ISSN 0189-0514
J. Anim. Prod. Res. (2017) 29(2):238-248

National Animal Production Research Institute
Ahmadu Bello University
P.M.B 1096, Shika-Zaria,
Kaduna State, Nigeria.
Email:japr@napri.gov.ng Url:journals.napri.gov.ng

COMPARATIVE STUDY OF EGG PRODUCTION AND REPRODUCTIVE PERFORMANCE OF INDIGENOUS CHICKENS AND THEIR NAPRI -X CROSSES

Alabi, I. I., *Abbaya, H. Y., Orunmuyi, M. and Mohammed, U. R.
Department of Animal Science, Ahmadu Bello University, Zaria
**Phone no: (+234)7036608339. Email: abbaya177@gmail.com*

ABSTRACT

A comparative study was conducted on the egg production and reproductive performance of three Nigerian indigenous chickens and their crosses with NAPRI X. These include; Normal feathered (N) Naked neck (Na) and Frizzle feathered (F) and their respective crosses with NAPRI X to form crosses of Normal x NAPRI X (NNPX), Naked neck x NAPRI X (NaNPX), and Frizzle x NAPRI X (FNPX). 115 birds comprising of 30 hens and 5 cocks each of the indigenous chickens and 10 cocks of NAPRI X Broilers were used as parent stocks. The birds were divided into 6 genotypic groups. Mating among the indigenous groups was done while mating among crosses was done using artificial insemination. Data obtained was analyzed using one way ANOVA using SAS. Egg set number, Percentage fertility, hatchability and dead in shell significantly differed (P <0.001) among both the indigenous and crosses. NNPX recorded the highest dead in shell (47.49%) among the indigenous chicken while the highest was in FNPX (31.86) among the crosses. Two Principal Components (PCs) were extracted for each genotype. PC1 was related to overall egg number while PC2 could be termed a measure of fertility measurements. In conclusion, the study revealed that the indigenous pure bred frizzle had better reproductive performance while frizzle and normal feather may have a better combining ability for egg production for commercial purposes.

INTRODUCTION

Poultry is now by far the largest livestock species worldwide **(**FAO, 2014), accounting for more than 30% of all animal protein consumption (Permin and Pedersen, 2000). The International Food Policy Research Institute (IFPRI, 2000) estimated that by year 2015, poultry would account for 40% of all animal protein. Indigenous chickens are widely distributed in the rural areas of tropical and sub-tropical countries where they are kept by the majority of the rural poor. Chickens largely dominate flock composition and make up for about 98% (Gueye, 2003) of the total poultry numbers (chickens, ducks and turkeys). The distribution and density of birds vary from place to place, but they are found in most parts of the country suitable for human settlement. The indigenous chickens, which are basically non descriptive in nature, vary widely in body size, conformation, plumage colour and other phenotypic characteristics.

Indigenous chickens are essential part of the Nigerian society which is reported to be domesticated as early as 2500 BC (Farrell, 2005). Indigenous chickens in Africa are in general hardy, adaptive to rural environments, survive on little or no inputs and adjust to fluctuations in feed availability (IFPRI, 2000; Ajayi, 2010). Earlier attempts to improve the performance of indigenous chickens started in the late 1930's (Otchere *et al.*, 1990; Oke, 2011) in which there was the introduction of the village poultry improvement scheme which was based on cockerel exchange. These attempts were made in the past to improve the productivity of the indigenous chicken due to its potential as a source of meat to reduce significantly the gap of animal protein deficiency in the society (Otchere *et al.*, 1990; Ubani *et al.*, 2011; Oke, 2011; Ojedapo, 2013).

One of the ways to enhance the commercial values of the indigenous chicken is to improve their fertility and breeding performance

(Ubani *et al*., 2011; Ojedapo, 2013). This may be achieved through the utilization of advantageous gene in breeding strategies. Horst (1998) identified nine major genes of the indigenous chicken that can be used in genetic improvement programme. Among these include Normal feathered (N) the Naked Neck (Na), and frizzle gene (F), in our indigenous chicken populations. Machebe and Ezekwe (2005) reported that birds which possessed these genes needed to be explored for the development of a viable indigenous poultry industry.

The productivity of indigenous birds which is expressed in terms of egg production, egg size, growth and survivability of chicks under the rural production systems was reported to be very low (Ajayi and Agaviezor, 2016). This low productivity may be attributed to lack of improved poultry breeds, presence of predators, incidence of chicken diseases, poor feeding and management factors among others (Alemu, 1995).

Crossbreeding has been a major tool for the development of present day commercial breeds of chickens (Sheridan, 1981) and could likewise be used to improve the indigenous chicken. Parent stocks of NAPRI X used in this work had been selected for fast growth over several years and can be used to upgrade indigenous chickens. In Nigeria, limited attention has been given to the upgrading of indigenous non-descriptive chicken types using high performing broiler breed types. Similar research is at its rudimentary stage for the identification, description and evaluation of these genetic resources for improved performance and productivity. Therefore, this paper aims at comparing the egg production and reproductive performance of indigenous chickens and their crosses with NAPRI X broiler chicken.

MATERIALS AND METHODS

Location of the Study

The study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Zaria. The geographical location of Zaria is at the Northern Guinea Savannah of Nigeria, which lies between latitude 11º 09' 06" N and longitude 7º 38' 35" E (Ovimaps, 2015). Zaria is at an altitude of 706m above sea level. The area is characterized by 6 to 7 months of rainfall ranging from 1100mm to 1250mm annually. The ambient temperature of Zaria is 26°C. The area has clear distinctive dry and wet seasons. The ambient temperature rarely falls below 26°C except during Harmattan period when temperature below 26°C may be recorded. However, annual temperature rarely exceeds 35°C (Ovimaps, 2015).

Experimental Birds and Management

Three genotype of Nigerian indigenous chicken namely; Normal feather (N), Naked neck (Na) and Frizzle feather (F) and Exotic broiler breed known as NAPRI X were used as the foundation stocks. A total of 115 chickens comprising 30 of Normal feather (N), Naked neck (Na), Frizzle feather (F) hens each, 5 Normal feathered cock (N) and 5 of Naked neck (Na), 5 Frizzle feathered (F), and 10 of the Exotic broiler (NAPRI X) cocks. Chicken were raised on deep litter. Layers mash containing crude protein of 18.05% and metabolizable energy of 2520Kcal/Kg DM was fed to the birds and water was supplied *ad-libitum* to the indigenous birds while170g of feed/bird were fed to NAPRI X to prevent laying down fat. The birds were grouped in a separate pen while broilers were also kept on a separate pen for easy semen collection. Pen mating was allowed within each group of indigenous chicken while artificial insemination was used in crossing the indigenous hens and the NAPRI X cocks.

Breeding Plan

The three (3) genotypes (Normal feather, Frizzle and Naked Neck) comprised of 30 hens per genotypic group were divided into two groups per genotype containing 15 hens to make six groups. Five cocks were introduced to their respective genotypic group to allow pen mating while the other three groups were inseminated with semen from NAPRI X. The mating was done in the ratio of 1 rooster to 3

hens (1:3) among the first three genotypic groups of indigenous chicken while the other 3 groups were inseminated. A total of six genotype groups were generated from the mating as shown in the table as shown in the table below.

Table 1: Mating Scheme for the Foundation Stock

Male		Female	Genotype
Normal feathered	X	Normal feathered	N
Frizzle feathered	X	Frizzle feathered	F
Naked neck	X	Naked neck	Na
NAPRI X	X	Normal feathered	NNPX
NAPRI X	X	Frizzle feathered	FNPX
NAPRI X	X	Naked neck	NaNPX

N=Normal Feather, F=Frizzle, Na=Naked neck. B=broiler. NNPX=Normal x NAPRI X, FNPX = Frizzle x . NAPRI X. NaNPX = Naked neck x NAPRI X.

Hatching Process

Eggs laid were labeled with group identification numbers and was collected daily at an interval of one week and then taken to the hatchery. Settable eggs were sorted out in group-wise and within genotypes before setting. The eggs were set after which they were fumigated with potassium permanganate ($KMno_4$) and hydrogen peroxide (H_2O_2) in the fumigation room for about 30 minutes and later taken into the incubator with a temperature of about 37ºC. Candling of the eggs was done between the 10^{th} – 13^{th} days then on the 18^{th} day; the fertile eggs were transferred to the Hatcher. Hatching trays were partitioned into a number of compartments according to sire number. Eggs belonging to the same group were put into the same compartment. The chicks were hatched from 3^{rd} days in the Hatcher (Alao 2011).

Egg Production and reproductive Traits

Egg data were taken immediately after the collection to avoid loss of identification. The egg parameters taken include; egg number, percent fertility, percent hatchability, percent dead in shell, and percent hatched. Egg records were evaluated using percentages

Egg number was recorded as the total number of eggs laid by each genotype during experimental period.

Percentfertility: This is taken as the percent of eggs that were fertile out of the eggs set.

Percent Fertility

$$= \frac{\text{Number of fertile eggs}}{\text{Number of set eggs}} \times 100$$

Percent Hatchability: This is taken as the percent of eggs that hatched out of all the fertile eggs set.

Percent Hatchability

$$= \frac{\text{Number of chicks hatched}}{\text{Number of fertile eggs}} \times 100$$

Percent dead in shell: This is taken as the percent of dead in shell out of all the fertile eggs set

Percent Dead in shell

$$= \frac{\text{Number of dead in shell}}{\text{Number of fertile eggs}} \times 100$$

Percent Hatchability: This is taken as the percent of eggs that hatched out of all the eggs set.

Percent Hatch

$$= \frac{\text{Total number of chicks hatched}}{\text{Total number of eggs set}} \times 100$$

Statistical Analysis

Model for Investigating the Effect of Genotype and Hatch Number on Reproduction Trait is given below;

$$Y_{ij} = \mu + G_i + H_j + e_{ij}$$

Where; Y_{ij} = observation on the i^{th} genotype at the j^{th} Hatch, μ = overall population mean, G_i = Fixed effect of genotype (i=1, 2, 3, 4, 5 and 6), A_j = Fixed effect of hatch (j= 1, 2, 3, 4, 5) and e_{ij} = Random error.

The data generated from egg production and reproduction trait were subjected to one way analysis of variance (ANOVA) using the SAS, 9.2 (2003). Principal component was also used to compare among the six genotypes. Principal components analysis was performed using the same Software.

RESULTS AND DISCUSSION

The Means of reproductive performance of indigenous chickens and their crosses with NAPRI X are presented in Table 1. The number of egg set for N, and F (6.60 each) significantly differed (P <0.001) from Na (5.40) among the three group of indigenous chickens, also in the other three groups that were crosses, the FNPX (19.00) was significantly (P<0.001) higher than NaNPX (17.40) while the least number set was recorded in NNPX, (15.20). The total number set from each group of crossbreds were generally higher than their respective indigenous groups. Among the crosses, the percentage hatchability of NNPX (90.29) was significantly higher than that of FNPX which was equally higher than the NaNPX.

The significantly higher mean egg number collected from N, and F as compared to Na among the three group of indigenous chickens and the significantly higher mean egg number recorded for NAPRI-X and FNPX against NaNPX and NNPX in this study may be as a result of the parents stocks used that were of different ages or as a result of genotypic difference. The result obtained was in line with findings of some authors (Rogue and Soares, 1994; Buhr, 1995; Adomako *et al*., 2009), who said that age and genotype of flock affect egg laying and (Weis, 1991) who reported that system of husbandry and rearing technology affect egg number. The higher means of egg number of the crosses over their indigenous may be as a result of mating system adopted and hybrid vigour. The indigenous groups were allowed on pen mating while the other group was artificially inseminated. The results obtained agree with the findings of (Gebhardt-Henrich and Mark, 1991) who concluded that mating systems have effect on egg production.

In the Indigenous chicken population, the highest Percentage fertility was recorded in frizzle feather (75.76) which significantly differed from naked neck (71.62) while normal (64.75) recorded the least. In crosses as well highest fertility was recorded in FNPX (82.60) and is significantly (P<0.01) higher than NaNPX (73.20). The least was observed in NNPX (64.60). Across the whole six groups, the crossbred of frizzle was the highest and significantly higher than Frizzle indigenous birds, crosses of NaNPX and naked neck had similar performance, and local Normal feather birds performed better and significantly (P<0.05) higher than its crosses with NAPRI X. This implied that the Frizzled feathered indigenous chickens gave the best response in terms of fertility and that they could be used to improve fertility in poultry industry. These results are is in line with some researchers (Peters, 2000); Adedeji *et al.*, 2008; Adeleke *et al*., 2011) who observed that the effect of strain and breed differences do affect fertility of eggs but disagree with his conclusion that normal feathered Indigenous chickens laid more fertile eggs than frizzle feathered birds. Fayeye *et al.* (2006) reported that the Fulani ecotype birds (Normal feathered) had a fertility of 76% with a significantly lower hatchability (56%) recorded for the normal feathered chicken.

Percentage hatched was generally below average in Normal (42.29), naked neck (46.24), crossbred NNPX (48.72), and NaNPX (47.51), except in frizzle (50.00) which is average. The crossbred FNPX (61.98) is significantly (p<0.05) higher than the rest. The

percentage hatchability is high and significantly ($p<0.05$) differed in Frizzle feather (68.67) from Normal (63.00) and Naked neck (63.67). The NNPX (90.29) out-performed and significantly ($p<0.05$) higher than all other groups. This is in line with Ajayi *et al.* (2008) who reported that percentage hatchability was higher for naked neck chicken (73.1%) while lower hatchability was recorded for the normal feathered chicken (58%). They also reported that the superiority of the naked neck genotype with respect to hatchability could be attributed to the greater efficiency of thermoregulation that is associated with their gene (Adomako *et al*,. 2009). Cahaner *et al.* (2008) submitted that among the factors causing differences in hatchability of eggs among chickens was the effect of breed differences. Oluyemi and Robert (2008) reported that fertility and hatchability of eggs are both functions of breed and environment. Peters *et al.* (2008) confirmed that the strain of dam had prominent effect on fertility and hatchability of eggs in chickens. The high performance of frizzle over the other groups may be due to the fact that the frizzle chicken can dissipate heat and that feed intake might have been reduced in the Normal feathered hens and naked neck hens' as compared to hens possessing the frizzle feathered genotype (Duodu, 2013). The reproductive performance across the whole groups were generally low this may be attributed to the poor performance of indigenous chicken couple with a lot of other environmental factors which may include feed and feeding, management, genotypic differences, mating system, eggs collection and storage, as well as general hatchery management (Oluyemi and Robert, 2008; Adeleke *et al*., 2011). This therefore implies that in offspring production the NNPX may have a better combining ability with exotic broiler (NAPRI X) than others although a share advantage is there for FNPX for more egg production for commercial purposes.

Table 1: Means of Reproductive Performance of Indigenous Chickens and their Crosses with NPX

	Normal	Naked	Frizzle	NNPX	NaNPX	FNPX	SEM	LOS
Eggs set (no).	6.60^{d}	5.40^{e}	6.60^{d}	15.20^{c}	17.40^{b}	19.00^{a}	0.84	***
%fertility.	67.55^{d}	71.62^{c}	75.76^{b}	64.60^{e}	73.20^{c}	82.60^{a}	2.05	**
No.hatched	2.80^{e}	2.40^{f}	3.40^{d}	6.80^{c}	8.00^{b}	11.60^{a}	0.37	***
%Eds	37.00^{b}	11.67^{f}	20.67^{e}	47.49^{a}	28.72^{d}	31.86^{c}	2.76	*
%Lds	27.00^{b}	33.00^{b}	15.67^{c}	26.08^{b}	41.39^{a}	30.12^{b}	3.69	*
%Hatched	42.29^{c}	46.24^{b}	50.00^{b}	48.72^{b}	47.51^{b}	61.98^{a}	2.37	*
%Hatchability	63.00^{d}	63.67^{d}	68.67^{c}	90.29^{a}	69.72^{c}	84.26^{b}	2.56	*

Means in the same row with different superscripts are significantly different *= ($p<0.05$) significantly difference, **= ($p<0.01$) and ***= highly significant at ($P<0.001$), NNPX=Nornal x NAPRIX, NaNPX= Naked neck x NAPRIX, FNPX= Frizzle x NAPRI X, %= percent, No. = Number, Eds= Early dead in shell, Lds= Late dead in shell, SEM = Standard error of Mean, LOS = Level of significance

Most of NNPX (47.49) were dead early during embryo development, and this is significantly higher than Normal feather (37.00). Crossbred FNPX (31.86) was also significantly higher than Frizzle (20.67). Least dead in shell was observed in naked neck (11.67), with its majority surviving this stage as compared to its crosses with NAPRI-X that is NaNPX, (28.72). The NaNPX (41.39) recorded highest mean in late dead in shell which was significantly higher than the rest. Similar results were obtained in N, Na, NNPX and FNPX (26.08-33.00). Least late dead in shell was recorded in Frizzle (15.08). The higher mean value recorded for NaNPX in this study supports the observation of Peters (2005) and Adeleke *et al*.

(2011) that reported that naked neck (*Na*) birds produced a higher percentage of infertile eggs and dead-in-shell embryos due to the Naked neck (*Na*) genes.

Peters *et al.* (2008) recorded a reduction of 6.1 % for naked neck *(Na*) in embryonic survival when compared with normal feathered (*N*) birds and explained that this embryonic mortality was normal during the last stage of incubation (18-21 days). The embryonic deaths attributed to the naked neck could explain the low hatchability associated with the naked neck (*Na*) birds in this experiment.

Tables 2 and 3 present the share of total variance, factor loading and Eigen value of principal components of egg measurable traits of Nigerian chickens by genotype. The result showed that two discernable patterns of variation in the genetic groups were recorded. The first PC accounted for 61.00% of observed variation and was related to overall egg number, as indicated by the eigen vectors (factor-variate correlations) of all the ten measurements. The second component (PC2) contributed 17.50% of the observed egg traits variations. The variables most associated with PC2 was percentage fertility, hence PC2 could be termed a measure of "fertility measurements". PC1 which explained 46.10% of the generalized variance, was determined by PLDS, ED and LD. PC2 was primarily determined by egg no, no. hatch and fertile egg, contributing to 37.40% of the variation.

PC1 accounted for most of traits considered in reproductive performance of the whole six genetic groups. The present results from the principal component analysis revealed zoometric phenotypic differentiation between different genotypes of chicken. Reports of PC extraction of more than 2-3 have been reported, but the consistency of 3 components for all classification bases in this study may point to the effect of lower associations between egg measurable traits. Thus selection to improved fertility is an important target for egg production (Salako, 2006) hence, breeders could improve fertility traits through selection and crossbreeding in order to better egg production traits.

Principal components are a weighted linear combination of correlated variables, explaining a maximum amount of variance of the variables (Truxillo, 2003). The communalities, which represent the proportion of the variance in the original variables that is accounted for by the factor was high for the six genetic groups between and within traits respectively. Ogah (2011) reported high range of communalities (0.85 to 0.99) and (0.86 to 0.99) for morphometric measurements of male and female turkeys; which was similar to what was obtained in this experiment. The three principal components obtained for each of the genetic group in the present study could be important in evaluating animals for breeding and selection purposes. Since the correlation between principal components is zero, the selection of animals for any principal component will not cause correlated response in terms of other principal components (Pinto *et al*., 2006).

CONCLUSION

It could be concluded that the crosses performed better in egg production than their respective indigenous counterparts. Frizzle feather had better reproductive performance than its indigenous counterparts and that frizzle and normal feather may have a better combining ability with NAPRI X than others.
Also, the Principal Components extracted for both indigenous and their crosses could be maximized to choosing the variables that could
serve as indices for productive traits in poultry

Table 2: Eigen Values and Share of Total Variance along with Factor Loading and Communalities of Fertility Traits of Indigenous Chicken

	Normal			**Naked**			**Frizzled**		
	PC1	PC2	Comm	PC1	PC2	Comm	PC1	PC2	Comm
Traits									
EGGSET	0.64*	-0.63	0.53	-0.53	0.70*	0.88	0.99*	-0.00	0.78
FERT (%)	0.37	0.81*	0.55	0.97*	0.03	0.47	0.00	0.99*	0.86
NO. HATCH	0.95*	0.09	0.73	0.79*	0.51	0.88	0.70*	0.60*	0.74
EDS (%)	0.96*	-0.21	0.58	-0.57	-0.69	0.99	-0.90	-0.44	0.62
LDS (%)	0.72*	-0.27	0.66	-0.68	0.40	0.89	0.56*	-0.76	0.54
HAT (%)	0.77*	0.64	0.49	0.99*	-0.13	0.82	-0.53	0.74	0.58
HATY(%)	0.96*	0.21	0.69	0.71*	-0.22	0.96	-0.76	0.01	0.81
FERTEG	0.56*	-0.06	0.88	0.31	0.69*	0.99	0.88*	0.48	0.88
ED	0.89*	-0.19	0.64	-0.59	-0.66	0.87	0.00	0.00	0.74
LD	0.77*	-0.27		-0.64	0.69*		0.68*	-0.63	
Eigen value	6.10	1.75		4.61	3.74		4.69	3.27	
%variance	61.00	17.50		46.10	37.40		46.90	32.70	

% = Percent, No. = Number, EDS = early dead in shell, LDS= Late dead in shell; PC= Principal Component; %fer, % hat and %haty, explaining 32.70% of variance., Cumm= Communality, Ed=early dead , Ld= Late dead

Table 4.3: Eigen values and Share Of Total Variance Along With Factor Loadings And Communalities Of Fertility Traits Of Indigenous Chicken with NAPRI X

	NNPX			NaNPX			FNPX		
Traits	**PC1**	**PC2**	**COMMUNALITY**	**PC1**	**PC2**	**COMMUNALITY**	**PC1**	**PC2**	**COMMUNALITY**
EGGSET	0.98*	-0.02	0.53	0.37	0.89*	0.06	0.78*	-0.59	0.68
FERT(%)	-0.83	0.34	0.84	-0.83	0.19	0.77	-0.59	0.75*	0.50
NOHATCH	0.81*	0.50*	0.63	-0.59	0.57*	0.51	0.92*	0.06	0.74
EDS(%)	0.55*	-0.76	0.53	0.93	-0.19	0.68	-0.60	-0.69	0.62
LDS(%)	0.79*	-0.46	0.36	0.64*	-0.73	0.81	0.66*	0.21	0.74
HAT(%)	-0.56	0.74*	0.49	-0.87	-0.29	0.82	0.14	0.76*	0.58
HATY(%)	-0.09	-0.69	0.69	-0.65	-0.60	0.98	0.06	0.83*	0.71
FERTEG	0.80*	0.39	0.90	0.07	0.99*	0.85	0.88*	-0.13	0.88
ED	0.95*	0.27	0.59	0.84*	0.45	0.973	-0.36	-0.81	0.64
LD	0.95*	0.26		0.77*	-0.37		0.97*	-0.03	
Eigen value	5.89	2,67		4.95	3.49		4.46	3.38	
%variance	58.90	26.70		49.50	34.90		44.60	33.80	

NNPX=Nornal x NAPRIX, NaNPX= Naked neck x NAPRIX, FNPX= Frizzle x NAPRI X, % = Percent, No. = Number, EDS = early dead in shell, LDS= Late dead in shell; PC= Principal Component; %fer, % hat and %haty, explaining 32.70% of variance., Cumm= Communality, Ed=early dead , Ld= Late dead

REFERNCES

Adedeji, T.A., Ojedapo, L.O., Ige, A.O., Ameen, S.A., Akinwumi, A.O and Amao, S.N. (2008). Genetic evaluation of growth performance of pure and crossbred chicken progenies in a derived savannah environment. *Proceedings of the13th Annual Conference of the Animal Science Association of Nigeria,(ASAN). Bawa G.S., Akpa G.N., Jokthan G.E., Kabir M., and Abdul S.B.* Ahmadu Bello University, Zaria. 15th–19th September, 2008. Pp 8-12.

Adeleke, M. A., Peters, S. O., Ozoje, M. O., Ikeobi, C. O. N., Bamgbose, A. M. and Adebambo, O. A. (2011). Growth performance of Nigerian local chickens in crosses involving an exotic broiler breeder. *Tropical Animal Health and Production*, 43 (3): 643–650

Adomako, K., Hagan J.K. and Olympio O.S. (2009). Potentials of indigenous naked neck and frizzle birds in the Ashanti region of Ghana. *Proceedings of the sixteenth Biennial Conference of the Ghana Society of Animal Production (GASP)*. Pp 177-180.

Ajayi FO (2010). Nigerian Indigenous Chicken: A valuable genetic resource for meat and egg production. *Asian Journal of Poultry Science*, 4(4):164-172.

Ajayi, F.O. and Agaviezor, B.O. (2016). Fertility and Hatchability Performance of Pure and Crossbred Indigenous Chicken Strains in the High Rainforest Zone of Nigeria. International Journal of livestock Production, *7(12): 141-144*

Akpa, G.N., and Jokthan, G.E. (1996). Effect of feeding and routine management in rabbit production in Zaria area of Kaduna State, Nigeria. *Agricultural System in Africa*. 6(1):60-64

Alao, H. A. (2011). *Fertility and Hatchability of Crosses of Nigerian Indigenous Chicken* unpublished BSc. Project Report. University of Agriculture , Abeokuta Nigeria.

Alemu, Y. (1995). Poultry production in Ethiopia. *World's Poultry Science.* 51:197-200.

and constraints. *World's Poultry Science Journal* 61, 298–307.

Buhr, R. J., (1995). Incubation relative humidity effects on allantoic fluid volume and hatchability. *Poultry science*, 74: 874-884.

Cahaner, A., Ajuh, J.A., Siegmund-Schultze, M., Azoulay, Y., Druyan, S. and Valle- Zárate, A. (2008). Effects of the genetically reduced feather coverage in naked neck and featherless broilers on their performance under hot conditions. *Poultry Science*, 87:2517-2527.

Duodu A. (2013). *The effect of naked neck, frizzle and normal feather genotypes on laying performance and pterylosis of brown and white layer parents*. A Dissertation submitted to the School of Graduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi, pp 23-30

F.A.O. (2000). Small scale poultry production: FAO Corporate Document Repository, h ttp://www.fao.org/docrep 008/y5169e/.htm 2000. 1 May 2013.

Farrell, D.J. (2005). Matching poultry production with available feed resources: issues

Fayeye, T. R. (2014). *Genetic principles and animal breeding*. Happy Printing Enterprises, Ilorin, Nigeria. Pp123-137.

Fayeye, T.R., Ayorinde, K.L., Ojo, V. and Adesina, O.M. (2006). Frequency and influence of some major genes on body weight and body size parameters of Nigeria local chickens. *Livestock Research for Rural Development*, Volume 18, *2004.*

Gebhardt-Henrich, S. G. and Mark, H. L. (1991**).** The effect of switching males among caged females on egg production and hatchability in Japanese quail. *Poultry Science*, 70: 1845-1847.

Gueye, E.F., (2003). Production and consumption trends in Africa. *World Poultry,* 19 (11):12-14.

Horst, P. (1998). Native fowl as reservoir for genomes and major genes with direct and indirect effects on production adaptability. Proceedings of the 18th World Poultry Congress, W. G. Hill, (ed) September 4-9, 1988, Nagoya, Japan, pp: 105.

IFPRI (International Food Policy Research Institute) (2000). www.cgiar.org/IFPRI International Food Policy Research Institute (2000). Food Policy Statement Number 18 http:/www.cogiar.org/IFPRI

Machebe, N. S. and A. G. Ezekwe (2005), Effect of Season on Ejaculation Quality of Genotype of Nigerian Local Chicken in; Hamessing the Livestock Resources for National Economic Empowerment, Nsukka Nigeria pp 24-26.

Ogah, D. M. (2011). Assessing Size and Conformation of the body of Nigerian indigenous Turkey. *Slovak Journal of Animal Science*, 44 (1): 21-27.

Ojedapo, L.O. (2013). Evaluation of Body Weight and Other Linear Parameters of Marshall Broiler for Repeatability Estimates. *International Journal of Applied Agriculture and Apiculture*, 9: 1-2.

Oke, U. K. (2011). Online Journal of Animal and Feed Research, 1(3): 92-98 (2011) ISSN 2228-7701.

Oluyemi, J. A. and Roberts, F. A. (2008). Poultry production in warm wet climate. Mcmillan Press Ltd., London.

Otechere, E. O.Adeoye, A. T. Gefu, J. O. and Adewuti, A. A. (1990). Preliminary Observations on Village Poultry Production in North Central Nigeria. In: *Proceedings of an Intermz and Oruzl Workshop* Sonaiya (E.d.) Rural Poultry Development in Africa. Ile Ife Nigeria. Pp196-200.

Ovimaps, (2015). Ovilocation map; ovi earth imaginary. Dated July, 2015

Permin, A. and Pedersen, G. (2000). Problems related to poultry production at village level. Feasibilities for small-holder poultry projects in Eastern and Southern Africa. In: *Proceedings of a workshop Mattee M.Z., Evers G., and Moilel,, N.M. (eds) held at Morogoro, Tanzania* between 22th to 25th May, 2000. Page 65-69.

Peters S.O. (2000). Genetic Variation in the Reproductive Performance of Indigenous Chicken and Growth of Pure and Half Bred Progeny. M. Agric Thesis, department of Animal Breeding and Genetics. University of Agriculture, Abeokuta. Pp 25-27.

Peters, S.O., Shoyebo, O.D., llori, B.M., Ozoje, M.O., Ikeobi, C.O.N., and Adebambo, O.A. (2008). Semen quality traits of seven strain of chickens raised in the humid tropics. *International Journal of Poultry Science, 7*(10): 949-953.

Pinto, L.F.B., I.U. Dacker, C.M.R. De melo, M.C. Ledur and L.L. Coutinho. (2006). Principal components analysis applied to performance and carcass traits in the chicken. Anim. Res. 55: 419-425.

Rogue, L. and Soares, M. C. (1994). Effects of eggshell quality and broiler breeder age on hatchability: *Poultry Science*. 73: 1838-1845.

Salako, A.E. (2006). Principal component factor analysis of the morph structure of immature Uda sheep. *International Journal of Morphological Traits*. 24 (4): 571–574.

SAS. (2003). Statistical Analysis System, Computer Software, Version 9: Statistics SAS Institute Inc. Cary, Northern Carolina 27513, USA.

Sheridan, A. K. (1981). Cross breeding and Heterosis. *Animal Breeding Abstracts, 19*(3), 131-144.

Teketel, F. (1986).Studies on the meat production potentials of some local strains of chickens in Ethiopia. Ph.D. Thesis, J. L. University Giessen, Germany. Pp 123-126.

Truxillo, C. (2003). Multivariate Statistical Methods: Practical Research Applications Course Notes. Cary, NC: SAS Institute. Pp 336-338.

Ubani, E. O. A., Adeyinka, I. A., Nwagu, B. I., Abeke, F. O. Sekoni, A. A. Otu, M. O. and Iyiola – Tunji, A. O. (2011). Estimates of repeatability for some growth traits in naked Neck broiler chickens. *Proceeding of the 36th Conference of Nigerian Society for Animal Production* (NSAP). (Editors) A.A. Adeniji, E.A. Olatunji, O.A. Olafadehan and E.S. Gana.University. of Abuja. Nigeria Pp. 48 – 50.

Weis, J., (1991). Analysis of fertility, hatchability and egg quality indices in reproduction breeding of guinea fowls. *Acta Zootechnica Universitatis Agriculturae* (CSFR), 47: 5-15