Proceedings of 30th Annual Conference of ASAN 2025, Abuja, Nigeria (49-53)

GENETIC VARIATIONS IN GROWTH TRAITS OF THREE BREEDS OF BROILER CHICKENS INOCULATED WITH *Salmonella typhimurium* VACCINE

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ABSTRACT
This study investigated the effect of genotype on body weights and linear traits of three breeds of broiler chickens (Arbor acre, Ross 308, and Cobb 500) challenged with *Salmonella typhimurium* vaccine. Seventy-five (75) day-old broiler chicks comprised of twenty-five (25) each of the three breeds were used for this study. Body weight and growth traits which include body length, height, wing length, breast girth, drum stick, shank length and thigh length of the birds were taken on a weekly basis from 1 day-old to 8 weeks of age. Data were analyzed using the General Linear Model (GLM) Procedure of SAS. The results showed significant ($P<0.05$) differences in body weights and linear traits among the breeds, with Cobb 500 having the highest body weight (439.27 and 3834.27g at weeks 2 and 8 respectively) from week 2 onwards. Cobb 500 also had the longest ($P<0.05$) value for most linear traits examined. The study concluded that Cobb 500 broiler chicken is heavier than Arbor Acre and Ross 308, and recommended exploiting the genetic differences among the breeds for genetic improvement of tropical broiler breeds.

Keywords: Growth traits, *Salmonella typhimurium* vaccine, Arbor acre, Ross 308, Cobb 500

DESCRIPTION OF PROBLEM

Broiler chicken production in Nigerian is becoming the most popular aspect of poultry production because its production can be found across ethnic and geopolitical zones in the country. Most of the broiler breeds reared in Nigeria are; Ross, Marshall, Cobb and Arbor acre (1). These breeds generally have heavy weight and can attain maturity in less than 8 weeks. However, they differ in terms of growth and immunity. Growth is an increase in the amount of protein and mineral matter accumulated in the body (2). Growth is a complex trait in animals that is controlled by genetic and non-genetic factors. Body weight and body conformations are the two important parameters for measuring growth in the domestic chicken (3). According to Amao *et al* (4), live weight and other conformation traits are known to be good indicators of body growth and market value of broiler chicken, such conformation traits were thigh length, breast girth length, neck length, back length and shank length and body weight among others. The body weight of any animal is an important parameter that determines the market value of that animal. The relationship between body weight and other linear body measurements has been described to have an important implication in the production of broilers and these relationships were always direct and positive (5). Henry *et al* (6) opined that one of the criteria for genetic improvement is the knowledge of genetic parameters for important economic traits while successful breeding programme relies on the ability to established relationship that exists between identified variables or traits.

There is wide variation in body weight and body measurements within a species. Even within breeds there is considerable variation in body measurements and body weight among individuals (2). Body weight and body dimension have been used as parameters for selection by local sellers and for research (2). Breeders need to establish the variations that exist between body weight and body measurements in different breeds of broiler chickens in order to be able to organize breeding programme for efficient production and maximum economic returns in a specific geographical location.

Salmonella contamination of poultry meat and eggs has been a continued global threat to public health (7). *Salmonella enterica serovar typhimurium* is a leading cause of foodborne gastroenteritis in humans (8) and is commonly associated with the consumption of *Salmonella*-contaminated broiler chicken meat (9). According to Gong *et al.* (10), young chicks are more susceptible to *Salmonella* colonization than older chickens because they lack the presence of a mature, protective microflora in the intestine. So, the increasing expansion of exotic chicken breeds, the public health importance, asymptomatic property and creating the drug resistance make *S. typhimurium* more difficult to control both in chicken and human beings. To solve this problem there should be an option that involves developing a poultry breed which has relatively better resistance to the disease (11). Therefore this study unraveled genetic variations in growth traits of three breeds of broiler chickens inoculated with *Salmonella typhimurium* vaccine.

MATERIALS AND METHODS

Study area

The study was conducted at the Poultry Unit of the Livestock Teaching and Research Farm, Ambrose Alli University, Ekpoma, Edo State, Nigeria, located in a tropical climate with average rainfall of 1556 mm, relative humidity of 75%, and a mean temperature of 24°C. Seventy-five day-old broiler chicks, comprising 25 each of Ross 308, Cobb 500, and Arbor Acre breeds, were obtained from a hatchery in Ibadan. The Completely Randomized Design (CRD) was used with each breed as a treatment group and 25 replicates per treatment (one bird per replicate). The *Salmonella typhimurium* vaccine was treated as a covariate across the groups. Birds were brooded for three weeks under controlled temperatures, starting at 34°C and reducing weekly by 3°C to 26°C. Continuous lighting was provided for the first three days, gradually reduced to 16 hours daily. Birds were fed standard commercial broiler diets and given free access to water. Strict hygiene was maintained to prevent disease. On day 14, each bird was given a 0.5 ml subcutaneous injection of *Salmonella* vaccine (LD50) sourced from a veterinary laboratory in Jos, Plateau State.

Body linear traits measured

Body weight and linear body traits (body length, height, wing length, breast girth, drumstick, shank, and thigh lengths) were recorded biweekly from a day-old to 8 weeks. A 5 kg sensitive scale was used for measuring body weights while measuring tailor's tape was used to measure linear traits.

Statistical analysis

Data were analyzed using the General Linear Model (GLM) Procedure of SAS (2014), and significant means were compared using Duncan's Multiple Range Test (12).

RESULTS AND DISCUSSION

Effect of Genotype on Body Weights and Linear Traits of Broiler Chickens Challenged with *Salmonella typhimurium* Vaccine

The study evaluated the impact of broiler genotype (Arbor Acre, Ross 308, and Cobb 500) on body weights and linear body measurements following vaccination with *Salmonella typhimurium*. Results (Table 1) showed that genotype significantly influenced ($P<0.05$) growth traits across various stages.

Week 1: Arbor Acre had the highest ($P<0.05$) body weight (40.40 g), followed closely by Cobb 500 (40.00 g), while Ross 308 had the lowest (34.5 g). Cobb 500 had the longest ($P<0.05$) body length (7.53 cm) and height, while Arbor Acre and Cobb 500 shared similar body girths and drumstick lengths. Arbor Acre had the longest ($P<0.05$) shank (2.30 cm), and Ross 308 and Cobb 500 had the longest ($P<0.05$) wing lengths. Thigh lengths were not significantly ($P>0.05$) affected by genotype.

Week 2: Cobb 500 had the heaviest ($P<0.05$) weight (439.27 g), with Ross 308 slightly behind. Shank length was longest ($P<0.05$) in Arbor Acre (3.17 cm), while Cobb 500 had the shortest. Cobb 500 and Ross 308 had longer wing lengths. Arbor Acre had the longest

(P<0.05) thigh length (8.07 cm), while Cobb 500 had the shortest.

Week 4: Cobb 500 showed the highest (P<0.05) body weight (1378.14 g) and the longest (P<0.05) body length, wing, and thigh lengths. Arbor Acre was the tallest (20.07 cm), though not significantly different (P>0.05) from Cobb 500. Cobb 500 also had the longest (P<0.05) drumstick while Arbor Acre had the longest (P<0.05) shank length.

Week 6: No significant (P>0.05) differences in most traits, except for body length and girth. Cobb 500 had the longest (P<0.05) body length (26.71 cm) and largest (P<0.05) body girth (34.71 cm), followed by Ross 308 and Arbor Acre.

Week 8: Though body weight differences were not significant (P>0.05), Cobb 500 was the heaviest (3834.27 g). Cobb 500 was also significantly (P<0.05) tallest (26.27 cm), had the longest wing (23.00 cm), and thigh (18.27 cm) lengths. Ross 308 had the longest (P<0.05) drumstick (11.40 cm), while Cobb 500 had the longest (P<0.05) shank.

The ability of animal to adapt to its environment differs between and within species, breeds and strains, as a result of genetic variation. In the current study, the body weight of the three breeds of broiler chickens increased as their age increased with Arbor acre genotype showed the highest body weight at week 1 while Cobb 500 consistently showing the highest body weights from week 2 and throughout the weeks of the experiment. This variability in body weights of Arbor acre, Ross 308 and Cobb 500 broiler chickens suggests that broiler chickens vary in genetic capacity for growth rates. This also implies that Cobb 500 may have higher genetic potential for higher body weight than their Ross 308 and Arbor acre counterparts. In addition, since the three breeds of broiler chicken in this study were exposed to similar environmental conditions, it may therefore follow that Cobb 500 are best adapted to the prevailing environmental conditions in the study's location than the Arbor acre and Ross 308 broiler chickens. This is also in line with the report of Udeh and Ogbu (3) who observed that Arbor acre, Ross and Marshall Broiler chickens differ significantly in body weights at 8 weeks of age. Generally, the body weights of the three breeds of broiler chickens in this study are higher than 1300.00-2000. 00g market weight at 8-10 weeks of age reported by Akanno *et al* (13) and average bodyweight of 1801.00g for Ross broiler chicken at 7 weeks of age as reported by Abdullah *et al* (14).

Table 1 effect of genotype on body weights and linear traits of broiler chickens challenged with *Salmonella typhimurium* vaccine

Wks	Genotypes	Body weight	Body length	Body girth	Height	Drum stick	Shank length	Wing length	Thigh length
1	Arbor acre	40.40±0.90^{a}	7.19±0.09^{b}	8.33±0.13^{a}	7.63±0.17^{b}	3.38±0.11^{a}	2.30±0.07^{a}	4.79±0.14^{b}	4.80±1.98^{a}
	Ross 308	34.53±0.59^{b}	6.93±0.12^{b}	7.97±0.10^{b}	7.47±0.90^{b}	3.07±0.05^{b}	1.60±0.05^{b}	5.23±0.13^{a}	2.93±0.05^{c}
	Cobb 500	40.00±0.70^{a}	7.53±0.11^{a}	8.33±0.08^{a}	8.33±0.08^{a}	3.37±0.06^{a}	1.53±0.03^{b}	5.13±0.08^{a}	3.03±0.06^{b}
2	Arbor acre	389.07±12.38^{b}	14.13±0.20	17.87±0.28	14.57±0.47	4.87±0.35	3.17±0.13^{a}	10.73±0.59^{b}	8.07±0.30^{a}
	Ross 308	430.87±12.79^{a}	14.10±0.22	18.13±0.21	14.73±0.17	5.20±0.14	2.90±0.07^{ab}	12.57±0.18^{a}	6.77±0.13^{b}
	Cobb 500	439.27±9.05^{a}	13.93±0.18	18.53±0.22	14.77±0.11	5.43±0.12	2.83±0.11^{b}	12.67±0.12^{a}	6.50±0.10^{b}
4	Arbor acre	1164.43±5.19^{b}	20.43±0.29^{b}	27.71±0.47	20.07±0.30^{a}	8.64±0.26^{b}	6.46±0.26^{a}	13.71±0.30^{b}	11.36±0.39^{b}
	Ross 308	1211.13±5.6^{b}	20.73±0.32^{b}	27.73±0.44	18.87±0.41^{b}	9.03±0.20^{ab}	5.23±0.16^{b}	13.93±0.23^{b}	11.33±0.25^{b}
	Cobb 500	1378.14±3.40^{a}	21.86±0.27^{a}	28.64±0.20	19.46±0.37^{ab}	9.57±0.23^{a}	5.00±0.10^{b}	16.25±0.25^{a}	13.64±0.34^{a}
6	Arbor acre	2134.54±1.24	25.38±0.46^{b}	31.00±78^{b}	19.96±0.51	12.46±0.53	5.38±0.21^{b}	18.08±0.42	15.50±0.44
	Ross 308	2296.33±8.7	26.13±0.42^{ab}	32.40±0.55^{b}	20.80±0.42	12.60±0.25	5.73±0.15^{b}	17.80±0.37	15.20±0.28
	Cobb 500	2391.71±8.70	26.71±0.34^{a}	34.71±0.80^{a}	21.29±0.66	12.18±0.27	6.54±0.17^{a}	18.36±0.62	15.93±0.27

8	Arbor acre	3555.79±2.20	28.21±0.73	40.36±1.14	23.27±0.67^{c}	8.79±0.70^{b}	7.00±0.23^{a}	19.29±0.69^{b}	14.71±0.42^{c}
	Ross 308	3764.67±1.45	28.13±0.55	41.53±0.66	24.79±0.42^{b}	11.40±0.38^{a}	7.13±0.22^{a}	17.87±0.50^{b}	16.00±0.01^{b}
	Cobb 500	3834.27±1.02	28.73±0.30	42.00±0.86	26.27±0.40^{a}	8.40±0.83^{b}	6.20±0.28^{b}	23.00±0.47^{a}	18.27±0.44^{a}

Note: mean with different superscripts a, b, c in the same column and group are significantly different (P<0.05), wks: weeks.

As regards to body linear measurements, Cobb 500 had the longest values for most of the linear traits examined. Indeed, this result showed that a great deal of genetic variability may exist among different breeds of broiler chickens. The highest values of body linear traits recorded in Cobb 500 justified the highest body weights recorded in this broiler chicken breed. This is because growth is general an increase in size as a result of increase in both internal and external body parts. According to Sanda *et al* (15) it is only the genetically determined variation which can be utilized for a permanent improvement of the production characteristics in the populations. Thus, both body weight and linear traits are genetically differ among Arbor acre, Ross 308 and Cobb 500 broiler chickens and could be exploited for genetically improvement of tropical broiler breed.

CONCLUSION AND APPLICATION

Genotype significantly affects growth performance and linear body traits, particularly in early growth phases. Cobb 500 consistently exhibited superior growth in most traits compared to Arbor Acre and Ross 308, indicating its potential advantage under *Salmonella* challenge conditions. This study recommends exploitation of the genetic differences among Arbor acre, Ross 308, and Cobb 500 broiler chickens for genetic improvement of tropical broiler breeds.

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