~~Genetic~~ Variation in Body Weight and Biometric Traits of Exotic (Nicholas White) and Nigerian Locally Adapted Turkeys Reared in Humid Tropics

ABSTRACT

The performance of animal in a given environment differs between and within species, breeds and strains and genotypes, as a result of genetic variation. A total of 200 turkeys comprising 50 exotic (Nicholas white) and 50 each of Nigerian locally adapted turkeys (black, white and lavender) was used to investigate genetic variation in body weight and some biometric traits of exotic turkey and Nigerian locally adapted turkey at the Turkey Breeding unit of the Teaching and Research Farm of Ambrose Alli University, Ekpoma Edo State, Nigeria. The growth performance of the experimental birds was recorded biweekly throughout the period of the experiment. Genotype had significant effect ($p<0.05$) on body weight in all the weeks with exotic turkey consistently having higher ($p<0.05$) body weight throughout the experiment. The black plumage colour turkey performed better in body weight than the other two plumage colours of Nigerian locally adapted turkeys but was not significant ($p>0.05$). Similarly, exotic turkey has the highest ($p<0.05$) body length, body height, wing length, wing span and thigh length in most of the weeks of the experiment. Among the Nigerian locally adapted turkeys, black plumage turkey performed better ($p<0.05$) in most of the measured biometric traits than white and lavender plumage colour turkeys. The exotic turkey with higher body weight and biometric traits can be used to upgrade Nigerian locally adapted turkeys to obtain tropically adapted broiler turkey breed and also selection preferential should be given local black turkey for genetic improvement.

Key words: Body weight, Biometric traits, Nigerian locally adapted turkey, Exotic turkey, Nicholas white turkey,

1. INTRODUCTION

Poultry production in Nigeria is considered as a major way of reducing the incidence of malnutrition, particularly protein deficiency in the diets of increasing populace [1]. The poultry industry is helping to fast bridge the gap of protein malnutrition in the diet of Nigerians as its products are available and affordable [2]. Poultry population in the country composed of 84% indigenous and 16% exotic [3] out of which 52.3 million are chickens, 7.6 million are guinea fowls, 3.6 million ducks, 0.4 million turkeys and 1.2 million other birds makes up subsistence poultry farming [4]. Despite the low production of turkey in Nigeria, its consumption is relatively increasing just like chicken and other animal products. However, unlike chicken,

turkey production has not gained much popularity in Nigeria; its demand is majorly dependent upon its importation as frozen food [5]. The need for profound research in turkey production in Nigeria is necessitated by its valuable meat with its high rate of economic return. Peters *et al.* [6] earlier reported that turkeys have considerable economic and social significance in the tradition of Nigeria. The majority of turkeys raised in Nigeria is indigenous or locally adapted one. The eggs of the exotic turkeys (such as Nicholas white, British United and Hybrid converter) are often imported into the country and therefore their poults are generally expensive.

Generally, Nigeria indigenous turkeys are very hardy, tolerant to most of the diseases of turkey in tropical region, can survive on low nutrient feed resources and best adapted to prevailing tropical climatic conditions. However, they are characterized with small size and required long time to attain slaughter weight. On the other hand, the exotic turkeys are peculiar for their body weight and early maturity [7]. Therefore, the productivity of the indigenous turkeys can be improved by crossbreeding exotic Toms having superior genetic make-up with Nigerian indigenous hens. Based on feather colour, three genotypes can be identified among Nigerian locally adapted turkeys, namely; black, white and lavender [8]. They are all suitable to develop the tropical broiler turkey because they possess some inherent advantages which include good fertility and hatchability, better flavor of meat, high degree of adaptability to prevailing conditions, high genetic variance in their performance, hardiness, disease tolerance, ease of rearing and ability to breed naturally [8,9].

Indeed, biometric traits are used to characterize poultry species [10] because they can give an indication of the origin, shape and size of animal genetic resources as they give idea of body conformation [11]. Body weight and body linear traits are used as indicator of type and function in domestic animals [12]. The differences in body weights and body linear traits of exotic and

Nigerian locally adapted turkeys would serve not only as basis for characterization but also for the development of tropical broiler turkey, through exploitation of their genetic diversity. This study therefore aimed to investigate genetic variations in body weight and body linear traits of exotic and Nigerian locally adapted turkeys reared in the humid tropics.

2.0 MATERIALS AND METHODS

2.1 Description of Experimental Site

This research was done at the Turkey Breeding unit of the Teaching and Research Farm of Ambrose Alli University, Ekpoma Edo State, Nigeria. The farm lies between latitude 6.44^{o} North and 6.80^{o} East, located in the rain forest zone of Esan West Local Government Area of Edo State, Nigeria. The areas have an annual rain fall of about 1500mm – 2000mm per annum a relative humidity of about 75% and an average temperature of 24^{o}C. The study lasted for sixteen weeks.

2.2 Experimental Birds and Management

Two hundred (200) turkeys made up of 50 each of Nigerian locally adapted (black, lavender and white genotypes) and 50 Nicholas white (exotic) day old poults were used for this experimement. The two breeds were purchased from a local private hatchery in Oyo state, Nigeria. The birds were reared on deep litter pens and provided intensive care including adequate medications and vaccinations. The birds were allowed access to commercially available diets and clean water *ad libitum*. All the experimental poults were wing tagged individually for identification and provided with the same management practices throughout the experimental period of 16 weeks.

2.3 Data Collection

The body weight and biometric traits of the experimental birds were measured and recorded biweekly throughout the period of the experiment. The **body weight** was recorded by placing individual bird on Avery Berkel scale with 0.01kg sensitivity; the **body length** was measured as the distance between the base of the snood and the base of the cloaca using measuring tape; the s**hank length** was measured as the distance between the tarsometatarsus and the hock joint; the **Keel length** was measured as the length of the cartilaginous keel bone or metasternum, **wing length** was measured as the length from the shoulder joint to the extreme of the terminal balance; **thigh length** was recorded as the distance between the hock joint and pelvic joint; **breast girth** was measured as the circumference of the breast around the deepest region while the **wing span** was measured as the distance between the left wing tip to the right wing tip across the back of the turkey. All the biometric traits were measured using a tape rule calibrated in centimeters (cm). The data obtained was subjected to analysis of variance using the General Linear Model (GLM) procedure of SAS [13]. The model is as follows:

$Y_{ij} = \mu + G_i + \varepsilon_{ij}$

Where: Y_{ij} = The dependent variable (Feed intake and Feed conversion ratio); μ = Overall population mean; G_i = Effect of the i^{th} turkey genotypes (1,2, 3 and 4) and ε_{ij} = The residual random error.

Significant means were separated using the Tukey's Studentized Range (HSD) Test of SAS 9.2 software (SAS Institute Inc. Cary, North Carolina, USA).

3.0 RESULTS

3.1 Effect of Genotype on Growth Performance of Local and Exotic Turkeys

The effect of genotype on the growth performance of Nigerian locally adapted (black plumage colour, lavender and white plumage colour) and exotic (Nicholas white) turkeys is presented in Tables 1a and 1b. Genotype had significant effect ($p<0.05$) on body weight in all the weeks considered. As expected, exotic turkey consistently had higher body weight from the beginning to the end of the experiment at week 16. Among the local turkey, the black plumage colour turkey performed better in body weight than the other two plumage colours however not significant ($p>0.05$). In like manner, genotype was observed to have significant effect ($p<0.05$) on turkey height from week 1 to 16 with exotic turkey being the tallest followed by Nigerian black plumage colour turkey. However, differences in body height among Nigerian locally adapted turkeys of different plumage colour was not significant ($p>0.05$) at week 16. Further, the exotic turkey had the longest ($p<0.05$) body length while no significant difference ($p>0.05$) in body length were observed among the local turkeys at week 6. Also At week 10 and 14, there was no significant difference in body length between the exotic and local black turkey. The effect of genotype on breast girth of turkey was significant ($p<0.05$) in all the weeks considered. The higher ($p<0.05$) breast girth was observed in exotic turkey while the local turkeys had the least, specifically at weeks 8 and 10, the local white and lavender turkey had the least breast girth.

The values of keel length was significantly ($p<0.05$) influenced by the genotype in all the weeks considered except at week 2. Longer keel length was observed in exotic turkey except at week 8 where local black and lavender turkey had longer ($p<0.05$) keel length. The highest ($p<0.05$) wing length was observed in exotic turkey. Among the local turkeys, the shortest wing length was observed in white plumage colour turkey at weeks 10, 14 and 16. Similarly, the wing span was highest ($p<0.05$) in exotic turkey in all weeks considered. Among the local turkeys, the

shortest wing span was observed in white plumage colour turkey at weeks 4 and 14 and in local black turkey at week 12.

The effect of genotype on shank length was significant ($p<0.05$) except at weeks 2 and 16. Significantly ($p<0.05$) higher shank length was observed in the exotic turkey throughout the experiment while the local turkeys had the least shank length. However among the Nigerian locally adapted turkeys, lavender and white local turkey had the least shank length at week 4, 8 and 12 and white local turkey the least at week 10 and 14. In addition, highest ($p<0.05$) values of thigh length were observed in exotic turkey throughout the study except at week 16. However, the thigh length of exotic turkey was not significantly ($p>0.05$) different from that of local white turkey at week 6 and local black turkey at week10.

Table 1a: Effect of genotype on growth performance of different plumage colour of local and exotic turkey (Week 0 – 6)

Age (Week)	Gen	BW(g)	HG(cm)	BL(cm)	BG(cm)	KL(cm)
0	Local black	55.46±1.25^{a}	3.58±0.09^{b}	4.71±0.24^{b}	3.66±0.06^{b}	0.82±0.0^{b}
	Lavender	48.92±1.37^{b}	3.15±0.08^{c}	4.50±0.16^{b}	3.39±0.16^{b}	0.98±0.1^{b}
	Local white	46.00±1.35^{b}	3.13±0.14^{c}	4.40±0.25^{b}	3.38±0.21^{b}	0.86±0.1^{b}
	Nicholas white	58.67±2.10^{a}	4.73±0.07^{a}	6.80±0.11^{a}	5.71±0.18^{a}	1.47±0.10^{a}
2	Local black	136.25±4.47^{b}	5.97±0.09^{b}	9.54±0.11^{b}	11.40±0.27^{b}	3.76±0.75^{a}
	Lavender	120.67±3.28^{c}	5.75±0.08^{bc}	9.67±0.14^{b}	11.08±0.22^{b}	3.00±0.02^{a}
	Local white	118.58±4.15^{c}	5.50±0.11^{c}	8.88±0.15^{c}	11.08±0.18^{b}	3.10±0.08^{a}
	Nicholas white	205.58±7.72^{a}	6.63±0.11^{a}	11.04±0.19^{a}	13.42±0.28^{a}	3.87±0.07^{a}
4	Local black	298.67±12.20^{b}	7.54± 0.18^{ab}	14.46±0.17^{b}	15.38±0.30^{b}	4.83±0.0^{b}
	Lavender	284.58±10.82^{b}	7.44±0.06^{b}	13.33±0.17^{c}	15.00±0.35^{b}	4.77±0.0^{b}
	Local white	269.33±8.44^{b}	7.03±0.08^{c}	12.83±0.26^{c}	15.04±0.29^{b}	4.63±0.1^{b}
	Nicholas white	515.75±25.08^{a}	7.79±0.07^{a}	15.29±0.39^{a}	19.54±0.23^{a}	5.71±0.10^{a}
6	Local black	611.75±29.8^{b}	8.45±0.13^{b}	16.00±0.3^{b}	20.25±0.33^{b}	6.98±0.0^{b}
	Lavender	532.75±22.6^{c}	8.27±0.08^{c}	16.08±0.20^{b}	19.17± 0.30^{c}	6.11±0.12^{c}
	Local white	524.33±14.10^{c}	8.05±0.11^{c}	16.00±0.18^{b}	19.46±0.23^{bc}	6.08±0.11^{c}
	Nicholas white	977.58±33.3^{a}	9.07± 0.09^{a}	19.08±0.32^{a}	24.5 ±0.29^{a}	7.55±0.16^{a}
8	Local black	916.67±29.73^{b}	8.84±0.15^{b}	19.08±0.19^{bc}	21.5±0.26^{b}	8.08±0.04^{a}
	Lavender	807.58±29.66^{c}	8.85±0.07	18.67±0.1	20.75±0.2	8.00±0.01^{a}

			b	4[c]	5[c]	
	Local white	845.17±42.17[b]	8.57±0.05[c]	20.17±0.76[b]	20.92±0.15[bc]	7.53±0.05[d]
	Nicholas white	1337.5±41.34[a]	10.42±0.06[a]	22.75±0.25[a]	29.5±0.29[a]	7.82±0.08[c]
10	Local black	1162.90±205.4[b]	9.29±0.13[c]	26.96±0.20[a]	27.92±0.31[b]	8.94±0.07[b]
	Lavender	1566.67±74.96[a]	9.8±0.11[b]	22.71±0.65[b]	24.75±0.39[c]	8.68±0.08[b]
	Local white	1625±70.84[a]	9.38±0.11[c]	22.72±0.56[b]	24.42±0.47[c]	8.05±0.11[c]
	Nicholas white	1787.5±162.15[a]	10.21±0.20[a]	28.33±0.68[a]	29.71±0.45[a]	9.46±0.19[a]
14	Local black	2575.00±122.55[b]	12.21±0.10[b]	30.71±0.52[a]	31.25±0.57[b]	11.62±0.11[b]
	Lavender	2425.00 ±119.42[b]	11.88± 0.09[b]	30.17±0.60[ab]	32.42±0.57[b]	12.27±0.16[a]
	Local white	2275.00±102.34[b]	11.42± 0.21[c]	29.08±0.42[b]	30.33±0.45[b]	12.21±0.21[ab]
	Nicholas white	3716.67± 165.98[a]	12.79±0.19[a]	30.33±0.31[ab]	38.5±1.23[a]	12.13±0.29[ab]
16	Local black	3025.00 ±176.29[b]	11.71±0.17[b]	32.38±0.55[b]	33.00 ±0.52[b]	12.73±.15[b]
	Lavender	2908.33±153.47[b]	11.56±0.17[b]	30.67±0.69[bc]	32.42±0.50[b]	12.85±.13[b]
	Local white	2637.50±135.84[b]	11.88±0.18[b]	29.75±1.02[c]	33.2±0.42[b]	12.05±0.21[c]
	Nicholas white	4783.33±306.21[a]	12.88±0.20[a]	38.17±1.11[a]	42.17±1.04[a]	13.58±0.33[a]

Note: [a, b, c] Means in the same column in the same group with the different superscripts are significantly different (P<0.05)

Gen: Genotype; BW: Body weight; HG: Height; BL: Body length; BG: Breast girth; KL: Keel length

HG: height measurement not mentioned in the data collection

Table 1b: Effect of genotype on growth performance of different plumage colour of local and exotic turkey (Week 0 – 6)

Age (Week)	Gen	WL(cm)	WS(cm)	SL(cm)	TL(cm)
0	Local black	5.11±0.27^{b}	11.13±0.48^{b}	0.72±0.06^{b}	1.85±0.10^{b}
	Lavender	5.10±0.10^{b}	10.56±0.24^{b}	0.88±0.04^{b}	1.86±0.05^{b}
	Local white	5.13±0.17^{b}	10.62±0.33^{b}	0.79±0.05^{b}	1.83±0.09^{b}
	Nicholas white	6.68±0.13^{a}	14.11±0.32^{a}	1.33±0.09^{a}	2.98±0.38^{a}
2	Local black	10.02±0.61^{b}	22.08±1.07^{b}	4.79±1.66^{a}	7.34±0.38^{b}
	Lavender	10.08±0.15^{b}	21.86±0.21^{b}	3.18±0.09^{a}	7.86±0.06^{b}
	Local white	9.82±0.13^{b}	21.79±0.14^{b}	3.15±0.12^{a}	7.58±0.14^{b}
	Nicholas white	12.04±0.26^{a}	26.5±0.29^{a}	3.75±0.08^{a}	9.17±0.19^{a}
4	Local black	14.29±0.24^{b}	31.38±0.41^{b}	4.79±0.10^{b}	10.73±0.12^{b}
	Lavender	14.33±0.18^{b}	30.75±0.33^{bc}	4.15±0.05^{c}	10.73±0.11^{b}
	Local white	13.71±0.23^{b}	29.92±0.23^{c}	4.08±0.04^{c}	10.23±0.10^{c}
	Nicholas white	16.54±0.26^{a}	35.71±0.59^{a}	5.21±0.09^{a}	12.26±0.17^{a}
6	Local black	18.42±0.47^{b}	40.33±0.82^{b}	5.76±0.13^{a}	13.38±0.28^{b}
	Lavender	18.21±0.23^{b}	40.17±0.58^{b}	6.08±0.06^{a}	13.46±0.14^{b}
	Local white	17.83± 0.23^{b}	39.42±0.53^{b}	7.00±0.83^{a}	14.17±1.45^{ab}
	Nicholas white	21.46±0.29^{a}	46.42±0.69^{a}	6.33±0.15^{a}	15.94±0.19^{a}
8	Local black	21.08±0.30^{b}	45.5±0.62^{b}	7.1±0.05^{b}	16.13±0.07^{b}
	Lavender	20.66±0.28^{b}	44.67±0.58^{b}	6.72±0.07^{c}	15.42±0.15^{c}
	Local white	20.58±0.19^{b}	44.52±0.47^{b}	6.84±0.08^{c}	14.67±0.19^{d}
	Nicholas white	24.29±0.41^{a}	53.25±0.90^{a}	7.84±0.07^{a}	18.83±0.21^{a}
10	Local black	23.33±0.28^{c}	50.58±1.05^{c}	8.41±0.14^{b}	19.25±0.17^{a}
	Lavender	24.75±0.18^{b}	53.67±0.95^{b}	8.13±0.08^{b}	18.46±0.16^{b}
	Local white	24.00±0.28^{c}	51.08±0.69^{c}	7.73±0.07^{c}	18.13±0.07^{b}
	Nicholas white	27.5 ±0.29^{a}	59.5±0.67^{a}	9.21±0.21^{a}	19.67±0.33^{a}
12	Local black	25.08±0.23^{c}	55.33±0.66^{c}	10.34±0.12^{b}	21.33±0.22^{c}
	Lavender	26.92±0.40^{b}	57.89±0.69^{b}	9.94±0.17^{c}	21.36±0.15^{c}
	Local white	26.33±0.33^{b}	59.38±0.33^{b}	10.00±0.00^{c}	23.21±0.58^{b}
	Nicholas	31.33±0.38^{a}	71.17±0.34^{a}	11.17±0.09^{a}	24.5 ±0.23^{a}

	white				
14	Local black	30.25±0.35[b]	63.58±0.66[b]	11.4±0.14[b]	25.44±0.18[b]
	Lavender	30.63±0.36[b]	64.79±0.87[b]	11.25±0.18[b]	25.35±0.38[b]
	Local white	28.20±0.58[c]	60.42±1.15[c]	10.50±0.15[c]	23.71±0.31[c]
	Nicholas white	32.92±0.69[a]	71.08±1.20[a]	12.78±0.16[a]	27.75±0.58[a]
16	Local black	29.96±0.43[bc]	64.75±0.90[b]	11.82±0.22[b]	28.06±0.44[a]
	Lavender	31.54±0.57[b]	66.67±1.30[b]	11.73±0.17[b]	26.43±0.68[a]
	Local white	29.46±0.35[c]	63.46±0.66[b]	11.53±0.27[b]	26.08±0.47[a]
	Nicholas white	35.92±0.90[a]	76.33± 1.84[a]	13.00±0.35[a]	28.17±1.14[a]

Note: [a, b, c] Means in the same column in the same group with the different superscripts are significantly different (P<0.05)

WL: Wing length; WS: Wing span; SL: Shank length; TL: Thigh length.

4.0 DISCUSSION

4.1 Effect of Genotype on Growth Performance of Local and Exotic Turkeys

Growth in farm animals and especially poultry is a reflection of an intricate balance between a great number of endogenous (hormonal, immunological and genetic) and exogenous (environmental) factors. Though growth performance of an animal is a phenotypic attribute influenced by the environment, to a larger extent, it is a manifestation of the genetic constitution of the animal [14,15].

In this study, genetic variation in feather colour and between local and exotic turkey existed in the body weight, shank length, body length, breast girth, wing length, height, thigh length, wing span and keel length of local and exotic turkeys. This is in agreement with the result of Ilori *et al.* [15, 16, 17] and Adeoye *et al*. [18] who reported large genetic variation among the growth traits between local and exotic turkeys and between the different plumage colours of Nigerian local turkeys. The exotic turkeys displayed superiority of growth traits over the local counterparts and

this could be attributed to the unimproved nature of the local turkey. The exotic turkey has been selected over many generations for improved performance. This was further corroborated by Ilori *et al.* [17] who reported differences and superiority in the exotic turkey which suggested that they had a better growth potential than the local counterparts. This is due to the fact that the breed had gone through intense selection for higher growth rate. The fact that the local turkey had lower growth rate is expected since our indigenous poultry have gone through more of natural selection for survival to the tropical climate rather than artificial selection for productivity [19]. The results on body measurements followed the same trend. The linear measurements studied (shank length, drum stick, body length, girth, wing length, keel length, height, thigh circumference) showed that the exotic turkey had superiority over the local turkeys. The results obtained in the linear body parameters measured in this study justify the report by Gous [20] that growth is normally accompanied by an orderly sequence of maturational changes and involves accretion of protein and increase in length and size, not just an increase in body weight. Also, Sola-Ojo *et al*. [21] who studied the growth traits of Nigerian local turkeys and Nicholas White exotic turkeys further reported that the Nicholas White exotic turkey generally had significantly higher values when compared to the Nigerian local turkey.

Among the Nigerian indigenous turkey with the different plumage colour; black, lavender and white, although the differences in body weight was not significant, the black local turkey had the best performance which was followed by that of lavender while the least was observed in white feather local turkey. Linear body measurement in the different feather colour turkeys also followed the same trend with that observed with body weight. Ilori *et al.* [15] showed significant effect of feather colour on growth performance of turkey, growth performance of turkey with dark feather-pigmentation were better than that of the white feather turkey. Black feather turkey

consistently has better performance followed by the lavender color while the least was observed in white feather turkey. Our results corroborated that of Ilori *et al*. [15]. ~~They stated that growth performance of turkey with the different pigmentation suggested that Nigeria indigenous turkey may be able to control their temperature and avoid being overheated by other mechanism rather than the structural colors and plumage pigmentation.~~ Need to be reframed

5.0 CONCLUSION

There is a great deal of genetic variation in the body weights and biometric traits of exotic (Nicholas white) and Nigerian locally adapted turkeys. The exotic turkey has heavier body~~y~~ weight and longer biometric traits than any of the Nigerian locally adapted breed. However, the Nigerian locally adapted turkey with black plumage colour showed higher body weight and longer biometric traits than white and lavender plumage colours. The black plumage colour turkey of Nigerian locally adapted turkeys can therefore be selected for genetic improvement using exotic turkey genetic resources.

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