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Nigerian Fulani Ecotype Chickens: Growth Performance under Two Production Systems

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Abstract

The study evaluated the growth performance of Nigerian Fulani ecotype chicken (NFEC) under intensive and pastured poultry production systems. Two hundred (200) day-old chicks of Nigerian Fulani ecotype chicken (NFEC) were obtained from established stocks of NFEC population at the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. The chickens were separated randomly to intensive and pastured poultry production systems at 12 weeks of age. Data on body weight were taken weekly from day-old to 20 weeks. Data were analyzed using PROC GLM of SAS® at statistical significance level of P<0.05. Results showed significant effect of sex of chicken from the 10th to the 20th week of age (P<0.05). Significant interaction effect was observed between sex and production system at weeks 16 and 18 (P<0.05) when the male chickens under the intensive production system outpaced their male counterparts in the pastured poultry. Average daily gain for the period of 20 weeks was 6.83g and 9.21g for female and male chickens respectively. Weight gain pattern across weeks was not uniform. Therewas no significant difference in the growth rate in the two production systems (P>0.05).

Keywords: Growth, Production System, Pastured Poultry, Average Daily Gain

Introduction

The rearing of indigenous chickens is an integral part of the smallholder farming systems in developing countries, where they are kept by the rural poor to satisfy multiple functions (Sonaiya and Swan, 2004; Mack *et al.*, 2005). Indigenous chickens are specially adapted to environmental stresses and poor husbandry practices under low-input systems, and this has made these stocks a suitable choice for smallholder production systems (Gondwe, *et al.*, 2001; Sonaiya and Swan, 2004).

Nigeria is endowed with locally adapted chickens found in different agro-ecological zones where they contribute significantly to the livelihoods of the people who raise them in the urban, peri-urban and rural settlements. Some popular locally adapted chickens in Nigeria include the Fulani ecotype, Yoruba ecotype, and other ecotypes from the southeastern states of Nigeria (Olori, 1992; Fayeye *et al*., 2005; Ajayi, 2010). The Fulani ecotype chicken has been described as a potential meat type breed of chickens in Nigeria because of the broiler-type body conformation, with mature body weight ranging between 0.9 Kg to1.5 Kg and 1.5 Kg to 2.5 Kg for hens and cocks respectively (Olawunmi *et al*., 2008; Sola-Ojo and Ayorinde, 2009; Jesuyon and Salako, 2013). The Fulani ecotype chicken has long been associated and preserved by the Fulani tribe of Northern Nigeria, who raise these chickens in *Kraals* (Fulani settlements) and villages under extensive or semi-intensive production systems where the Fulani chicken serves as a veritable source of proteins in terms of eggs and meat, and as a means of livelihoods. The Fulani ecotype chicken is widespread across Nigeria, being taken along to different ecological zones by Fulani pastoral nomads. Though this chicken is smaller in

size, with adult body weight of 0.9 Kg to1.5 Kg and 1.5 to 2.5 Kg for hens and cocks respectively (Sola-Ojo and Ayorinde, 2009; Ajayi, 2010), the small body size is said to be important to reduce maintenance and feed requirements (Olawunmi, *et al.,* 2008). This is necessary for survival under the free-range system because of scarce feed resources and the uncertainty surrounding feed supply all year round (Ige, 2013).

Growth, a fundamental characteristic of all living organisms, is a complex trait of economic importance in any poultry operation. Growth being a continuous and dynamic process requiring integration of numerous mechanisms, is influenced by genetic, physiological and ecological factors (Narinc, 2010). Though the maximum size of an animal is determined by its genetics, other factors influence whether the animal reaches its genetic potential for size or not (Tickle, 2004; Darmani *et al.*, 2010). Growth as an increment in body size, can be measured in body mass change over time (Aggrey, 2002). In chickens, linear measurements such as wing span, comb length, shank length, wing length, body length, beak length, keel length, neck length and body girth have been used as proxies to estimate body weight (Karkach, 2006; Ige, 2013).

The Fulani ecotype chickens have been reported to possess intrinsic growth potentials that can be tapped in commercial chicken production (Fayeye *et al., 2005*). However, there is limited information on the growth performance of NFEC under different production systems. The objective of this study was therefore, to evaluate the growth performance of NFEC under two production systems (*viz*: deep litter and pastured poultry systems), with a view to ascertaining possible production environment effect on the growth pattern of NFEC.

Materials and methods

Experimental Location

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife (OAU), Osun State, Nigeria. The Farm is located at Latitude **07º33´05.916´´N,** Longitude **04º33´00.444´´E** at an altitude of 800m above sea level (Android-TS GPS). The farm is located in the tropical rain forest ecological zone of Nigeria with annual mean precipitation usually above 2000 mm, characterized with two seasonal rainfall peaks, the zone is very humid with temperature as low as 24^0 C during the cold periods and can reach 32^0 C during the hot seasons (Nigeria-Global yield Atlas).

Brooding and Management of Chicks

Two hundred (200) day-old chicks of the Nigerian Fulani ecotype chicken (NFEC) were obtained from an established parent population of NFEC at the Poultry Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Nigeria. The chicks were brooded for two weeks and were retained in the brooding pen till the fifth week before they were transferred to the deep litter pen. During brooding, adequate heat (temperature range of 35^0C to 40^0C) was supplied using a gas burner as source of heat. Proper hygiene was ensured daily, while biosecurity was guaranteed by providing a foot deep at the entrance to the pens. Feed and water were given to the chicks *ad libitum*. The chicks were fed starter ration containing 20% crude protein (CP) and 3000 Kcal/Kg of metabolizable energy (ME). The chicks were vaccinated against Newcastle disease on the 8^{th} day since NFEC have been reported to be susceptible mainly to this disease while it is highly resistant to other viral diseases (Ogie *et al.,* 2006). Appropriate measures were taken to control endo- and ecto-parasites.

Management of Chickens in Deep-Litter System

Chickens were moved to deep litter pens made of wood and wire netting containing twenty cells of 1.5m ×1.4m dimension each. Proper fumigation of pens was carried out before the commencement of the experiment. Wood-shavings were spread on the floor of the cells, while feeders and drinkers were positioned before chickens were brought in. Daily routine management practices to ensure high standard of hygiene and sanitation were observed. The chickens were fed growers' ration (formulated diet) containing 18% crude

protein and 3200 Kcal/Kg of ME from the fifth week onward till the twentieth week when the experiment was terminated.

Preparation of Pastured Poultry Unit

A 30m × 30m pasture plot already established as the experimental Pastured Poultry Unit at the Teaching and Research Farm, OAU Ile-Ife, Nigeria, was renovated and used as the second production system. The pasture land is made of aluminium poles and fenced with a wire mesh of 1.2m high. All holes in the entire perimeter of the fence were blocked with concrete apron to prevent predators' (especially snakes) invasion and the chickens from escaping due to their flighty behaviour. Six roofed wooden shelters of 1.9m × 1.2m were constructed and positioned in the pasture plot to provide shades for the birds against sun, rain and inclement weather. Plant species in the pasture plot (in order of abundance) included *Panicum maximum, Ipomoea involucrata, Desmodium scorpiurus, Pueraria phaseoloides, Plastostoma africanum and Leptochloa caerulescens.*

Selection of Chickens for Pastured Poultry Production System

Chickens were allocated to pastured poultry production system by randomization at the 12th week of age. A key reason for the delay in introducing these chickens to pasture is the prevalence of hawks and other predators in open door systems and the susceptibility of the NFEC to these predators because of their small body size at younger ages. As at the time of allocation, the average body weight was 700g and 550g for male and female chickens respectively. The population of the chickens moved to the pasture consisted of 40 males and 50 females, the population of chickens retained in the deep litter was 55 males and 45 females while 10 chickens died in the course of brooding.

Managements of Chickens on Pasture

On arrival at the pasture site, the chickens' feathers were trimmed by mildly cutting the tips of the wing feathers in order to prevent the birds from escaping from the fenced area as the birds are very flighty in nature. The chickens on pasture were fed commercial growers ration at the rate of 50g per bird while they were left to scavenge on the pasture to supplement the feed given. The birds were vaccinated against Newcastle disease after two weeks on pasture. Birds on deep litter were also vaccinated against Newcastle. Maintenance of the pasture was done by mowing whenever it reaches 20 Cm above ground level.

Data Collection

Throughout the period of the experiment, all birds (deep litter and pastured plot) were weighed weekly using a digital weighing scale calibrated in grams with a sensitivity of 1g and a maximum capacity of 5 Kg. The chickens' body weights were taken in the morning before feeding.

Data Analysis

The general linear procedure (PROC GLM) of SAS® was used to analyze body weight records from the two production systems. The following model was fitted:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where: Y_{ijk} = body weight of the kth bird of the jth sex in the ith production system;

μ=overall mean;

α_i =fixed effect of the ith production system (i=2, for Deep Litter and Pastured Poultry systems),

β_j =effect of jth sex of NFEC (j=2, for male and female chickens)

$(\alpha\beta)_{ij}$=effect of the interaction between the jth sex of chicken and the ith production system.

ε_{ijk}= random error associated with each observation, assumed to be normally and independently distributed, with zero mean and constant variance.

Figure. 1. Fulani ecotype chickens on deep-litter (right and middle) and pastured poultry (left)

Results and discussion

Table 1 shows the least squares means of body weight of the NFEC from hatch till the birds were 20 weeks of age, across two production systems. The trajectory of growth from Table (1) and Figure (1) indicates that NFEC are slow growing chickens. The male chickens were heavier than the female chickens at hatch and across all the weeks of the study period. Weights at hatch of 28.64±0.215g and 33.865±0.248g for female and male chickens respectively obtained in this study are higher than 23±1.6g and 29±1.0g reported by Adedokun and Sonaiya (2001) for Fulani ecotype chickens. The means are also higher than 27±4g and 28±4 reported by Fayeye *et al*., (2005) for Fulani ecotype chickens in North-central Nigeria. The overall mean body weight of 1099.05±14.25g obtained at 20 weeks, irrespective of sex of chicken and production system, is in agreement with the report of Sola-Ojo and Ayorinde (2009) for NFEC raised intensively on deep litter with overall mean of 1099±196g. At 20 weeks of age, matured body weight of 1320g and 1000.02g based on overall means was recorded for male and female chickens respectively. These values (for both sexes) are higher than body weight of 1022g and 1143g at week 21 reported by Gakige *et al*., (2016) for adult female and male indigenous chickens of Kenya, but were lower than means reported by Jesuyon and Salako (2013) for Nigerian Fulani ecotype chickens based on live weight data collected from five Fulani settlements in Osun State, Nigeria. The mean matured body weight reported across the five locations were in the ratio 2.29Kg:1.44Kg for male:female respectively. The lower value obtained in this study compared with the report of Jesuyon and Salako (2013) can be attributed to the challenge of appropriate age determination of chickens under *on farm* conditions in Fulani settlements, as compared to the current study which was under *on station* conditions.

Average weekly gain was 65g and 48g, while the average daily gain for the period of 20 weeks was 6.83±0.17g and 9.21±0.15g for the female and male chickens respectively. Average daily gain in this study is close to values 6.99g and 9.83g reported by Momoh *et al*., (2010) but lower than the values 16.41g and 11.35g reported by Rizzi *et al*., (2013) for male and female Italian local chickens raised intensively. These results are also higher than 5.8g and 8.65g reported by Olori (1992) for NFEC under intensive production. The weight gain pattern across weeks was not uniform. There was no significant difference in the growth rate of NFEC in the two production systems (P>0.05).

Table 1. Least squares means (LSM) for live body weight of Nigerian Fulani ecotype chicken under two production systems from 0 to 20 weeks

Age (weeks)	LSM ± SE (intensive)	LSM ± SE (pastured)	LSM ±SE (intensive)	LSM±SE (pastured)
	Female		Male	
0	28.64±0.25	-	33.86±0.21	-
2	66.89±1.61	-	95.33±1.48	-
4	181.28±2.89	-	184.36±2.66	-
6	210.87±2.67	-	273.12±2.31	-
8	340.35±22.1	-	482.23±19.14	-
10	472.97±17.2	-	553.96±14.96	-
12	619.36±18.3	620.09±17.65	723.92±15.86	731.23±18.32
14	681.63±49.3	759.24±49.03	899.15±17.22	886.79±19.88
16	751.01±48.8	882.19±48.58	1112.14±44.7	1089.52±17.10
18	846.75±49.2	968.77±51.39	1236.63±47.3	1179.01±50.64
20	938.66±60.3	1061.805±59.9	1343.43±55.2	1295.57±59.12

LSM= Least squares means, SE=Standard error of the means, NFEC=Nigerian Fulani ecotype chicken

Table 2. Average daily gain of Nigeria Fulani Ecotype Chicken from 0-20 weeks under two production systems

Sex of chicken	PS	ADG(g/d)	AWG
Male	intensive	9.21±0.15	65.49±6.25
	pastured	8.88±0.17	64.25±6.03
Female	intensive	6.76±0.17	48.53±6.75
	pastured	6.70±0.16	47.27±4.81

PS=production system, ADG is the average daily gain, AWG=average weekly gain

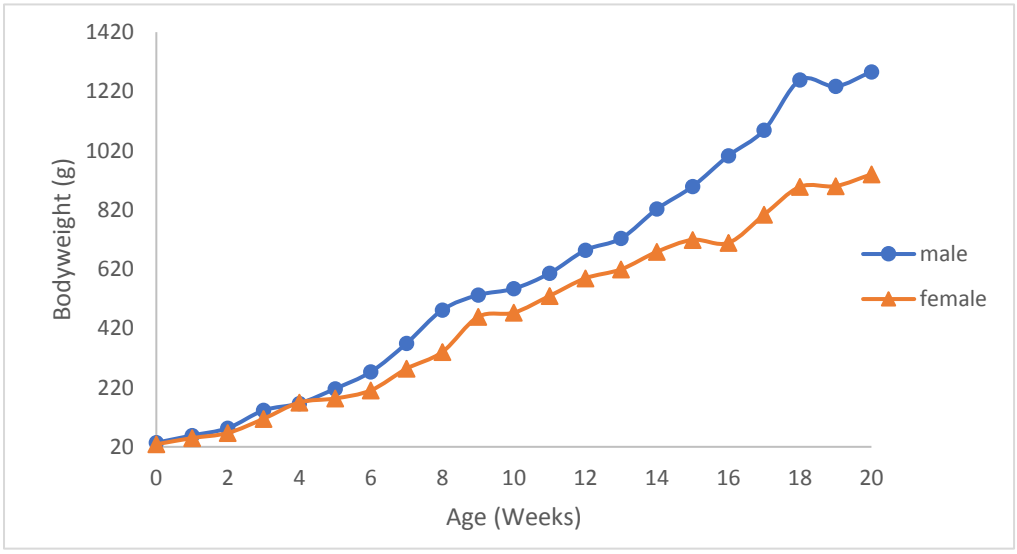

Figure. 2. Linear growth pattern of Nigerian Fulani Ecotype Chickens (male and female) from 0-20 weeks (combined data for intensive and pastured poultry production system)

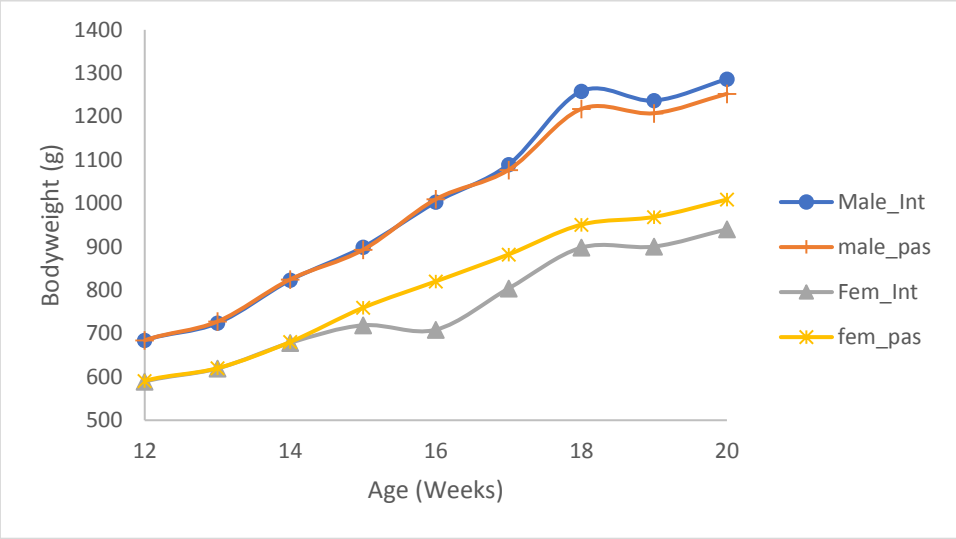

Figure. 3. Linear growth patterns of Fulani ecotype chickens (male and female) from 12-20 weeks under intensive (Int)and pastured (pas) production systems

The analysis of variance for the effect of sex of chicken, production system and sex by production system interaction effect on the growth performance of Nigerian Fulani ecotype chickens from 12th to the 20th week showed significant effect (P>0.05) of sex of chicken on body weight (P<0.05). At 10th week to the 20thweek, there was a marked difference between male and female NFEC in growth rate (P<0.05) while from 0 to the 8th week the growth rate for both sexes were relatively the same (P>0.05).This may suggest that the chickens should be separated by sex from 8th week for maximum growth rate.

There was significant interaction effect (P>0.05) between sex of chicken and production system at weeks 16 and 18 with NFEC males under intensive system showing superiority in growth rate over NFEC males in the pastured poultry system. There was slight decrease in body weight after the chickens were moved to pasture, in spite of the 50% reduction in feed for the chickens under pastured poultry system. Freedom of movement, exposure to sunlight and fresh air, consumption of fresh grass and legumes were all available to the chickens on pasture and thus, enabled to maximize their intrinsic growth potentials. Also, the pastured poultry is a simulation of the natural production environment under which NFEC are raised in villages and towns. This observation may indicate the enormous advantage of the pastured poultry system in terms of economics of production, which needs to be properly evaluated. In this regard, detailed cost-benefit and gross margin analyses are needed to validate the economic advantages of the two systems.

The body weight recorded from 12th week up to 20thweek on pastured poultry system compared well with those in intensive (Table 1). Similarly, the growth performance of NFEC on pasture compared well with the report of Eleroglu *et al.*, (2014) for local chickens raised on the pasture (organic) system from 2 weeks to 14 weeks. Michalcuzk *et al.*, (2016) also observed similar findings for medium-growing meat type chickens raised under semi-confined conditions from 0 to 9 weeks. These results also confirmed the report of Moyle *et al*., (2014) that access to pasture did not alter the growth rate and feed efficiency of chickens during an experiment performed on broilers reared under pasture and other types of production systems with outdoor access. The chickens experienced rapid increase in body weight from 16th to 17th week, but the female chickens on pasture outpaced their counterparts in intensive, a proof of sex by production system interaction. Figure (iii) showed the consistent superiority of female chickens raised under a pastured poultry system, when compared to a deep litter system. There was a slight decline in weight gain from 19th to 20thweek (Figure iii) for both male and female chickens in the two production systems but that of the intensive system was higher than chickens in the pasture. A slight drop in body weight at the onset of puberty of chickens was

reported by Sola-Ojo *et al*., (2012) in a study conducted on a crossing experiment of Fulani ecotype with exotic chickens. A study by Eleroglu *et al*., (2014) on slow growing local chickens raised under pasture (organic) system reported growth performance of the chickens with no adverse effect of pastured or out-door system on matured body weight. In these studies, maximal growth rate was recorded between 5th to 8th week and 16th to 18th week for both male and female chickens.

Conclusion

The study revealed that little disparity exists in the growth performance of Nigerian Fulani ecotype chickens reared under the intensive and pastured poultry production systems. This implies that the pastured poultry system may be embraced for the production of Nigerian Fulani Ecotype chicken. However, the enormous advantage of the pastured poultry system in terms of economics of production needs to be properly evaluated. Significant effect of sex of chicken on growth performance started from week 8, suggesting that the chickens may be separated by sex from that period onward for maximum growth performance.

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Author's contribution

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