0.00	1 (1.04)	0.00	0.00	**1**	1.04
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13(13.54)**	**96**	**(100.00)**
Is temperament Heritable?							
Yes	12 (12.50)	9 (9.37)	9 (9.37))	16 (16.67)	3 (3.12)	49	51.04
No	0.00	0.00	2 (2.08)	10 (10.41)	2 (2.08)	**14**	14.58
don't know	1 (1.04)	0.00	4 (4.17)	20 (20.84)	8 (8.33)	**33**	34.38
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Do you select Bunaji based on temperament?							
Yes	9 (9.38)	4 (4.17)	7 (7.29)	26 (27.08)	8 (8.33)	54	56.25
No	3 (3.13)	5 (5.21)	6 (6.25)	18 (18.75)	2 (2.08)	34	35.42
No response	1 (1.04)	0.00	2 (2.08)	2 (2.08)	3 (3.33)	8	8.33
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Most reactive temperamental class of cattle							
Bulls > Cows > Calves	5 (5.21)	7 (7.29)	9 (9.38)	18 (18.74)	8 (8.33)	47	48.96
Cows > Bulls > Calves	5 (5.21)	1 (1.04)	4 (4.17)	15 (15.62)	0.00	25	26.04
Cows > Calves > Bulls	1 (1.04)	0.00	0.00	3 (3.33)	0.00	4	4.17
Calves > Bulls > Cows	1 (1.04)	1 (1.04)	0.00	8 (8.33)	3 (3.33)	13	13.54
Don't know	1 (1.04)	0.00	2 (2.08)	2 (2.08)	2 (2.08)	7	7.29
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Activity that cause cattle arousal							
Loading/weighing/ear-ta./dr	1 (1.04)	0.00	8 (8.33)	0.00	2 (2.08)	11	11.46
Dehorning/castration./foot tr.	1 (1.04)	2 (2.08)	3 (3.33)	1 (1.04)	4 (4.17)	11	11.46
Pregnancy examination	1 (1.04)	0.00	0.00	0.00	0.00	1	1.04
Parasites control	1 (1.04)	0.00	0.00	34 (35.42)	1 (1.04)	36	37.50
Vaccination/medication/dos	3 (3.33)	2 (2.08)	4 (4.17)	8 (8.33)	6 (6.25)	23	23.96
Udder cleaning/ milking	2 (2.08)	0.00	0.00	3 (3.33)	0.00	5	5.21
All of the above	4 (4.17)	5 (5.21)	0.00	0.00	0.00	9	9.38
Total	**13 (13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**
Places of cattle aggression							
On handling facilities	4 (4.17)	5 (5.21)	9 (9.38)	24 (25.00)	3 (3.33)	45	46.88
On the field at grazing	6 (6.25)	3 (3.33)	3 (3.33)	15 (15.63)	2 (2.08)	29	30.21
In pens or yards	3 (3.33)	1 (1.04)	3 (3.33)	7 (7.29)	8 (8.33)	22	22.92
Total	**13(13.54)**	**9 (9.38)**	**15 (15.63)**	**46 (47.92)**	**13 (13.54)**	**96**	**(100.00)**

Values in parenthesis ( ) stands for values in percentages, tr: trimming, dos: dosing, >: greater than.

Table 4: Perception of Handlers to Temperament Traits in Bunaji Cattle (N= 96).

		Perceived temperament score							
S/No.	**Parameter**	**1**	**2**	**3**	**4**	**5**	**Mean**	**Min.**	**Max.**
1.	**Category of handlers**								
	Animal Scientists	0	0	7	6	0	3.46	3	4
	Veterinary Doctors	0	0	5	4	0	3.44	3	4
	Cattle Traders	0	2	6	2	5	3.67	2	5
	Pastoralist (herders)	1	18	9	9	9	3.15	1	5
	Village cattle rearers	0	5	1	5	2	3.31	2	5
	Total	1	25	28	26	16	3.32	1	5
2.	**Sex of respondents**								
	Male	1	25	23	23	13	3.26	1	5
	Female	0	0	5	3	3	3.82	3	5
	Total	1	25	28	26	16	3.32	1	5
3.	**Age of respondents (years)**								
	1 - 10.	0	0	3	0	0	3.00	3	3
	11-20.	1	1	2	0	0	2.25	1	3
	21-30.	0	18	13	10	4	3.00	2	5
	30 years and above	0	6	10	16	12	3.77	1	5
	Total	1	25	28	26	16	3.32	1	5
4.	**Educational level**								
	Non-formal	1	17	0	1	6	2.76	1	5
	Primary	0	3	10	9	5	3.59	2	5
	Secondary	0	3	3	5	1	3.33	2	5
	Tertiary	0	2	15	11	4	3.53	2	5
	Total	1	25	28	26	16	3.32	1	5
5.	**Purpose of handling**								
	Beef production	0	2	8	3	4	3.53	2	5
	Milk production	1	18	11	12	6	3.08	1	5
	Farming (draught)	0	5	0	7	3	3.53	2	5
	Meat and milk trading	0	0	0	1	3	4.75	4	5
	Health	0	0	8	3	0	3.27	3	4
	Prestige	0	0	1	0	0	3.00	3	3
	Total	1	25	28	26	16	3.32	1	5
6.	**Handling experience (years)**								
	Less than 1	0	0	2	2	3	4.14	3	5
	1—5.	0	2	8	9	0	3.37	2	4
	6 –10.	1	2	9	3	0	2.93	1	4
	Above 10	0	21	9	12	13	3.31	2	5
	Total	1	25	28	26	16	3.32	1	5
7.	**Herd size**								
	None	0	2	2	0	0	2.50	2	3
	1—10	0	0	0	1	0	4.00	4	4
	11—50	1	6	20	19	15	3.67	1	5
	51-100	0	8	1	5	1	2.93	2	5
	Over 100	0	9	5	1	0	2.47	2	4
	Total	1	25	28	26	16	3.32	1	5
8.	**Type of handling facility**								
	Permanent	0	7	9	2	3	3.05	2	5
	Temporary	1	17	11	13	3	3.00	1	5
	Both	0	1	8	11	10	4.00	2	5
	Total	1	25	28	26	16	3.32	1	5

N: number of observation, 1: Very calm (non- reactive), 2: Calm (slight- reactive), 3: Moderately- calm, 4: Reactive (nervous/ aggressive), 5: Very reactive (nervous or aggressive), SE: standard error, Min. minimum, Max.: maximum.

Perception of Handlers to Temperament Traits in Bunaji Cattle.

The temperament of Bunaji cattle as perceived by its handlers is described on Table 4. The result showed that the temperament trait of *Bunaji* cattle varied among their handlers. The minimum, maximum and overall mean scores of 1, 5 and 3.32 shows that Bunaji cattle were generally perceived to be moderately-reactive by its handlers. The general perception suggested how the animals' sensitivity is viewed when it is to be approached, driven, weighed and treated for injury,

transported and other routine activities like milking (Haskell *et al.,* 2014). The respondent opinions in regard to ability to predict the animal's response could have differed by their knowledge of cattle handling, the animal and the facilities used in handling (Handling cattle-NSW, 2017) as the opinion showed that most handlers: pastoralists and village cattle rearers; of male gender; of ages below thirty (30) years; with no formal education; for milk, prestige and health related purposes; with larger herd size of over 50 animals; and handlers that used temporary handling facilities like stick and ropes and curd score the animal below the mean. The implication is that the animals are calm, easy to approached managed and control in a large herd and carry out several routine activities like milking and health related activities.

This agrees with Grandin (2015) that pastoralist have over time been selecting for cattle that are gentle towards human. However selection for cattle on resource based aggression should be encouraged as it is the major cause of conflict between farmers and herders in Nigeria. Sunday (2021) unpublished thesis recommended that cattle that exit chute at a speed above 3.0 meters per seconds should be treated with caution as they could be dangerous, difficult to control and possibly stir up other animals in the heard.

CONCLUSION AND RECOMMENDATION.

In concluding, the perception of Bunaji cattle temperament varied by the handlers. The study thus recommends that in the era of insufficient grazing lands or ranches, very reactive cattle should be kept on a smaller herd size of less than 50 with more number of herdsmen; an improvement in the knowledge of cattle temperament could improve handler's safety, animal welfare, and economic efficiency.

REFERENCES.

Adedibu, I. I. and Musa, S. (2017). Evaluation of temperament and morphometric traits in White Fulani and Simmental X Sokoto Gudali Cattle. *Nigerian Journal of Animal Science*, 2: 1-7.

Breuer, K., Hemsworth, P. H., Barnett, J. L., Matthews, L. R. and Coleman, G. J. (2000). Behavioural response to humans and the productivity of commercial dairy cows. *Applied Animal Behavior Science,* 66: 273–288. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10700627.

Census, (2006). List of Nigerian States by Population. Retrieved from https://en.m,wikipedia.org/wiki / list_of_Nigerian_States_by population.

Friedrich, J., Brand, B., Schwerin, M. and Archivfuer, T. **(**2015**).** Genetics of cattle temperament and its impact on livestock production and breeding: a review, *Archive Animal Breeding*, 58:13-21

Grandin, T. (2015). Assessment of temperament in cattle and its effect on weight gain and meat quality and other recent research on hair whorls, coat color, bone thickness, and fertility. Department of Animal Sciences, Colorado State University.

Grandin, T. (1993). Behavioral agitation is persistent over time. *Applied Animal Behaviour Science.* 36: 1 – 9.

Handling Cattle (2017). *Department of Primary Industries, Roy Hurst. NSW Government.* Retrieved from https://www.dpi.nsw.gov.au/animals-and-livestock/beef-cattle/husbandry/general-management /handling-cattle

Haskell, M. J., Simm, G., and Turner, S. P. (2014). Genetic selection for temperament raits in dairy and beef cattle. *Frontiers Genetics*, 5:368. doi: 10.3389/fgene.2014.00368.

IBM Corp. (2017): IBM SPSS Statistics for Windows, Version 25, Amonk, NY: IBM Corp. (Computer software).

Kaduna State Agricultural Structure Survey (2017). Retrieved from https://kdbs.ng/app/uploads/2018/02/KASS-STRUCTURE-SURVEY.pdf

Kubkomawa, H. I. (2017). Indigenous Breeds of cattle, their Productivity, economic and cultural values in Sub-Saharan Africa: A Review. *International Journal of Research Studies in Agricultural Sciences (IJRSAS.)* 3 (1): 27-43. doi.org/10.20431/24546224.0301004.

Louise, H., and Hanne, L. (2015). Personality and production: Nervous cows produce less milk. *Journal of Dairy Science*, (98), 9, 5819-5828. http://dx. doi.org/10.3168/jds.2014-8667.

Maffei, W. E., Bergmann, J. A. G. Pinotti, M., Lima neto. and H. R., (2018). Reactivity in a mobile cage- a new methodology to evaluate bovine temperament. CAB Reviews Perspectives in Agriculture Veterinary Science Nutrition and Natural Resources. Retrieved from https://www.researchgate.net/publication/323703475_Reactivity_in_a_Mobile_cage_a_new_methodology_to_evaluate

Turner, S. P., Jack, M. C. and Lawrence, A. B. (2013). Pre-calving temperament and maternal defensiveness are independent traits but pre calving fear may impact calf growth. *Journal of Animal Science*, 91: 4417–4425. https://doi.org/10.2527/jas.2012-5707.

Tawah, C. L. and Rege, J. E. O. (1996). White Fulani cattle of west and central Africa. *Animal Genetic Resources Information Bulletin.* 17:137–158. http://dx.doi.org/10.1017/s101423390000064x.

Journal of Applied Agricultural Research 2022, 10(1): 169-179
ISSN 2006-750X.

EFFECTS OF DIETARY TYPES ON FEED INTAKE AND NITROGEN UTILIZATION IN WEST AFRICAN DWARF GOATS

Daniel Akpofure INWEH [1]. Ikhatua U. J [2]. Bamikole M. A [3]
[1] Corresponding Author - Department of Animal Science, University of Benin, Benin City, Edo State, Nigeria
[2] Department of Animal Science, Faculty of Agriculture, University of Benin.
[3] Department of Animal Science, Faculty of Agriculture, University of Benin.
. Email: iwedan@yahoo.com. Phone no. 08025112153; 08063914827

ABSTRACT.

This study was undertaken to determine the feed intake and nitrogen utilization pattern of composite diets comprising of varied proportions of rumen waste (RW), poultry waste (PW) and cassava peels (CP) fed to West African Dwarf goats. Four experimental diets were formulated, Diet 1 (control diet), diet 2, 3 and 4 contained the wastes in three different combinations of 5 %, 15 %, and 25 %. The goats were given a basal diet of concentrate containing Brewer's dried grain (BDG); vitamin/mineral salts mixtures and *Panicum maximum.* A feeding trial and digestibility study was conducted using sixteen (16) West African Dwarf (WAD) goats in a completely randomized design (CRD). Feed intake, feed digestibility, and nitrogen utilization were determined. "Chemical composition of the experimental diets" was also analyzed. Results of chemical composition of the diets showed no significant ($P > 0.05$) variation in nutritional composition except diet 3, which had greater ($P < 0.05$) value of crude protein (21.00 %) and neutral detergent fibre (61.00 %). Also, diets 2 and 3 had the least ($P < 0.05$) metabolizable energy of 3.91 and 5.65 MJ/Kg DM respectively. Results showed significantly ($P < 0.05$) low nutrient intakes for composite diets 2, 3 and 4 compared to the control (diet 1). Nitrogen utilization showed a positive nitrogen balance for goats on diet 1 (2.63 g/day) and 4 (0.32 g/day) and diet 2 and 3 had a negative nitrogen balance of -14.19 g/day and -13.27 g/day respectively. An indication that nitrogen in diets 2 and 3 were poorly utilized by the goats, while nitrogen in diets 1 (control) and diet 4 (25 % RW, 5 % PW and 15 % CP) were better utilized by the WAD goats during the feeding trial. This study concludes that a moderate amount of poultry waste will enhance feed intake and a positive nitrogen balance in West African dwarf goats fed these composite diets. Higher levels as in diets 2 and 3 could lead to ammonia toxicity, and consequently poor acceptability, reduced nutrient intake of diets.

Keywords: waste, feed intake; nitrogen balance.

INTRODUCTION.

The use of Agricultural Waste has gained relevance over the years in developing nations of the world (Sabiti, 2011). Their use gained considerable increase due to the high cost of conventional feeding stuffs (Akinmutimi, 2003). Efforts are therefore geared towards minimizing the cost of finished animal products via alternative

feedstuffs for livestock production (Adeloye, 1994). The acceptability and nutritive value of these waste is a major concern.

Ruminant nutritionists have been considering the role of ruminant animals in meeting the growing demand for animal protein. Ruminants are able to convert feed materials of poor nutritional value to meat, milk and energy (Gutierrez, 1985). This is made possible by the activity of rumen microbes, which are capable of producing protein from simple nitrogenous compounds. Fermentation by bacteria and protozoa in the rumen requires nitrogen to synthesize amino acids and proteins which later become available to the host animal.

Nitrogen is a component of essential nutrients and it is critically important for animal growth and productivity. Ruminants however, are relatively inefficient utilizers of nitrogen in feeds. However, non-protein nitrogen (NPN) in the form of poultry waste based on its relatively affordable value to local farmers and it is not utilizable by human, has been given immense attention (Belewu, 1997). It use serves as a means of minimizing production cost and maximizing profit, thereby contributing to self-sufficiency in protein, phosphorus and other expensive nutrients in ruminant rations.

However, in the ruminant, nitrogen metabolism cannot be considered separately from carbohydrate digestion. This balance of nitrogen and carbohydrate can influence nitrogen utilization, carbohydrate utilization, and feed intake (Odigie *et al*., 2005). Hence, a need for cheap, relatively available source of fermentable carbohydrate such as cassava peels. (Oni *et al*., 2017)

Poultry waste has been fed adequately in the diets of West African Dwarf (WAD) goats without any depression in rate and efficiency of feed utilization (Ukanwoko and Ibeawuchi, 2009). It is necessary to provide a readily fermentable carbohydrate as an energy source in the form of cassava peel, which has been a household waste-product traditionally offered to sheep and goats in southern Nigeria (Adegbola *et al*., 1990).

Also, the critical need for fibre or roughage for efficient ruminal activity is of relevance. Rumen waste is rich in fibre, about 25% (Efrem Gebrehawariat, 2016) and varies in crude protein content. Amoo (1990) gave the crude protein of Rumen waste as 13.5%, Okorogbona (1994) reported a crude protein of 13.19%, Dairo *et al.* (2005) estimated a value of 9-20% crude protein. Rumen content-barley mixture has been used up to 50% in the diets of lambs (Abouheif *et al*., 1999). Inweh *et al.* (2010) fed rumen content to goats up to 40% dietary level as a replacement for palm kernel cake without any adverse effect on the goat's performance. This study was undertaken to determine the feed intake and nitrogen utilization in West African dwarf goats fed composite diets containing rumen waste, poultry waste and cassava peels.

MATERIALS AND METHODS.

The experiment was carried out at the Small Ruminant Unit of the University of Benin Farm Project (Edo State, Nigeria) located on latitude 6^0 and 30^0 N of the equator and longitude 5^0 $40^{'}$ and 6^0 E of the Greenwich Meridian in the rainforest zone with an average temperature of 27.6^0C; annual rainfall of 2162 mm and mean relative humidity of 72.5% (Orheruata *et al*., 2010).

Rumen waste were collected from slaughter houses (abattoirs) at Ewa road in Benin City, Edo state, Nigeria and transported in sacs to University of Benin farm project. It was sun-dried on concrete slabs for 4-5 days to about 10% moisture content, milled and bagged pending utilization for experimental diets formulation.

Poultry waste was collected in dried form, from an air conditioned deep litter poultry house at Ojemai farms, Ugbiohokho, Benin city, Edo state, Nigeria. It was dried on concrete slabs until it was gritty to touch. The cassava peels were collected fresh from a "garri" processing plant, sun-dried for 6-8 days to produce a dry matter content of 85-87%. After proper sun drying, the poultry manure and cassava peels were milled separately in a hammer mill and bagged before usage in the formulation of experimental diets.

The experimental diets shown on Table 1 were used for feed intake and nitrogen balance studies. Sixteen West African dwarf goats of an average weight of 8.13 kg, between 6 and 11 months old were used for this experiment. The goats were quarantined, treated for internal and external parasites and randomly allotted to the treatments in a Completely Randomized Design (CRD). Animals were fed twice daily based on 3 – 4 % of their body weight at 0800 hours and 1600 hours for a period of 84 days which was preceded by two weeks adaptation period. And this was followed by a metabolism trial over a period of 14 days. Clean water was offered at *ad libitum* and feed intakes were recorded daily. Samples of faeces and urine were collected bulked and preserved for proximate analysis according to AOAC (2000) as well as cell wall determination (Van Soest *et al.,* 1991).

Digestibility was calculated using the formula:

$$\frac{\text{Nutrient intake in feed} - \text{Nutrient output in faeces}}{\text{Nutrient intake in feed}} \times \frac{100}{1}$$

While nitrogen balance was determined by applying the formula:

Nitrogen intake in feed – (Nitrogen loss in urine + nitrogen loss in faeces)

And Nitrogen retention calculated as:

$$\frac{\text{N-balance}}{\text{N-intake}} \times \frac{100}{1}$$

Data obtained were analysed using statistical analytical system software (SAS, 2008). Variations among the treatment means that are significant was computed using Duncan Multiple Range Test (1955) of the same SAS (2008) software.

RESULTS AND DISCUSSION.

Feed Intake

Dry matter intake (DMI) (g/day) decreased with increasing dietary levels of poultry waste in the diets (Table 4). However, there was no statistical difference between the DMI (g/day) for all the diets, except diet 1 (control diet). This is contrary to findings by Bawala *et al*. (2003) and Ukanwako and Ibeawuchi (2009). However, the least DMI in diet 3 agrees with findings by Yousuf *et al*. (2013), who reported a decrease in dry matter intake at 22 % inclusion level of poultry waste. Asrat *et al.* (2008) reported a similar decrease at 45% inclusion level. Nadeem *et al*. (1993) reported a reduction in total DM1 at 30% inclusion level of broiler litter in the diet of Barbari goats. Furthermore, Tinnimit *et al*. (1972) also reported that goats even refused to consume ration containing more than 30% poultry litter.

Feeding high level of dry poultry waste at low dietary energy level may cause low palatability. Energy contents of diets have been shown to decrease with increasing level of dry poultry waste (Ukanwoko and Ibeawuchi, 2009). But this trend was not entirely the case in this study as the energy level of diet 2 (3.91MJ/Kg DM), as seen on Table 3, is lower than that of diet 3 (5.65MJ/Kg DM). The decrease in dry matter intake in diet 3 as shown on Table 4 despite an increase in energy level can be attributed to a lower amount of readily fermentable energy necessary for rumen microbes for effective fermentation. Studies by Tan *et al*

(2002) showed that rumen microbes need a specific amount of non-structural carbohydrates for proper functioning.

The increased DMI in diet 4 could be attributed to the effect of increased rumen waste and cassava peels (i.e. 25 % & 15 % respectively), which increases the substrates available to cellulolytic microbes with a consequent increase in the population of these micro-organisms and are liable to increase feed intake. There is evidence that a source of readily degradable fibre can result in increased intakes of poor quality roughage diets (Ndlovu and Buchanan-Smith, 1987).

Nutrient Digestibility.

Dry matter digestibility (DMD) was considerably high for all diets (Table 5).

Table 5 showed that nutrient digestibility ranged between 75.72 - 85.62%, which agrees with studies by Yousuf *et al.* (2013) who reported DMD of 75.38 - 88.75%. But higher than values (23.97- 36.32%) reported by Fajemisin *et al.* (2010), who fed sun dried or fermented rumen digesta-poultry droppings mixed diets to goats. The higher DMD observed in this experiment (Table 5) could be due to the addition of cassava peel, a source of readily fermentable energy, which will enhance microbial digestion. This observation agreed with earlier reports by Odigie *et al.* (2005) that for rumen microbial flora to perform at optimum level, the presence of nitrogen and soluble carbohydrate had to be synchronized.

There was a trend towards lower digestion coefficient for dry matter, when percent of poultry litter increase from 15 - 30%. This was corroborated by findings by Yousuf *et al.,* 2013, Asrat *et al.,* 2008, Hadjipanayiotou (1984) and Tegene (1984).

Nitrogen Utilization.

Table 6 showed that Nitrogen intake (NI) values (g/day) obtained for goats on all diets ranged from 3.30 to 11.28, with goats on diet 2 and diet 1 having the least and highest values respectively. The values were higher than the range of 225 — 671 mg/day recorded by Tuah e*t al*. (1992) for sheep fed cassava peel supplemented with palm kernel cake in which animal performances were reported to be generally poor. Nitrogen intake (g/day) observed in this study (Table 6) is comparable to 6.04 to 8.41 g/day reported by Ukanwoko and Ibeawuchi (2009), who fed goats with cassava peel and dried poultry waste diets. Except for goats on diet 2 and diet 3, nitrogen intake in this study compares well with 8.21 to 8.80 g/day reported by Jokthan *et al.* (2013).This result agrees with finding of Asrat *et al*. (2008) who observed that NI of goats increased at 14 %and 28 % then decreased at 45 % level of broiler litter inclusion. The lower nitrogen intake by goats on 15 % and 25 % poultry waste agrees with researches by Yousuf *et al*. (2013) with lower nitrogen intake for goats fed 22 % poultry manure.

Jokthan *et al*. (2013) reported a faecal nitrogen output of 2.00 to 2.51 g/day, while Ukanwoko and Ibeawuchi (2009) reported a faecal nitrogen output of 2.72 to 4.03 g/day, which are quite lower than faecal output of 6.73 to 12.30 g/day observed on Table 6 in this study. Nevertheless, there is no significant difference between the faecal outputs by the experimental goats. Nitrogen in urine of 0.45 to 1.67 g/day reported on Table 6 in this study compares well with l.42 to 1.51 g/day reported by Jokthan *et al.* (2013).The higher urinary excretion of nitrogen for animals on diet 2 and diet 3 could be attributed to the expected high rumen degradability of nitrogen contained in poultry litter. High excretion of urinary nitrogen is associated with high rumen nitrogen degradability (McDonald *et al.,* 2002).

Table 1: Composition of experimental diets (g/kg).

Ingredients (g/kg)	DIET 1	DIET 2	DIET 3	DIET 4
Cattle rumen waste	-	5.00	15.00	25.00
Poultry waste	-	15.00	25.00	5.00
Cassava peels	-	25.00	5.00	15.00
Palm kernel meal	23.00	-	-	-
Wheat Offals	18.00	-	-	-
Maize	4.00	-	-	-
Brewer Dried Grains	51.00	51.00	51.00	51.00
Bone meal	1.00	1.00	1.00	1.00
Limestone	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50
Vit./Min Premix	1.50	1.50	1.50	1.50
Total	100	100	100	100

Table 2: Chemical composition (%) of ingredients.

Variables %	Rumen waste	Poultry waste	Cassava peel	*Panicum maximum*	SEM
Dry matter	86.02^{ab}	82.91^{b}	78.00^{b}	93.21^{a}	7.53
Organic Matter	88.78^{a}	84.64^{a}	82.62^{a}	89.89^{a}	7.27
Crude Protein	12.25^{a}	23.92^{b}	5.52^{c}	9.04^{d}	2.67
Neutral Detergent fibre	74.00^{a}	63.00^{b}	57.00^{b}	41.00^{c}	5.97
Acid Detergent Fibre	50.00^{a}	26.00^{b}	36.00^{c}	25.00^{b}	3.65
Hemicellulose	24.00^{a}	37.00^{b}	21.00^{ac}	16.00^{c}	4.31
Ash	11.22^{a}	7.38^{b}	15.36^{c}	11.11^{a}	1.05

abc, – means along the rows with the same superscript are not significantly different.

Table 3: Chemical composition (%) of composite diets.

Variables %	[1]DIET 1	[2]DIET 2	[3]DIET 3	[4]DIET 4	SEM
Dry Matter	88.08^{a}	81.71^{a}	84.33^{a}	79.92^{a}	8.94
O**rganic Matter**	70.41^{a}	62.73^{b}	67.04^{ab}	67.06^{ab}	6.05
C**rude Protein**	14.53^{a}	14.00^{a}	21.00^{b}	16.98^{b}	5.12
Neutral Detergent fibre	51.00^{a}	52.00^{a}	61.00^{b}	51.00^{a}	3.38
Acid Detergent Fibre	27.00^{a}	40.00^{b}	39.00^{b}	33.00^{ab}	10.12
Hemicellulose (%)	24.00^{a}	12.00^{b}	22.00^{a}	18.00^{c}	2.98
Ash	29.05	31.27	32.96	32.94	3.06
*Metabolizable Energy (MJ/kg DM)	7.05^{a}	3.91^{b}	5.65^{c}	5.99^{c}	1.27

*Metabolizable Energy (MJ/Kg DM) = 13.5 — 0.15 X ADF% ÷ 0.14 + CP% — 0.15× ASH% (MAFF, 1984)
SEM – Standard error of mean;
abc, – means along the rows with the same superscript are not significantly different

Table 4: Effect of composite diets comprising Rumen waste, Poultry waste and Cassava peels on nutrient intake (g/day and g/$W_{kg}^{0.75}$day respectively) of WAD goats.

Variables	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**SEM**
Intake (g/day)					
DMI(g/day)	426.39^{a}	214.20^{b}	114.53^{c}	220.21^{b}	40.31
OMI (g/day)	340.85^{a}	164.52^{b}	114.90^{c}	184.86^{b}	32.26
CPI (g/day)	70.34^{a}	36.72^{b}	35.99^{b}	41.54^{b}	6.74
NDFI (g/day)	246.89^{a}	136.38^{b}	104.55^{b}	140.59^{b}	24.32
ADFI (g/day)	130.71^{a}	104.91^{b}	66.84^{c}	90.97^{b}	14.73
ASH intake(g/day)	143.24^{a}	97.75^{b}	56.49^{c}	90.80^{b}	15.00
Intake (g/d//kgw$^{0.75}$)					
DMI(g/d//kgw$^{0.75}$)	84.05^{a}	54.04^{b}	35.03^{c}	46.03^{b}	16.35
OMI(g/d//kgw$^{0.75}$)	64.19^{a}	41.54^{b}	27.85^{c}	41.54^{b}	13.03
CPI(g/d//kgw$^{0.75}$)	13.90^{a}	8.92^{b}	6.54^{a}	9.78^{b}	5.45
NDFI(g/d//kgw$^{0.75}$)	48.67^{a}	34.44^{b}	21.04^{c}	34.44^{b}	9.41
ADFI(g/d//kgw$^{0.75}$)	25.77^{a}	26.47^{a}	16.20^{b}	19.01^{b}	5.67
ASH intake(g/d//kgw$^{0.75}$)	28.24^{a}	24.66^{a}	13.83^{b}	19.01^{ab}	5.85

DMI - Dry matter intake; OMI - Organic matter intake; CPI -Crude protein intake;
NDFI - Neutral detergent fibre intake; ADFI - Acid detergent fibre intake
SEM - Standard error of mean
abc, – means along the rows with the same superscript are not significantly different

Table 5: Effect of composite diets comprising Rumen waste, Poultry waste and Cassava peels on nutrient digestibilities (%) of WAD goats.

Variables	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Dry Matter	85.62^{a}	80.71^{ab}	75.72^{ab}	85.47^{a}	4.20
Organic Matter	66.6^{a}	43.43^{b}	53.27^{a}	53.37^{a}	13.07
Crude Protein	85.04^{a}	56.00^{b}	64.52^{b}	85.95^{a}	8.99
Neutral Detergent Fibre	67.41^{a}	46.05^{b}	41.11^{b}	48.64^{b}	12.98
Acid Detergent Fibre	63.44^{a}	45.49^{b}	41.24^{b}	59.94^{a}	13.83
Ash	77.6^{a}	65.89^{a}	57.78^{b}	77.12^{a}	6.89

SEM - Standard error of mean; NDF - Neutral detergent fibre; ADF - Acid detergent fibre
abc – means along the rows with the same superscript are not significantly differen

Table 6: Effect of composite diets comprising Rumen waste, Poultry waste and Cassava peels on nitrogen utilization of WAD goats.

Variables	DIET 1	DIET 2	DIET 3	DIET 4	SEM
Nitrogen Intake					
Intake (g/day)	11.28^{a}	3.30^{b}	5.7^{bc}	7.50^{c}	1.08
Intake **(**g/$W_{kg}^{0.75}$DM)	2.22^{a}	0.83^{b}	1.40^{bc}	1.57^{c}	0.43
Nitrogen Output					
Faecal (g/day)	7.52^{a}	16.05^{b}	12.30^{c}	6.73^{a}	2.74
Urine(g/day)	1.13^{a}	1.44^{a}	6.73^{b}	0.45^{c}	0.40
Total	8.65	17.49	19.03	7.18	
Nitrogen balance (g/day)	2.63^{a}	-14.19^{b}	-13.27^{b}	0.32^{a}	2.46
Nitrogen balance (g/kg$w^{0.75}$DM)	0.42^{a}	-3.44^{b}	-1.78^{c}	0.15^{a}	0.53
Nitrogen retention (%)	23.32	ND	ND	4.27	ND

abc – means along the rows with the same superscript are not significantly different
SEM — Standard Error of Mean
ND – Not determined

The result on nitrogen balance on Table 6 shows that the crude protein in poultry waste and rumen waste in diet 2 and diet 3 were not well utilized by the goats, since there was a negative nitrogen balance. Animals on these diets (2 and 3) did not absorb or retain nitrogen in their body; rather, there was a nitrogen loss in urine and faeces. The higher nitrogen excreted by animals fed higher level of poultry waste was an indication that animals had lower nitrogen absorption and digestibility.

These could be attributed to low palatability and digestibility of these diets due to the proportion of poultry waste in these diets. Yousuf *et al.* (2013) reported that poultry manure though rich in fermentable nitrogen that could promote rumen fermentation process to improve fibre digestibility, but it is only efficient at a moderate level of intake. Consequently, much of the nitrogen in the poultry waste leave the gut undigested as indicated by the lower digestibility of crude protein in diet 2 and 3. However, considering the quantity of faecal nitrogen from goats on diet 2 and 3 as observed on Table 6, endogenous sources cannot be ruled out.

Nitrogen retention observed on Table 6 for diet 1 and diet 4 of 2.64 g/day and 0.32 g/day respectively, is very low compared to 2.33 g/day to 6.30 g/day reported by Alli-Balogun *et al.* (2003) and 8.36 g/day to 11.02 g/day reported by Inweh *et al.* (2010). Nitrogen retention observed in the present work decreased with the increased level of poultry waste in the diet. Sarwar *et al*. (2003) observed that nitrogen retention is dependent on the intake of nitrogen and amount of fermentable carbohydrates. Also, Alli-Balogun *et al.* (2003) asserted that nitrogen utilization is strongly affected by the amount and type of fermentable carbohydrate ingested by the animal.

CONCLUSION.

Therefore, nitrogen utilization levels of diets by goats reduced at high levels of inclusion of poultry waste in diets. However, an optimum utilization of nitrogen in diets can be achieved when a moderate level of poultry

waste such as 5 % in this research is ensured. But the balance of nitrogen and carbohydrate influences nitrogen utilization, carbohydrate utilization, and feed intake. Invariably, the amount of readily fermentable energy in the diet largely affects nitrogen metabolism, and the latter cannot be considered separately from carbohydrate metabolism.

REFERENCES.

Abouheif, M.A, Kraides, M. S and Al-Selbood B.A. 1999. The Utilization of rumen content– Barley meal in diets of growing lambs. *Asian – Austrialian Journal of Animal Science*. 8:1234-1240.

Adeloye A.A (1994). The influence of varying rations of cowpea husk and maize milling waste on the feed intake, protein and energy utilization by West African Dwarf goats. Nigerian Journal of Animal Production. 21: 108-112.

Adegbola, A.A., Smith, O.B. and Okeudo, N.J. 1990. Responses of WAD sheep fed cassava peel and poultry manure based diets (PANESA/ARNAB pastures network FOR Eastern and Southern Africa/African Research Network for Agricultural By-Products).Proceedings of the first joint workshop held in Lilongwe, Malawi, 5-9 Dec. 1988PANESA/ARNAB, Addis Ababa, Ethiopia. Pp. 833.

Akinmutimi A. H. (2003). Effect of processing on metabolizability of energy content of Sword Bean (*Canavalia gladiata*) using broiler chicks (starter phase). Proceedings of 28th Annual Conference of Nigerian Society of Animal Production. Edited by Taiwo A. A, Raji A. M., Ogbonna J. U. and E. A. Adebowale. Pp. 194-196.

Alli-Balogun.J.C. Lakpini, C. A.M Alawa., A. Mohammed and J. A. Nwanta. 2003. Evaluation of cassava foliage as protein supplement for sheep. *Nigeria Journal of Animal Production*. 30:37-46

Amoo. A. K. 1990. Protein and Energy Value Content and Mixture of rumen content and bovine blood in broilers. B. Agric. Project University of Ilorin. In: The feeding value of Rumen content-maggot meal mixture in the diets of early weaned piglets. (Adeniji. A. A.). *Asian Journal of Animal and Veterinary. Advances*, 3:115-119.

AOAC. 2000. Association of Official Analytical Chemists. Official Method of Analysis, 15th edition, 22 Wilson Boulevard, Arlington Virginia USA

Asrat, G.T., Berban, T. and Solomon, M. 2008. Inclusion of different proportions of poultry litter in the rations of yearling Hararghe Highland goats. *Livestock Research for Rural Development*.20 (3) 2008.

Belewu, M. A. 1997. Broiler litter as feed fpr ruminants – Potential and Limitation under Nigerian conditions. *Ghana journal of Agricultural science*, vol.30 (1). Pp. 79-85.

Belewu, M. A., Belewu, K. Yand Bello, I. 0. 2006. Effects of *Trichoderma* treated cassava waste in the diets of WAD goat on blood parameters, reproductive and Urinary parameters. *African Journal Biotechnology*. 5 (21): 2037 -2040.

Blood, D. C., Henderson, J. A., Radostits. 0. M. 1979. Veterinary Medicine.5th edition. Balliere Lindell, London. Pp. 866

Dairo, F. A. S, Ama, 0. 0 and Asafa, A.R. 2005. Performance evaluation of growing rabbits fed rations containing rumen content. Proceedings of 7th Annual Conference of

Animal Science Association of Nigeria.September 16-19, University of Agriculture, Abeokuta, Nigeria. Editors: Fanimo A.O and J. A. Olanite. Pp 131.

Daramola, J. O., Adeloye, A. A., Fatoba, T. A. and Soladoye, A. O. 2005. Haematological and Biochemical parameters of West African Dwarf goats. *Livestock Research for Rural Development* Vol. 17: www. Cipav.org.co/lrrd.

Duncan, B. 1955. Multiple ranges and multiple F. test. Biometrics 11: 1-41.

Efrem G., Getachew A., Mengistu U. and Yoseph M. 2016. Sun-Dried Bovine Rumen Content (SDRC) as an Ingredient of a Ration for White Leghorn Layers. *East African Journal of Sciences,* 10 (1) 29-40

Fajemisin, A.N., Alokan, J.A., Aro, S.0., Alowofeso, 0. and Fawolu, T.S. 2010. Nutrient intake, Digestibility and weight gain of West African Dwarf sheep fed rumen content- poultry droppings mixed diets. Proceedings of 33rd Annual Conference, Nigeria Society of Animal Production. Pp.583-586.

Fraser, C., and Mays, A. 1986. The Mercks Veterinary Manual. A handbook of diagnosis,therapy and disease prevention and control for the veterinarian. 6th ed. March and Co.The Rahway, New Jersey, USA.

Guitierrez, A.N. (1985). Economic constraints on sheep and goats production in developing countries,. Proceedings of an expert consultation held in Sofia, Bulgaria, 8-12 July, 1985. Edited by V.M. Timon and J.P. Hanraham. FAO Animal Production and Health Paper. Pp 58.

Hadjipanayiotou, M., 1984.The use of poultry litter as ruminant feed in Cyprus. World Animal Review, 49: 32-38.

Inweh D. A., Oyegun B. J., Bamikole M. A. and Ikhatua U. J. 2011. Performance of West African Dwarf Goats fed different dietary levels of Cattle and Goat Rumen Contents. Proceedings of 36thAnnual Conference of Nigeria Society for Animal Production (NSAP). 13-16t1i March, 2011. University of Abuja, Nigeria. Pp. 539-541.

Inweh D. A., Oyegun B. J., Bamikole M. A. and Ikhatua U. J. 2011. Performance of West African Dwarf Goats fed different dietary levels of Cattle and Goat Rumen Contents. Proceedings of 36thAnnual Conference of Nigeria Society for Animal Production (NSAP). 13-16t1i March, 2011. University of Abuja, Nigeria. Pp. 539-541.

Jain. N. C. 1993. Essentials of Veterinary Hematology.Lea and Febiger.Philadephia. PA. Pp. 33-44.

Jokthan, G.E., Muhammad, S.A. and Osuhur, C.U. 2013. Effect of cottonseed cake replacement with broiler litter on performance of Yankasa rams fed maize husk Basal diets. FUTA. *Journal of Research in Sciences*, 1: 147-155.

Lazzaro, J. and J. Saanendoah, 2005. Normal blood chemistry value for adult goats. Spore Spreading the word about leaf meal in Reviving lost lands issue 125, Oct., 2006. In: Haemotological Indices of West African Dwarf goats fed leaf meal. (Belewu M. A. and K. O. Ojo-Alokomaro). *Bulgaria Journal of Agricultural Science.*. 13: 601-606.

McDonald, P., Edwards, R. A., GreenHalgh, J. F. D. and Morgan, C. A. 2002 Animal

Nutrition.6th Edition. Pearson Education Ltd. Essex, USA.

Nadeem, M.A, Ali A., Azim A. and Khan A.G. 1993.Effect of feeding broiler litter on and nutrient Utilization by Barbari goat. *Journal Agricultural Science.* (Cambridge). 6:73- 77.

Odeyinka S.M., Oyedele O.J and Olubumi P.A. 2003. The performance of West African Dwarf goats fed soyabean milk residue, cowpea seed waste and corn starch residue. *Livestock Research for Rural Development.* 15:12. Pp. 111.

Odigie P.A., Bangbose A.M. and S.O and Omoikije. 2005. Nutrient retention carcass yield of weaner rabbits fed graded levels of unpeeled cassava root meal. Proceedings of 10th Animal Science Association of Nigeria. Pp. 283-285.

Okorogbona, A.O. 1994. Changes in the Microbial Population and proximate composition of decomposed Blood Rumen Content mixture and Abomasum content. B. Agriculture project, University of Ilorin. In: The feeding value of Rumen content – maggot meal mixture in the diets of early weaned piglets. *Asian Journal of Animal and Veterinary. Advances,* 3:115-119.

Oni, A. O., Oluwayemisi, A. Adebayo, K., Sowande, O.S., Iposu, S. and Onwuka, C.F.I. 2017. Effects of supplementing cassava peels with cassava leaves and cowpea haulms on the rumen environment and blood profile parameters of West African dwarf goats. Archivos de Zootecnia, vol. 66:255, Pp. 397-404 Universidad de Córdoba Córdoba, España: http://www.redalyc.org/articulo.

Plumb. D. C. 1984. Veterinary hand book, Lowa state University press, 1999 veterinary clinical pathology practice publishing co and other sources.

Puls, R. 1988. Mineral levels in animal health: diagnostic data 2nd ed. Sherpa International, Clear brook, Canada. Pp. 304

Sabiiti E.N. 2011. Utilising agricultural waste to enhance food security and conserve the environment. African Journal of Food, Agriculture, Nutrition and Development.Published by African Scholarly Science Communication Trust.Josem Trust Place, Bunyala road, Upper Hill, Nairobo, Kenya.*African Journal of Food, Agriculture, Nutrition and Development.* 11 (6). http://www.biolin.org.der.

Sarwar, M., Ajmal Khan.M.and Mahr-un-Nisa. 2003. Nitrogen retention and chemical composition of urea treated wheat straw ensiled with organic acids or fermentable carbohydrates. *Asian-Australian Journal of Animal Science.* 16:1583-1592.

Statistical Analysis Software (SAS).2000. Guide for personal computers. Statistical Analysis Software Institute Inc., Cary, NC, USA.

Tegene Negesse. 1984. Digestibility of poultry litter and its influence on the performance of beef Cattle.MSc.Thesis.Alemaya College of Agriculture, Addis Ababa University, Ethiopia.

Tuah A. K, Orskov E. R, Obese F. Y, Okai D. B. and Greenhalgh J. F. D. 1992. The supplement of cassava peel (CP) diets with graded levels of palm kernel cake (PKC) on the performance of growing Djallonke sheep. In: Small Ruminants Research and Development in Africa. Proceedings of Conference of the African Small Ruminant

Research Network held in Arusha, Tanzania. 7-11th Dec. S. H. B. Lebbie, B. Rey and E. K. Irungu (eds). ILCA/ CTA. Pp.163 -167.

Ukanwoko, A.I, and Ibeawuchi, J.A. 2009. Nutrient Intake and Digestibility of West African Dwarf Bucks Fed Poultry Waste – Cassava Peels Based Diets. *Pakistan Journal of Nutrition*, 8: 1461-1464

Van, Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991. Methods for dietary fiber neutral detergent fiber and non – starch polysaccharides in relation to animal nutrition *J. Dairy Sci*. 74, 3583-3597.

Yousuf, M.B., Adeloye A.A., Okukpe K.M., Adeyemi, K.D., Badmus, A.H.A.,Daramola, J. O. and Ogundun, N.J. 2013. Performance Characteristics of Goats Fed Varied levels of Poultry Manure in whole Cassava Plant Based Concentrates Diets. *Asian Journal of Agriculture and Rural Development.* 3(11): 823-828.

Journal of Applied Agricultural Research 2022, 10(1): 180-189
ISSN 2006-750X.

EFFECTS OF SUNDRIED SWEET ORANGE PEEL MEAL SUPPLEMENTED WITH QUANTUM BLUE® ENZYME ON BLOOD PARAMETERS AND APPARENT NUTRIENT DIGESTIBILITY OF BROILERS.

*Egberuare[1], T.A., Alu[2], S. E., Adua[2], G.A Malomo[1], M.M, Kidda[1] D, Odeyemi[1] T.A,
[1]Agricultural Research Council of Nigeria, P.M.B. 5026, Wuse-Abuja, Nigeria.
[2]Department of Animal Science Nasarawa State University, Keffi, P.M.B.135, Shabu-Lafia Campus, Nasarawa. State, Nigeria.
*Corresponding Author: Tel. +2348068792486 & +2349068958240, email timothy.abraham40@yahoo.com

ABSTRACT.

The apparent nutrient digestibility of 270 broiler chicks (Cobb 500) was evaluated using a 3x3 factorial experiment. The birds were randomly allotted to 9 experimental diets, each with 3 replicates having 10 birds per replicate in a deep liter system. Isocaloric (3020.31 - 3075.35 Kcal/kg ME) and isonitrogenous (20.22 – 20.23 % crude protein) experimental diets were formulated using Sundried Orange Peel (SDOP) meal at an inclusion levels of 0, 25 and 50% and three levels of enzyme; 0, 100, and 200 ppm fed adlibitum to the birds for 8 weeks. All standard routine management practices were strictly observed throughout the experimental period. At end of the feeding trail, 2 birds from each replicate were selected and transferred to digestibility cages for daily faecal sample collection over a period of one week. The result showed no significant ($p>0.05$) difference for all the apparent nutrients digestibility except for Dry Matter, Ether Extract and ash which were significant ($p<0.05$) due to interaction between SDOP and enzymes supplementation. Red Blood Cell, White Blood Cell, Hemoglobin concentration, Packed Cell Volume, Total Protein, Albumin, Aspartate and Globulin showed significant improvement with enzyme supplementation making it at par with the control. Enzyme supplementations affected ($p<0.05$) uric acid, Total Protein and Globulin for birds at 200 ppm showing lower bioavailability compared with other treatments. Interactive effect of SDOP and enzymes supplementation significantly affected ($p<0.05$) Muscular Cell Volume and uric acid. It was concluded that broilers finishers can tolerate sundried sweet orange peels up to 50% inclusion level and 200 ppm enzymes supplementation without adverse effects on nutrient digestibility and blood parameters.

Keywords: Broiler chicken, Digestibility, hematology and serum, Orange peel meal, Quantum blue®

INTRODUCTION.

Protein intake from animal origin in developing countries like Nigeria is facing a great challenge in-terms of meat, egg and milk, resulting to malnutrition and lower productivity in humans (FAO, 2009). This is as a result of increasing population and demand by food industries. This has led to increasing competition between man and animals for energy and protein feedstuff as well contributing to higher cost of animal feed and finished product. This challenge has been exacerbated by the impact of climate change on animal production system due to lowered cereal and legume green farm outputs (Oluwafemi, 2009). Agro-industrial by-products from fruits

and tubers are commonly used as replacement for maize as energy source. Most of these by-products are associated with anti-nutritional factors that were harmful to the performance of animals and high fibre content which reduces the feed value of these by-products, thereby making their processing before use in animal feed (Oluremi *et al*., 2017). Khempaka *et al. (*2009) found that dried citrus pulp (DCP) was appropriate to be used as an alternative feedstuff for broilers. Their experiment showed that broiler growth performance and nutrient digestibility decreased with increasing levels of DCP more than 8% in most cases. Nazok *et al*. (2010) studied the effect of different levels of dried citrus pulp on performance, egg quality, and blood parameters of laying hens in early phase of production. They found that utilization of DCP up to 16% significantly increased serum glucose and high-density lipoprotein and reduced cholesterol, low-density lipoprotein, and triglycerides.

Ebrahimi *et al.* (2012, 2014) evaluated the effects of different levels of *Citrus sinensis* peel extract (CSPE) on the blood parameters of broilers. They found that cholesterol, glucose, uric acid, low density lipoprotein (LDL) and high density lipoprotein (HDL) at the rearing period was significantly influenced. Pourhossein *et al.* (2012) found the positive effect of different levels of dried *Citrus sinensis* peel (SOPM) on broiler gastrointestinal microbial population stating that the mean of *Lactobacilli* in cecum on the postnatal 42 day indicated no significant results. This necessitated this research on the use of sundried sweet orange peels and enzymes supplementation in the diets of broilers chicken to evaluate the effects on apparent nutrient digestibility and blood parameters.

MATERIALS AND METHODS.

Experimental site: The experiment was conducted at Ibas Farms Nigeria Ltd, Keffi Nasarawa State.

Source of Test ingredient: The Sweet orange peels were sourced from Orange Market, Mararaba in Nasarawa State Nigeria. The SOP was sun dried cleaned and milled while enzyme was purchased from a registered dealer of animal feed products.

Experimental birds, diets and management: Following the approval of the Research ethics committee of the university, two hundred and seventy (270) day old chicks were purchased from Olam Farm Kaduna, and reared in a deep later system. They were randomly assigned to isocaloric and iso-nitrogenous dietary treatments (T1, T2, T3, T4, T5, T6, T7, T8, and T9 Table 1) for the broiler finisher birds with three levels inclusion sundried sweet orange peels meal (0, 25 and 50%) and three levels inclusion of exogenous enzymes (0, 100, 200 ppm Enzymes) and replicated in three treatment groups of 10 birds each. Each unit pen was equipped with feeders, drinkers and light was provided at night using electric bulb throughout the period of the experiment. Broilers were fed with weighed amount of the experimental diets and drinking water *ad-libitum* and broad antibiotics, and anti-stress was administered according to the prescription of the manufacturer in their drinking water. Other routine management practices were observed daily such as washing of drinkers, weekly cleaning of pen, daily inspection.

Nutrient Digestibility trial.

The experiment was conducted to evaluate the nutrient utilization of diets containing different levels of treatments. Fecal samples were collected daily over a period of one week from trays placed below the cages to collect daily fecal droppings. Some of the feces collected were sun dried, bulked by replicates weighed and thoroughly mixed. Sub samples were taken for analysis of proximate constituents. The apparent nutrient digestibility was calculated using the formula:

Nutrient digestibility (%) = $\frac{\text{Nutrient intake} - \text{Nutrient in feces}}{\text{Nutrient in feed}} \times \frac{100}{1}$.

Table 1: Gross composition of experimental diets for finisher broilers.

Feed Ingredients	T1 (0%OPM+0ppm)	T2 (0%OPM+100ppm)	T3 (0%OPM+200ppm)	T4 (25%OPM+0ppm)	T5 (25%OPM+100ppm)	T6 (25%OPM+200ppm)	T7(50%OPM+0ppm)	T8(50%OPM+100ppm)	T9(50%OPM+200ppm)s
Blood meal	2.00	2.00	2.00	1.00	1.00	1.00	2.00	2.00	2.00
Salt	0.30	0.3.00	0.30	0.30	0.30	0.3.00	0.30	0.30	0.30
Maize bran	9.00	9.00	9.00	10.00	10.00	10.00	1.00	1.00	1.00
GNC	12.00	12.00	12.00	18.00	18.00	18.00	17.00	17.00	17.00
FFSB	18.00	18.00	18.00	16.00	16.00	16.00	18.75	18.75	18.75
Premix	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Maize	35.00	35.00	35.00	13.25	13.25	13.25	6.00	6.00	6.00
Rice bran	17.25	17.25	17.25	10.00	10.00	10.00	1.00	1.00	1.00
Palm oil	4.50	4.50	4.50	4.50	4.50	4.50	2.00	2.00	2.00
Bone meal	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
SDOP	0.00	0.00	0.00	25.00	25.00	25.00	50.00	50.00	50.00
Lysine	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Enzyme(PPM)	0.00	100	200	0.00	100	200	0.00	100	200
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient composition									
Energy	3075.35	3075.35	3075.35	3020.31	3020.31	3020.31	3011.74	3011.74	3011.74
Protein	20.22	20.22	20.22	20.23	20.23	20.23	20.33	20.33	20.33
Crude fibre	5.35	5.35	5.35	8.05	8.05	8.05	9.89	9.89	9.89
Ether Extract	12.94	12.94	12.94	14.10	14.10	14.10	13.16	13.16	13.16
Ash	3.83	3.83	3.83	4.10	4.10	4.10	4.21	4.21	4.21
Calcium	0.54	0.54	0.54	0.57	0.57	0.57	0.45	0.45	0.45
Phosphorus	0.68	0.68	0.68	0.58	0.58	0.58	0.48	0.48	0.48
Lysine	1.42	1.42	1.42	2.71	2.71	2.71	4.12	4.12	4.12
Methionine	0.7849	0.7849	0.7849	1.3024	1.3024	1.3024	1.8611	1.8611	1.8611

*Supplied the following per kg of diet as specified by the manufacturer: Vitamin A, 12500 IU; Vitamin D3, 2500 IU; Vitamin E, 50,00 Mg; Vitamin K3, 2.50mg; Vitamin B1, 3.00mg; Vitamin B2, 6.00mg; Vitamin B12, 0.25mg; Pantothenic acid, 5.00mg; Nicotinic Acid, 20,00mg; Folic acid, 1.00mg; Choline Chloride, 300mg; Manganese, 100mg; Iron, 50mg; Zinc, 45mg; Copper, 2.00mg; Iodine, 1.55mg; Cobalt, 0.25mg; Selenium, 0.1mg

Blood Parameters.

At the end of the experiment, two sets of red topped sample bottles were used to collect blood sample from sacrificed birds. One set contained anticoagulant while the other is anticoagulant free. The blood samples collected into bottle containing anti-coagulant: Ethylenediaminetetraacetic Acid (EDTA) as reported by Jain (1987) was used for hematological indices: Packed Cell Volume (PCV) using hematocrit method described by Wintrobe (1983), Hemoglobin Concentration (HB) described by Brown (1973), Red Blood Cell (RBC), White Blood Cell (WBC) as described by Dacie and Lewis (1991). Cholesterol was measured using the method described by Roeschlau *et al.* (1974). The other set of bottles was used to determine other biochemical indices. The serum protein, albumin and globulin was analyzed using SIGMA kits (Feteris, 1965).

Statistical Analysis.

All data collected were subjected to Analysis of Variance (ANOVA) for factorial arrangement using (SPSS, 2007) Model. Significantly different means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION.

The effects of sundried sweet orange peels meal on apparent nutrient digestibility of broiler finisher birds is presented in Table 2. The result indicated that crude protein 85.63, 88.37% and 87.96, ether extract 86.02, 86.18 and 85.73, crude fibre 37.80, 33.18 and 34.08, ash 44.92, 46.31 and 46.51, dry matter 66.92, 69.22 and 46.51 and nitrogen free extract 62.84, 61.76 and 64.77 digestibility were not significantly ($p>0.05$) affected by the inclusion of SDOPM. This observation is in consonance with report of Sunmola *et al.* (2018) who investigated the performance characteristics of starter broiler chicks fed dietary Sun-Dried Sweet Orange Peel Meal (SOPM) with and Without Polyzyme® and reported that the experimental diets did not show significant effect on dry matter, crude protein, crude fibre and nitrogen free extract digestibility of broiler chicks. The non-significant increase in the digestibility of crude protein for birds fed 100 and 200 ppm enzymes supplementation indicated that enzymes inclusion did not substantially improve crude protein digestibility of the fibrous material at the inclusion levels in this study. This is a deviation from the finding of Omole *et al.* (2011) who investigated the performance and nutrient digestibility of broiler chicks fed diets containing exogenous Hamecozyme and observed significant improvement in crude protein and crude fibre digestibility when level of Hamecozyme increased in the diets. The differences in effect on crude protein and fibre digestibility in the two studies could be as a result of differences in enzymatic activities and environment. According to Adeola and Olukosi (2008), high dietary fibre can only be properly digested and utilized in monogastric animals if exogenous enzymes are added to the diets. However, this study showed significant ($p<0.05$) effect of SDOPM and enzymes interaction in the digestibility of ether extract, ash and dry matter. Higher ($P<0.05$) values for DM, EE and ash were observed at birds fed on T1 88.86, 58.16 and 73.89% than T2 birds but did not differ from T3, T4, T5, T6, T7, T8 and T9. This finding may be indicative of improved availability of DM, EE and ash components comparable to birds fed the control diet as a result of enzymatic activities.

The effects of sundried sweet orange peels meal on haematology and serum biochemistry of broiler finisher is shown in Table 3. The result showed significant ($p<0.05$) depression in the white blood cell 17.27, 10.58 and $11.70x10^9$, red blood cell 3.17, 2.60 and $2.80x10^6$, haemoglobin 11.20, 9.07 and 9.40g/dl, packed cell volume 34.00, 28.00 and 29.00 %, total protein 88.75, 58.53 and 55.57g/l, albumin 31.72, 20.47 and 20.22g/l, aspartate 3.95, 1.74 and 2.09 µmol/l and globulin 60.95, 39.02 and 37.59g/l with the inclusion of SDOPM. Depressed WBC, RBC and

PCV are indicative of reduced immunity and anaemia, which could make the birds more susceptible to diseases and other forms of stresses. Akpe *et al.* (2019) reported significant improvement in the Hematology of Broiler Chickens fed diets containing graded levels of biodegraded Sweet Orange (Citrus sinensis) Peel. This means birds could benefit from some forms of pre-treatment of SDOPM before administration as feed. MCV (fl), MCH (g/dl), MCHC (g/dl) and uric acid (mmol/l) were not significantly affected ($p>0.05$).

The effects of enzyme supplementations on haematology and serum biochemistry of broiler finisher is shown in Table 4. White blood cell, red blood cell, haemoglobin, packed cell volume MCV, MCH, MCHC, cholesterol, albumin and aspartate were similar ($p>0.05$) across treatments due to enzymes supplementation. This means that the addition of exogenous enzymes significantly improved the health status and well-being of birds fed SDOPM. This means that enzymes supplementation could also be an effective tool for improving the hematological and serological parameters of birds fed SDOPM. Hajati *et al.* (2009) also reported significant increase in the concentration of blood total cholesterol, HDL and triglycerides and glucose when enzymes was added to broiler chicks fed corn-soybean meal-wheat diets. The result also showed that total protein and globulin were significantly ($p<0.05$) lower while uric acids of were higher ($p<0.05$) in birds fed 200 ppm enzyme supplemented diets than others. Lower total protein and higher uric acids concentration in the blood of birds are suggestive of lower bioavailability of dietary protein, especially at 200 ppm inclusion of enzyme. Therefore, this data suggests reduced bioavailability of protein in birds fed the experimental diets supplemented with 200 ppm of enzymes. This is indicative that there were no additional benefits of higher level of enzymes supplementation in terms of protein bioavailability in birds fed the experimental diets.

The effects of interaction of feeding sundried sweet orange peels and enzyme supplementations on haematology and serum biochemistry of broiler finisher is presented in Table 5. The results showed that white blood cell, red blood cell, haemoglobin, packed cell volume, total protein, albumin, and globulin were significantly ($p<0.05$) affected by treatment effects. The trend of the data suggests some improvement in blood parameters of birds as a result of enzyme supplementation bringing performance at par with the control, except for the white blood cell counts which were significantly depressed even with enzymes supplementation. While, some potential negative effects of feeding SDOPM at 25 and 50% inclusion levels were corrected with enzymes supplementation as shown in the interaction data, further studies are needed to address the observed uncorrected potential negative effects in this study.

CONCLUSION AND RECOMMENDATIONS.

The increasing cost of conventional ingredients for poultry production is negatively impacting on the gross margin and the affordability of the resultant products. Therefore, the quest for the utilization of cheaper non-conventional alternatives to conventional ingredients still remains a valid objective in poultry production. The results of this study showed that the use of SDOPM as a non-conventional ingredient in broiler diets holds great potentials in terms of nutrient digestibility and bioavailability of some nutrients, especially with enzymes supplementation. It was concluded that broilers finisher could tolerate sundried sweet orange peels up to 50% and 200 ppm enzymes supplementation with no observable negative effect on the nutrient digestibility and blood parameters.

Table 2. Main and interactive effects of feeding sundried sweet orange peels and enzyme supplementations on apparent nutrient digestibility of broiler finisher birds.

Factors		Parameters					
		Dry matter (%)	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Ash (%)	Nitrogen free extract (%)
*SDOP	0	85.63	86.02	37.80	44.92	66.36	62.84
	25	88.37	86.18	33.24	46.31	69.22	61.76
	50	87.96	85.73	34.08	46.51	67.62	64.77
	SEM	1.23	0.87	2.43	3.45	2.42	2.98
	LOS	NS	NS	NS	NS	NS	NS
Enzyme	0ppm	86.49	86.95	38.38	50.18	71.27	64.05
	100ppm	87.25	84.82	33.43	40.89	64.35	61.31
	200ppm	88.22	86.16	33.31	46.66	67.57	64.01
	SEM	1.23	0.87	2.43	3.45	2.42	2.98
	LOS	NS	NS	NS	NS	NS	NS
Interactions	T1	88.86a	83.03	45.71	58.16a	73.75a	70.89
	T2	82.82b	85.39	33.85	30.75b	57.73b	53.36
	T3	86.38 ab	88.47	33.85	45.86 ab	67.60ab	64.26
	T4	86.25 ab	88.56	34.95	45.54 ab	72.40 ab	56.95
	T5	86.07 ab	88.34	33.03	45.38 ab	67.66 ab	64.34
	T6	86.23 ab	88.22	31.75	48.01 ab	67.59 ab	63.98
	T7	85.75ab	87.87	34.49	46.84 ab	67.68 ab	64.29
	T8	85.56 ab	88.02	33.41	46.56 ab	67.67 ab	66.23
	T9	85.87 ab	87.99	34.33	46.13 ab	67.51 ab	63.80
	SEM	4.19	2.13	4.20	1.50	5.97	5.15
	LOS	**	NS	NS	**	**	NS

a,b, means on the same column having different superscript differ significantly (P<0.05); NS = not significantly different (P>0.05); SEM = standard error of mean; LOS = level of significant. SDOP= sundried sweet orange peels.

Table 3. Effects of sundried sweet orange peels meal on haematology and serum biochemistry of broiler finisher

PARAMETERS	SDOP INCLUSION LEVELS (%)				
	NO DSOP (0)	LOW DSOP (25)	HIGH DSOP (50)	SEM	LOS
White blood cell ($x10^9$)	17.27^a	10.58^b	11.70^b	0.49	*
Red blood cell ($x10^6$)	3.17^a	2.60^b	2.80^{ab}	0.15	*
Haemoglobin (g/dl)	11.20^a	9.07^b	9.40^b	0.55	*
Packed cell volume (%)	34.00^a	28.00^b	29.00^b	1.41	*
MCV (fl)	107.75	107.88	104.17	2.31	NS
MCH (g/dl)	35.48	34.97	33.92	1.46	NS
MCHC (g/dl)	33.03	32.28	32.35	0.93	NS
Serum biochemistry					
Cholesterol (mmol/l)	4.19	3.68	3.47	0.24	NS
Total protein (g/l)	88.75^a	58.53^b	55.57^b	2.80	*
Albumin (g/l)	31.72^a	20.47^b	20.22^b	2.06	*
Aspartate (µmol/l)	3.95^a	1.74^b	2.09^{ab}	0.64	*
Uric acid (mmol/l)	568.25	475.80	624.20	54.67	NS
Globulin (g/l)	60.95^a	39.02^b	37.59^b	2.55	*

ab means on the same row haven different superscript differ significantly (P<0.05); NS not significant (P>0.05)

Table 4. Effects of enzyme supplementations on haematology and serum biochemistry of broiler finisher

PARAMETERS	ENZYME SUPPLEMENTATION LEVELS (ppm)				
	NO ENZYME (0)	LOW ENZYME (100)	HIGH ENZYME (200)	SEM	LOS
White blood cell ($x10^9$)	13.58	12.85	13.12	0.49	NS
Red blood cell ($x10^6$)	2.97	2.92	2.68	0.15	NS
Haemoglobin (g/dl)	10.32	9.47	9.88	0.55	NS
Packed cell volume (%)	31.17	30.33	29.50	1.41	NS
MCV (fl)	105.48	103.98	110.33	2.31	NS
MCH (g/dl)	34.93	32.38	37.05	1.46	NS
MCHC (g/dl)	33.17	30.98	33.52	0.93	NS
Serum biochemistry					
Cholesterol (mmol/l)	3.558	4.007	3.777	0.24	NS
Total protein (g/l)	74.25^a	73.12^a	55.48^b	2.80	*
Albumin (g/l)	26.80	23.77	21.83	2.05	NS
Aspartate (µmol/l)	2.39	2.79	2.59	0.64	NS
Uric acid (mmol/l)	489.25^b	401.93^b	777.07^a	54.69	*
Globulin (g/l)	52.14^a	48.69^a	36.74^b	2.55	*

ab means on the same row haven different superscript differ significantly ($P<0.05$); NS not significant ($p>0.05$)

Table 5. Effects of feeding sundried sweet orange peels and enzyme supplementations interaction on haematology and serum biochemistry of broiler finisher

PARAMETERS	TREATMENT COMBINATIONS										
	T1	T2	T3	T4	T5	T6	T7	T8	T9	SEM	LOS
White blood cell ($x10^9$)	20.30^{a}	16.80^{b}	14.70^{bc}	12.55^{cd}	8.10^{e}	11.10^{d}	7.90^{e}	13.65^{cd}	13.55^{cd}	0.93	*
Red blood cell ($x10^6$)	3.55^{a}	3.25^{ab}	2.70^{ab}	2.55^{b}	2.50^{b}	2.75^{ab}	2.80^{ab}	3.00^{ab}	2.60^{b}	0.10	*
Haemoglobin (g/dl)	12.05^{a}	11.60^{a}	9.95^{ab}	9.35^{ab}	7.95^{b}	9.90^{ab}	9.55^{ab}	8.85^{ab}	9.80^{ab}	0.37	*
Packed cell volume (%)	37.00^{a}	35.50^{ab}	29.50^{abc}	27.50^{bc}	26.50^{c}	30.00^{abc}	29.00^{abc}	29.00^{abc}	29.00^{abc}	4.26	*
MCV (fl)	104.35^{ab}	109.20^{ab}	109.70^{ab}	108.50^{ab}	106.05^{ab}	109.10^{ab}	103.60^{ab}	96.70^{b}	112.20^{a}	6.07	*
MCH (g/dl)	33.80	35.65	37.00	36.90	32.00	36.00	34.10	29.50	38.15	3.72	NS
MCHC (g/dl)	32.75	32.65	33.70	33.90	30.00	32.95	32.85	30.30	33.90	2.17	NS
Serum biochemistry											
Cholesterol (mmol/l)	3.64	4.45	4.47	3.17	4.04	3.86	3.87	3.53	3.01	0.65	NS
Total protein (g/l)	102.35^{a}	101.90^{a}	62.00^{bc}	55.90^{bc}	61.80^{bc}	57.90^{bc}	64.50^{bc}	55.65^{bc}	46.55^{c}	20.26	*
Albumin (g/l)	42.40^{a}	27.95^{b}	24.80^{b}	17.15^{b}	21.65^{b}	22.60^{b}	20.85^{b}	21.70^{b}	18.10^{b}	8.21	*
Aspartate (µmol/l)	3.90	4.29	3.65	0.97	1.14	3.11	2.32	2.95	1.03	0.39	NS
Uric acid (mmol/l)	427.10^{c}	440.45^{c}	837.20^{ab}	682.30^{bc}	370.20^{c}	374.90^{c}	358.35^{c}	395.15^{c}	1119.10^{a}	65.43	*
Globulin (g/l)	70.04^{a}	70.034^{a}	42.77^{b}	39.94^{b}	40.82^{b}	36.30^{b}	46.43^{b}	35.21^{b}	31.15^{b}	3.46b	*

abc means on the same row haven different superscript differ significantly ($P<0.05$); NS not significant ($P>0.05$), SEM= standard error of mean; LOS= levels of significance.

REFERENCES.

Adeola, O. and Olukosi, O.A. (2008.) Opportunities and challenges in the use of alternative feeds.

Akpe, M.E., Oluremi, O.I.A and Tuleun, C. D3. (2019). Haematological and Serum Biochemical Indices of Broiler Chickens Fed Diets Containing Graded Levels of Biodegraded Sweet Orange (Citrus sinensis) Peel. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue 8 Ser. II (August 2019), PP 54-59.*

Brown, B.A. (1973). Haematology: Principles and Procedures. Second Edition. Lea and febiger, *Philidalphia*Pp 56-70.

Dacie and Lewis. (1991). Practical Haematology (8th) edition. Longman group Ltd. Pp 22-68.

Duncan, D.B. (1955). Multiple Ranges and Multiple F-Test Biometrics, 11:1-42.

Ebrahimi A, Qotbi, A. Seidavi A, Bahar B. (2014) The effects of dietary supplementation of *Citrus sinensis* peel extract on production and quality parameters of broiler chicken J. Appl. Anim. Res., 2014), pp. 1-6

Ebrahimi, A. Qotbi A. Seidavi R. (2012) The effect of different levels of *Citrus sinensis* peel extract on blood parameters of broiler chicken Ann. Biol. Res. (ABR), 3 (7) pp. 3614-3620

FAO, (2009). Food security and agricultural mitigation in developing countries*: Options for Capturing Synergies. Rome, Italy.www.fao.org/dopcrep/012/i1318e/i131e00.pdf.*

Feteris, W. (1965). A serum glucose method without protein precipitation. Am *J Med techno.31:17-21*.

Hajati,H., Rezaei, M., Soyyahzade, H. (2009). The Effects of Enzyme supplementation on performance, Carcass characteristics carcass composition and some blood parameters of broiler fed on Corn-soybean Meal-Wheat Diets. International Journal of Poultry Science 8(12):1199-1205, 2009.

Jain, N. C. (1993). *Essential of Veterinary Hematology*, comparative hematology of common domestic animals. Lea and Febiger, Philadelphia, PA, pp. 44-46.

Khempaka S, Molee W, Guillaume M. (2009) Dried cassava pulp as an alternative feedstuff for broilers: effect on growth performance, carcass traits, digestive organs, and nutrient digestibility J. Appl. Poult. Res., 18 (3) pp. 487-493.

Nazok, A., Rezaei, M. and Sayyahzadeh, H. (2010). Effect of different levels of dried citrus pulp on performance, egg quality, and blood parameters of laying hens in early phase of production. Trop. Anim. Health Prod. 42 (4): 737-742.

Oluremi, O.I.A., Ahile, A.A., Jande, T.F. (2017). Effect of Feeding Graded Levels of Fermented Sweet Orange (Citrus Sinensis) Fruit Peel Meal on the Growth and Nutrient Digestibility of Broiler Chicken. *International Journal of Environment, Agriculture and Biotechnology* (IJEAB), Vol -2, Issue-6, ISSN: 2456-1878.

Oluwafemi, R.A (2009). Palm Kernel Cake Utilization in Monogastric Animal Feeding – Implications for sustainable livestock development. International Journal of Veterinary Medicine 6(2): 68

Omole, A.J., Obi, O.O., Ogunleke, O.O., Odejide, J.O., Awe, O.A. and Y.A. Popoola, 2011. Performance and nutrient digestibility of broiler finishers fed diets containing exogenous Hamecozyme. Proceeding of 16th Annual Conference, Animal Science Association of Nigeria. (ASAN). Sept. 12th 15th 2011 Kogi State University, Anyigba, Nigeria. Pp 399-401.

Pourhossein Z, A.A.A. Qotbi A.A. A, Seidavi A. R. Investigation on the effects of different levels of *Citrus sinensis* peel extract on gastrointestinal microbial population in commercial broilers Afr. J. Microbiol. Res. (AJMR), 6 (34) (2012), pp. 6370-6378

Roeschlau, P., Bernt, E and Gruber, W. (1974). Methods of Enzymatic Analysis.2nd English Edition,H.U.Bergmeyer,ed.Academicpress, New York.

SPSS (2007). Statistical package for social science 160 Brief guide: Spssinc 233south wacker drive, 11th floor Chicago IL 60606-6412 16.

Sunmola, T.A., Tuleun, C. D. and Oluremi, O.I.A. (2018). Performance Characteristics of Starter Broiler Chicks Fed Dietary Sun-Dried Sweet Orange Peel Meal (SOPM) with and Without Polyzyme®. Who reported that their significant increase in the final weight, weight gain and feed intake broiler chicks fed 15 % dietary SOPM with and without polyzyme®. *Scientific Research Journal (SCIRJ), Volume VI, Issue VIII, August 2018. ISSN 2201-2796.*

Wintrobe, M. N. (1983). Chemical Haematology, 4th ed. Pitman Books Ltd.

Journal of Applied Agricultural Research 2022, 10(1): 190-200
ISSN 2006-750X.

EFFECTS OF DIETARY FORMS ON CARCASS CHARACTERISTICS OF BROILER CHICKENS IN SEMI ARID ZONE OF ZAMFARA STATE.

Mohammed Shu'aibu Shinkafi[1], Musa Mabu Isa [2], Abubakar Bello Anka[3,] and Abubakar Yusuf Kakagida[4.]

Directorate of Animal Health and Livestock Development, Zamfara State.

1. Yobe State University, Desert research Monitoring and Control Centre, Damaturu Nigeria
2. Federal Ministry of Agriculture and Rural Development Gusau Zamfara State Office, Nigeria
3. Agricultural Research Council of Nigeria Abuja.

Corresponding author: isamusamabu64@gmail.com, Phone number: 08035948608. Postal address Desert research monitoring and control Centre, Yobe State University, P. M. B 1144, Km 7 Gujba Road, Damaturu, Yobe State, Nigeria.

ABSTRACT.

The experiment was conducted at the Poultry Production Unit, Directorate of Animal Health and Livestock Development Gusau, Zamfara State. The study was conducted to determine the effects of different forms of diet on carcass evaluation in broiler chickens. Two hundred and twenty five (225) day old broiler chicks were used for the research and allotted to three (3) different treatment groups. Each group was divided into five (5) replication with Fifteen (15) birds each, in a Completely Randomized Design. The data generated were subjected to Analysis of Variance (ANOVA) using star view analytical Computer Package (SAS), and Least Significant Difference (LSD) was used for mean separation. Mortality record was calculated in percentage. Significant differences ($P<0.05$) were observed in live weight gain, dressed weight, thigh, breast and gizzard weight which was significantly higher for birds on mash and pellet groups. It could be concluded from the study that feeding mash or pellet forms at finisher could give better result for the carcass characteristics. The results of cost analysis for starter showed higher cost of feed/kg (₦) for crumbs and pellets forms compared to mash form, the higher cost of live weight gain bird/ kg (₦) for mash form compared to pellet and crumbs was directly influence by the weight gain of the bird in the performance at starter phase. The higher the weight gains of the broiler the higher the cost of live weight gain bird /kg (₦). It was recommended that, feeding mash or pellet forms at finisher phase should be adopted for optimum performance.

Key words: Poultry, mash, Chicken, Broiler, Diet and carcass.

INTRODUCTION.

Poultry production is regarded as a means of sustainable livelihood and way of achieving a certain level of economic independence (Nworgu, 2007). According to Ogundipe and Sani (2002), poultry farming has significant contribution to increase income as well as nutritional status of the populace. Scanes (2007) noted that eggs and poultry meat provide an excellent source of critically important nutrient, protein, together with minerals and vitamins. According to Longe (1986), poultry production represents the

fastest means of correcting shortage of animal protein, because of their faster rate of production and quick turn over rate of investment. Poultry products such as meat and eggs are considered as excellent source of proteins necessary to meet the requirements of both infants and vulnerable people (Olawumi *et al.,* 2012).

Broiler production is the third largest agricultural revenue generating industry in Nigeria, it represents one of the fastest growing industries around the world (Damona *et al.,* 1992). In 2003, approximately 42 billion poultry were produced worldwide (Skip and Anne, 2002). Broiler production started in Nigeria in 1950's and 60's along with other modern agricultural development technologies that were imported by the colonial masters during the colonial and immediate post-independence era when technology transfer was regarded to be the best method of modernizing the Nigeria agriculture (NAPRI, 2002).

Broiler production involves the keeping of chickens of heavy meat species for the purpose of getting good quality meat products usually sold live or processed at ten to twelve weeks of age (Amos, 2006). Broiler production in the tropical and sub-tropical countries has rapidly increased as a result of increasing population and rise in consumer income. Despite the challenges such as economic crises, currency devaluation, reliance on imported materials and climatic changes faced by broiler industries in developing nations, it is predicted that broiler production in these areas will continue to sustain further growth in the future (Ojano-Darei and Waldoup, 2002). Broilers are the important source of table meat in Nigeria. They are fast growing and are efficient converters of feeds.

The success of exotic breeds and the ease of mastering the techniques of poultry production among other factors has made it developed to the status of agribusiness in Nigeria as distinct from subsistence production (Nwajiuba and Nwoke, 2000; Sani, *et al.,* 2000). There has been rapid increase in the number of farmers owning broiler parent and grandparent stocks leading to an increase in the population of meat type chicken in Nigeria (Adebambo *et al*., 2005). Commercial hatchery operations are not well developed in Nigeria and the few hatcheries located in specific parts of the country appear to be experiencing increasing demand due to continued growth of the poultry industry (Muhammad *et al.,* 2009). These farmers hatch and sell strains of broilers using different brand names (Udeh *et al.,* 2011).

The challenges of food insecurity and hunger worldwide and particularly in developing countries like Nigeria have continued to receive attention from experts and governments (FAO, 2003; Babatunde *et al*., 2007). Poultry production enterprise in Nigeria has suffered more than any other livestock subsector as a result of these challenges. To end this, the government in collaboration with other International Agencies like the United States Agency for International Development (USAID) established poultry supply and training centres in Kaduna, Illorin and Jos (Northern Zone), Agege (western Zone) and Abakiliki (eastern Zone) to improve livestock production, supply and provide manpower generation (Yusuf, 2001).

The high cost of animal products could be traced to the high cost of feed which sometimes accounts for about 70% of the total cost of broiler production (Kehinde *et al.,* 2006). .The form (mash, crumbs or pellets) in which a diet is fed to poultry played significant role in growth rate

(Jafarnejad *et al.*, 2010). Therefore, diet form directly influences the cost of feed and production performance of broiler (Zohair *et al.,* 2012).

There is contradiction in results concerning the impact of the diet form on the performance of broiler. Mendes *et al.* (1995) showed that birds fed mash diet had better feed conversion efficiency than those fed pelleted diet Jahan *et al*. (2006) reported that feeding crumbs form is better than mash and pelleted forms for the production of the commercial broiler. However, mash or crumbs starter diets followed by pellet or crumbs have the same performance in some studies (Scott, 2002). According to these observation, birds fed a smaller pellet size could be comfortable eating and consequently these birds spend less energy for eating. Thus, birds fed pelleted diets increase the net energy value due to increasing resting behavior and decreasing time eating (Skinner-Noble *et al.,* 2005).

Feed wastage is considered as one of the most important problem facing the poultry industry in Nigeria, which causes reduction in the feed consumption by birds, increase in the cost of poultry feeding, which may have direct effect on the performance of broilers. Diet forms (mash, crumbs and pellet) directly influence the cost of feed and production performance of broiler (Zohair *et al.,* 2012). This may not be unconnected with the high cost of processing machine which increased the cost of production and materials used in either pelleting or making it crumbs. The use of locally fabricated materials to use for pelleting and make crumbs forms of poultry could reduce the cost of processing and are likely to improve farmers income.

The diet form directly influences the cost of feed and production performance of broiler (Zohair *et al.,* 2012). As the feed processing machine is very expensive the small and medium scale poultry farmers cannot obtain the machine easily. The study when completed may provide vital information to small and medium poultry farmers, on how to prepare their diet in different forms using cheap and locally available materials.

The objective of this study was to:

Evaluate carcass characteristics of broiler chickens fed different dietary forms

MATERIALS AND METHODS.

The Study Area.

The experiment was conducted at the Poultry Production Unit, Directorate of Animal Health and Livestock Development Old Kara area Gusau, Zamfara state. Zamfara state was created out of Sokoto state in 1996. The state covers a geographical land area of 38,418 square kilometers with an estimated population of about 3,259846 (NPC, 2006). It is located between Latitude $12^0\ 09^l\ 15$" N and Longitude $06^0\ 40^l\ 0$" E (Edwin *et al.,* 2014). The state shared border with Sokoto state and Niger republic to the North, Kebbi and Niger State to the west, Katsina state to the east, and Kaduna state to the south. The climate of Zamfara state is characterized by a long hot-dry season lasting from October to May and a short warm wet (rainy) season that usually starts in mid-May and ends in September. The annual rainfall of the area ranges between 550-900mm, with duration of 3-5 months. The maximum temperature of the area is 41^0C in April and minimum of 13.2^0C in January. Relative humidity varies from 20 to 72% in the morning and from 7.5 to 63% in the afternoon (Dan Gusau, 1998).

Experimental Design.

A total of 225 day old Arbor acre broiler chicks of mixed sexes were used, for the experiment in a completely randomize design. The birds were divided into three treatments groups each treatment was

replicated five times with 15 birds per replicate. The three treatment diets were formulated to contain the same levels of nutrients and ingredients, only to differ in the form in which the diet was offered (mash, pellets and crumbs).

Preparation of the Experimental Diet.

A single diet was formulated to contain the same levels of nutrients and ingredients, only to differ in the form in which the diet was offered (mash, pellets and crumbs). Table 1, represents the gross and chemical composition of the experimental diets at starter and finisher phases.

Table 1: Gross and Chemical Composition of the Experimental Diets at Starter and Finisher Phases

Ingredient in kilograms/grams	**Starter**	**Finisher**
Maize (Kg)	49.00	49.00
Ground nut cake (Kg)	18.40	13.00
Soya beans meal (Kg)	22.00	17.45
Wheat offal (Kg)	5.00	16.40
Blood meal (Kg)	1.00	0.00
Lime stone (Kg)	1.50	1.00
Bone meal (Kg)	2.00	2.00
Vitamin/Mineral Premix* in (g)	0.25	0.25
Methionine (g)	0.30	0.30
Lysine (g)	0.30	0.30
Salt (g)	0.30	0.30
Total	**100.05Kg**	**100.00Kg**
Calculated Chemical Analysis		
ME (Kcal/kg)	3,100.00	2,924.00
Crude Protein (%)	24.00	21.00
Lysine (%)	1.40	1.20
Methionine (%)	0.60	0.60
Calcium (%)	1.00	1.00
Available Phosphorus (%)	0.60	0.50
Crude Fibre (%)	5.30	5.60
Ether Extract (%)	5.00	4.70

Source: Animal care services consult, Nigeria limited

*Vitamin/Mineral Premix contained; Vitamin A, 1000 I.U, Vitamin D1, 3000 I.U, Vitamin E 8.0 I.U, Vitamin K, 2.0mg, Vitamin B1, 2.0mg, Vitamin B6, 1.2mg, Vitamin B12, 0.12mg, Pantothenic acid, 7.0mg, Mg 1000mg, Cu, 8.0mg, Co, 0.45mg and Se, 0.1mg per kg of diet.

The Mash diet was presented as formulated to the chicks at all stages i.e. starter and finisher stages. The mash form of the diet was used to form the crumbs. A total of 1% of edible starch was diluted with water and spread on the mash. It was thoroughly mixed and allowed to dry under shade for 2 hours. The dry diet was broken into desired crumbs and fed to the chicks at starter and finisher stages of growth.

The mash diet form was used to produce the pellets diet. Silver tray which was perforated at the bottom with desired holes (3 mm in diameter for the starter diet and 6 mm in diameter for the finisher diet) were used to prepare pellets. A total of 1% of edible starch

was diluted with 1 liter of water per 2 kg of feed. The starch served as a binder. The diluted starch was spread on the mash and thoroughly mixed together. The perforated silver tray was filled with the mixed diet and used mechanical forces to insert pressure to press the feed out from the holes. After that, the feed was allowed to dry under shade for 5 hours and fed to the chicks at starter and finisher stages.

Proximate Analysis of Different Dietary forms.

Proximate analysis was conducted using AOAC (1991) method in order to determine the proximate composition of the diet. To determine the energy, crude proteins, ether extract, crude fibre, and ash.

Sources and Management of the Experimental Birds.

The birds used for the experiment were sourced from commercial farm called Yamfy Farm at Kwara State Nigeria through their authorized Poultry Vendor in Gusau. The experimental birds were kept for three days after transport to take care of stress due to transportation. During the period, anti-stress and anti-biotic drugs were administered to the birds. After three days the birds were weighed and allotted to their replicate groups. Each treatment was replicated five times. Routine vaccination, antibiotic, and Coccidiostats were administered according to the recommendation of Oluyemi and Roberts (2000). The birds were housed on a deep litter with open sided walls. Prior to the arrival of the chicks, the house was cleaned, washed, fumigated and disinfected. After drying, the experimental room was divided into fifteen separate pens of equal size 5 x 5 feet length and breadth with wire net. The height of each net partition was ninety centimeters (90 cm). Litter materials were spread on the floor two days before the chicks arrived. Feeder trays and small drinkers were placed in each replicate in such a way that the chicks were able to eat and drink conveniently for starter phase. Conical feeder and large drinker size with grid wire were used for finisher phase. A 100 watt electric bulb was hanged at a height of 2.8 meters in the middle of each pen as a source of heat and light. Feeds and cleaned water were given *ad-libitum* during the experimental period. Drinkers were washed and cleaned daily in the morning and feeders were cleaned weekly before being used. Sanitary measures were followed during the experimental period. Dead birds were sent to the pathology laboratory for diagnosis during the experimental period.

Data Collection.

Feed intake and water intake were recorded on daily basis by subtracting the left over from the quantity of feed offered the previous day. Body weight gain was recorded weekly by weighing the birds and determining increase or loss of weight. Record of feed intake and weight gain were used to calculate the feed conversion ratio for each replicate. Mortality record was also carried out. The cost of feed ingredients, diets processing for the three diet forms were used to compare with weight gain which were used to calculate the cost analysis.

At the end of finisher phase (i.e. eight week), three birds were slaughtered from each replicate for carcass evaluation. Weight of primal cuts, internal organs, feathers and dressed weight were recorded. Weight of cut parts, fat and internal organs relative to dressed weight were also determined. Dressing percentage was determined from live weight and dressing weight, using the formula:

$$\text{Dressing \%} = \frac{\text{Dressed weight}}{\text{Live eight}} \text{ x } 100$$

Data Analysis

Data collected for final weight gain, and carcass evaluation were subjected to analysis of variance (ANOVA) using star view analytical Computer Package (SAS), and Least Significant Difference (LSD) was used for mean separation. Mortality record was calculated in percentage.

RESULTS AND DISCUSSION.

Proximate Analysis of the Experimental Starter and Finisher Diets.

Results of proximate analysis of the experimental diets for starter and finisher phases are represented in Table 2.

Table 2: Proximate Analysis of the Experimental Diet.

Parameters in %	Diets	
	Starter	Finisher
Moisture (%)	8.70	8.60%
Crude Protein (%)	24.50	21.90
Crude Fibre (%)	3.50	4.20
Ash (%)	10.06	12.27
Metabolizable Energy, ME Kcal/kg	3046.00	2970.55
Fat (g)	5.90	6.50

Source: Animal Care Services Konsult, Nigeria limited.

Table 3: Carcass Characteristics of Broiler Birds Fed Different Form of Diets.

Parameter	Diet Forms			
	Mash	Crumbs	Pellet	SEM
Live weight (g)	1680.00^{a}	1428.00^{b}	1692.00^{a}	62.23
Dressed weight (g)	1470.00^{a}	1224.00^{b}	1464.00^{a}	66.71
Dressing percentage (%)	87.20	85.75	86.38	1.25
Thigh (g)	377.00^{a}	298.00^{b}	390.00^{a}	23.38
Breast (g)	424.00^{a}	340.00^{b}	407.0^{a}	17.62
Neck (g)	61.00	61.00	60.00	1.72
Head (g)	53,00	56.00	52.00	1.89
Wing (g)	144.00	133.00	150.00	9.85
Gizzard (g)	58.00^{a}	52.00^{b}	56.00^{ab}	1.63
Liver (g)	37.00	32.00	39.00	5.50
Heart (g)	26.60	13.00	28.00	4.88
Intestine (g)	210.00	177.40	223.00	15.76
Abdominal Fat (g)	34.60	24.40	32.00	3.21

Means along the same row with different superscripts are significantly different at (P<0.05**)**

Table 4; Represents the weight of primal cut related to the dressed weight of different parts of broiler chicken fed different of dietary forms at finisher phase.

Weight of primal cut relative to dressed weight (%)

		Dietary Forms	
Parameter	Mash	Crumbs	Pellet
Live Weight (g)	1680.00	1428.00	1692.00
Dress Weight (g)	1470.00	1224.00	1464.00
Dressing (%)	87.20	85.75	86.38
Thigh (g)	25.65	24.35	26.64
Breast (g)	28.84	27.78	27.80
Neck (g)	4.15	4.98	4.10
Head (g)	3.61	4.58	3.55
Wing (g)	9.80	10.87	10.25
Intestine (g)	14.29	14.49	15.23
Abdominal Fat (g)	2.35	1.96	2.19
Mortality (%)			

Means along the same row with different superscripts are significantly different at (P<0.05**)**

Result showed that, the moisture content of the starter diet was higher than that of finisher diet. The dry matter was (93.00%) and (94.00%) respectively for starter and finisher diet. Starter diet had higher crude protein content than that of finisher diet. Crude fibre was lower in starter diet than that of finisher diet which had higher crude fibre content. Similarly, ash content of the finisher diet was higher than that of starter diet. The Ether Extract also was higher in finisher than that of starter diet. Similarly, mortality of chicks for all the groups were similar (P>0.05) across the dietary treatments.

Carcass Analysis.

From the results of the carcass analysis, presented in the table 3, live weight and dressed weight were significantly (P<0.05) higher for chicks fed mash and pelleted diets than those fed crumbs diet. These parameters were affected in similar pattern. However, dressing percentage of chicks for all treatment groups were similar (P>0.05) irrespective of the form in which the diet was fed. From the results in table 2.3 and 4, it was shown that with exception of thigh, breast, and gizzard all other components of the carcass cuts were not significantly different (P>0.05) among the broiler bird fed different experimental diets at the end of finisher phase (8 weeks of age).

The dressing percentage of the broiler for all the three forms of diet was similar. The results were similar to that of Farghly *et al.* (2014) who obtained similar non-significant value when they fed four forms of diet (mash, pellets, crumbs, and wet diets). Earlier, Engberg *et al.* (2002), Salari *et al.* (2006), Brickett *et al.* (2007) and Aderibigbe *et al.* (2013) reported that birds fed crumbs and pellets feed showed higher value for breast, gizzard and dressing percentage compared to those on mash feed.

The results agreed with the findings of Ahmed and Abbas (2012) who reported significantly heavier gizzard weight in broiler fed mash compared to those fed with pellets and (50:50) mash + pellet. Similarly, Frikha, *et al.* (2009), Yarghoubfar *et al.* (2009) and Hassan and El-sheikh (2010) found out that birds fed pelleted diet resulted in decrease of gizzard weight and meat yield.

The results were not in support of Engberg *et al.* (2002), Salari *et al.* (2006), Brickett *et al.* (2007) and Aderibigbe *et al.* (2013) who found that birds fed with the crumbs and pellets feed showed higher value for breast, gizzard and dressing percentage compared to those on mash feed. However, the result disagreed with Farghly (2012) who reported that birds fed pellets and wet diets had superior dressed carcass and breast percentages compared to birds fed mash. While birds fed pellets had higher gizzard percentage compared to birds fed mash form. The Results also were in disagreement with Shaflee Sarvestani (2006) who found that the weight of breast, thigh, abdominal fat, and heart were significantly (P<0.05) heavier in broilers fed pellet diets than in the broilers fed mash diets.

Cost Analysis.

From the results obtained; the cost analysis of broilers fed different forms of diet at finisher phase, were presented in the table 5.

Table 5. Cost Analysis of Broiler Finisher Fed Different Forms of Diet

	Diet Forms			
Parameters in Kg/bird and ₦/bird	Mash	Crumbs	Pellet	SEM
Total feed intake (kg/bird)	2.97	2.98	2.99	0.30
Body Weight Gain (kg/bird)	1.20	0.99	1.15	0.19
Cost of Feed (₦/kg)	130.85	138.05	138.94	3.75
Cost of Medication (₦/bird)	23.33	23.33	23.33	0.00
Cost of Feed consumed(₦/bird)	388.10	410.77	416.20	43.74
Cost of Live Weight Gain/ bird (₦)	720.12[a]	598.16[b]	692.02[a]	28.97

Means along the same row with different superscripts are significantly different at (P>0.05**)**

All parameters were similar (P>0.05) with exception of cost of live weight gain/bird in naira (₦). The cost of live weight gain/bird in naira (₦) were significantly (P<0.05) higher in broiler fed mash and pellet groups compared to those fed with crumbs. The results of cost analysis for starter showed higher cost of feed/kg in naira (₦) for crumbs and pellets forms compared to mash form. This was attributed to the additional cost of other materials used for crumbing and pelleting the diet such as edible starch, and tray for pelleting. The higher cost of live weight gain of bird/ kg in naira (₦) for mash form compared to pellet and crumbs was directly influence by the weight gain of the bird in the performance at starter phase. The higher the weight gains of the broiler the higher the cost of live weight gain per bird /kg in naira (₦). The results obtained from the cost analysis for the finisher phase showed higher cost of live weight gain of bird/ kg in naira (₦) for mash and pelleted foams compared to crumbs foam which had lower cost of live weight gain of bird/ kg in naira (₦). This have direct influence by the weight gain of the bird in the performance at finisher phase. The higher the weight gains of the broiler the higher the cost of live weight gain of bird /kg in naira (₦).

CONCLUSION.

From the result of this study it could be concluded that feeding birds at starter phase with mash form improves feed and water intake, feed conversion ratio and body weight gain. The performance of broiler birds at finisher phase, showed no significant effects for all parameters with exception of feed conversion ratio. The birds fed mash and or pellet diets had heavier breast, thigh and shank and gizzard weight and are better for economic benefit compared to those fed

crumbs diet. The mortality recorded was attributed to the Gomboro disease outbreak at the 4th week rather than the experimental diets. From the outcome of this study, it may be recommended that, feeding mash or pelletized diet forms at finisher phase would is more preferred for better performance of broiler birds and are better for economic benefit as compared to crumbs form.

REFERENCES.

Adebambo, A. O., O. I. Faybenvo, S. O. Faragite, C. O. N. Ikobi and O. A. Adebambo, (2005). Preliminary assessment of growth and reproductive data of three strains of chickens for broiler development in Nigeria. "Climate change implication for poultry production in Africa. Edited by O. M. Onagbesan". Proceedings 1st Nigerian International Poultry Summit. Ota Ogun State. Pp 9-11.

Aderibigbe, O. B., O. M. Sogunle, L. T. I. Egbeyale, S. S. Abiola, O. A. Ladokun, and O. L. Ajayi, (2013). Pelletizing Feed of Different Particle Sizes: Effect on Performance, Carcass Characteristics and Intestinal Morphology of two Strains of Broiler Chicken. *Pertanika Journal of Tropical Agricultural Science,* 36:127-144.

Ahmed, M. E. and T. E. Abbas (2012). The effect of feeding pellets versus Mash on performance and Carcass Characteristics of Broiler Chicks. *Bulletin of Environmental, Pharmacology and Life Sciences* 2(2):31-34.

Amos, T. T. (2006). Analysis of Backyard Poultry Production in Ondo State, Nigeria. *International Journal of Poultry Science.* 5(3): 247-250.

A. O. A. C, (1991), Official Methods of Analysis. 15th edition Association of Official Analytical Chemists, Washington D.C.

Babatunde, R. O., O. A. Omotosho and S. O. Sholoton (2007). Social-Economic Characteristics and food security status of farming Households in Kwara State, North Central Nigeria. *Pak. Journal of Nutrition.* 6:49-58.

Brickett, K. E., J.P. Dahiya, H. L. Classen, C. B. Annett, and S. Gomis (2007). The impact of nutrient density, feed form, and photoperiod on the walking ability and skeletal quality of broiler chickens. *Journal of poultry Science.* 86:2117-2125.

Damona, G. D., G. B. Joe, R. G. Parman, and E. N. Patricia (1992). Broiler production management. Oklahoma State University, Chicago, IL, USA.

Dangusau, A. M. (1998). *Who is who in Zamfara State?* Mega Press Limited, Kaduna Nigeria, pp 1-39.

Edwin, A. U., A. L. Ahmed, and O. M. Adamu (2014). Full paper in Environmental Dynamics and Sustainable power system infrastructure on the Zamfara plains: A longitudinal assessment. Department of Engineering Technogy. Federal Polytechnic Kaura Namoda, Nigeria.

Engberg, R. M., M. S. Hedemann and B. B. Jensen (2002).the influence of grinding and pelleting of feed on the microbial composition and activity in the digestive track of broiler chickens. *Broiler. Poultry Science.* 43:569-579.

FAO, (2003). Food and Agricultural Organization. The state of food and Agriculture, Rome, Italy.

Farghly, M. F. A.(2012). Effect of mash, pellets, crumbles and wet feed on performance of Japanese quail during the

summer. *Egyptian Journal of Nutrition and Feeds.* 15: 161-172.

Frikha, M., H. M. Safaa, M. P. Serrano, X. Arbe and G. G. Mateos (2009). Influence of the main cereals and feed form of the diet on performance and digestive track traits of brown-egg laying pullets. *Poultry Science.* 88:994-1002.

Hassan, M. M., and S. E. M. El-Sheikh (2010). Effect of Physical Form of Diets on the Performance of Ducks. *Egypt. Poultry Science,* 30:989-1002.

Jafanrnejad, S., Farkhoy M, sadegh M, Bohonar R. A (2010). Effect of crumble, pellet and mash diet with different levels of dietary protein and energy on the performance of broilers at the end of the third week. *Vet. Med. International article* 28123, *www.hindawi.com/journals/vmi/2010/328123/*

Jahan, M. S., Asaduzzaman M., Sarkar A. K. (2006). Performance of broiler fed on mash, pellet and crumble. *International Journal Poultry Science* 5(3):265-270.

Kehinde, A. S., Babatunde, T. O., Ayoola O. A. and Temowo, O. O. (2006). Effect of different levels of protein on the growth performance characteristics of broiler chicks. Proceeding of the 31th Annual Conference Nigerian Society of Animal production (NSAP), March 12th-15th Bayero University, Kano, Pp: 235-237.

Longe, O. G. (1986). Replacement value of biscuit waste for maize in broiler diets. *Nigerian journal of Animal Production* 13(1&2):70-78.

Mendes, A. A., Polity E. S., Carcia E. A. and Sartori J. R. (1995). Effect of ground of pelleted diets on the performance and carcass yield of broiler chicken. *Veterinaria-Zootecnia* 7:31-40.

Muhammad, M., L. U. Muhammad, A. U Mani and A. G. Ambali (2009): A survey of chick mortality at hatching in three selected hatcheries in Jos central Nigeria. *International Journal of Poultry Science.* 8(7): 656-659.

NAPRI, (2002). Poultry Production in Nigeria. A training manual on national training workshop on poultry production in Nigeria. Gefu, J.O., I.A. Adeyinka, and A.A. Sekoni (Eds). National Animal Production Research Institute, Ahmadu Bello University. Shikka, Zaria.

NPC, (2006). National Population Commission. National Population Census Report. Census 2006. Abuja, Nigeria.

Nwajiuba, C. and E. Nwoke (2000). Inflation and the poultry industry in Nigeria: Implication of profitability. In: Orji, U.I., O.O. Mgbere (Eds) Proceedings of the 5th Annual Conference of the Animal Science Society of Nigeria. Port Harcourt, Nigeria, pp. 206-208.

Nworgu, F. C (2007). Economic importance and growth rate of broiler chickens served Fluted pumpkin (*Telfaria occidentalis*) leaves extract. *African Journal of Biotechnology*, 6 (2) 125-129.

Ogundipe, S. O. and S. A. Sani (2002). Economic of Poultry Production in Nigeria. Training Manual on poultry production in Nigeria. (Eds. J. O. Gefu, I. A. Adeyika and A. A. Sekoni). Paper presented at a Training Workshop on Poultry Production in Nigeria held at NAPRI/A.B.U, Zaria. Sept. 1 – 6th, 2002.

Ojano-Darei, C. P and P. W Waldroup, (2002): Protein and amino acids need of

broilers in warm weather. *International journal of Poultry Science* **1**(4): 40-46.

Olawumi, S. O, Fajemilehin, S. O. and Fagbuaro, S. S. (2012). Genotype and sex interaction effects on carcass traits of three commercial broiler chickens. *Journal of World Poultry Research*, 2(1):21-24.

Oluyemi, J. A. and Roberts, F. A. (2000). *Poultry Production in the Warm Wet Climate.* 2nd edition. Macmillan Publishers. New Zealand.

Salari, S., H. Kermanshahi, and M. H Nasiri (2006). Effect of Sodium Bentoniite and Comparison of Pellet vs. Mash on Performance of Broiler Chickens. *International Journal of Poultry Science.* 1:31-34.

Sani, R. M., I. Tahir and S. Kushwasha (2000). Economics of poultry production in Bauchi State: A case study of Bauchi Local Government Area, Nigeria. *Journal of Animal Production.* 27(1): 109-113.

Scanes, C. G. (2007). Contribution of Poultry to Quality of Life and Economic Development in the developing world. *Poult. Sci.* 86 (11). http://ps.fass.org/cgi/reprint/86/11/2289.

Scott, T. A. (2002). Evaluation of lighting programs, diet density and short-term use of mash as compared to crumbled starter to reduce incidence of sudden death syndrome in broiler chicks to 35 days of age. *Can. Journal of Animal Science* 82: 375-383.

Shaflee Sarvestani, T., N. Dabiri1, M. J. Agah, and H. Norollahi, (2006). Effect of pellet and mash diets associated with Biozyme Enzyme on Broilers performance. *International Journal of Poultry Science.* 5(5): 485-490.

Skinner-Noble, D. O., McKinney, L. J. and Teeter, R. G. (2005). Predicting effective caloric value of non-nutritive factors: III. Feed form affects broiler performance by modification behavior patterns. *Poultry Science* 84: 403-41.

Skip, A. S. and G. F. Anne (2002). Which bird shall I raise? Genetic options for pastured poultry producers: Meat- Type chickens and Turkeys. American Pastured Poultry Producers Association (APPPA).

Udeh, I., J. O. Isikwnu and G. Ukughere, (2011). Performance Characteristics and Prediction of Body weight gain using linear body measurement in four strains in broiler chicken. *International Journal of Animal and Veterinary Advances* 3(1): 44-46.

Yarghoubfar, A., R. Samiei, B. Dastar, S. Zerehdaran, F. Niknafs and V. Taghizadeh (2009). The effect of feed form (Pellet and mash) and nutrients and metabolizable energy levels on performance of broiler chickens. *Journal of Agricultural Science and Natural Resources* 16: A pp. un-paginated.

Yusuf, A. L. (2001). Processing and acceptability of poultry in SokotoMetropolis. B.Sc. Project Report, Department of Animal Science, Usmanu DanFodiyo University Sokoto, Nigeria pp. 25-34.

Zohair, G. A. M., G. A. Al-Maktari, and M. M. Amer (2012). A comparative effect of mash and pellet feed on broiler performance and as cites at high altitude (field study). *Global Vet*. 154-15