Variation pattern in production traits of broiler strains reared in a humid tropical environment

*¹Obike, O. M., ¹Obi, O. C., ²Onunkwo, D. N. and ¹Aso, R. N.

¹Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

²Department of Animal Nutrition and Forage Science, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

*Corresponding author: uceemer@yahoo.com

Abstract

The study evaluated the effect of strain on productive traits of three broiler chickens. A total of 144 broilers, 48 each of Hubbard, Marshall and Ross were used for the experiment which lasted 8 weeks. The birds were reared in separate deep litter pens with each strain replicated into 4 having 12 birds per replicate. Data were generated on body weight and linear body parameters (body length – BL, keel length – KL, shank length – SL, wing length – WL, breast width – BSW, thigh length – TL and drumstick length – DL) at 2 weeks interval from the 2nd week, growth performance, carcass and economics of production indices. Data were analyzed using the general linear model procedure of SPSS package. Results obtained showed significant ($p < 0.05$) differences among the strains for the various parameters studied. The Marshall strain was significantly ($p < 0.05$) superior in final body weight (1861.14 g) followed by Ross (1714.44 g) while the least in body size was Hubbard (1432.45 g). Daily weight gain (g/bird/day) and FCR were significantly ($p < 0.05$) better in Marshall and Ross compared to Hubbard. Marshall and Ross strain had significantly ($p < 0.05$) heavier body weights and longer bodies in week 2 – 8; longer keels (week 6 and 8), thighs (week 2 and 6) and drumsticks (weeks 2, 6 and 8). Hubbard and Marshall showed statistically ($p < 0.05$) higher mean values for BSW than Ross in weeks 2 and 4. For the carcass traits, Marshall broiler also showed superiority ($p < 0.05$) over Ross and Hubbard in live weight 1818.75 vs 1653.13, 1500.00 g), defeathered weight (1643.75 vs 1487.50, 1375.00 g), dressed weight (1359.39 vs 1280.00, 1062.50 g) and percent breast 18.44 vs 16.95, 13.95). However, Ross and Hubbard had higher ($p < 0.05$) means for shank proportion than for Marshall. Results of the cost-benefit indices revealed that the Marshall strain significantly ($p < 0.05$) generated more revenue (₦1460.91/bird) and gross profit (₦666.52/bird) compared to its counterpart strains. Marshall could therefore be recommended to farmers in our study area as a choice strain with faster growth and superior carcass yield for maximum economic return.

Keywords: Variation, production traits, broiler, strain

Introduction

Consumer demand for chicken products has been on the rise in both foreign and local markets due to rapid increase in world population and the perceived health benefit of chicken meat.

Ojedapo *et al.* (2015) reported that statistics have shown that the demand for poultry products is on a geometric increase, and that chicken meat costs less than other

meats; thus its market share is also on the increase. The authors also noted that demand for poultry products is equally high in Nigeria, and that the current rate of production is extremely low and inadequate to meet the demand.

On this, the Nigerian poultry industry over the years has experienced the introduction of different broiler strains into the country. The evaluation of the different commercial

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broiler strains as well as management techniques is therefore important in order to improve production efficiency. The knowledge of variability of genotype/strain of chicken accompanied by manipulation of their production system will translate into desirable carcass and meat quality characteristics, which is paramount for consumers in making purchasing decisions (Assan, 2015). Fanatico *et al.* (2007) noted genotype as an important factor in any chicken production system since it influences carcass and meat quality. Ojedapo *et al.* (2008) and Amao *et al.* (2009) stressed on the different commercial broiler strains with regards to breeding management and growth traits. Razuki *et al.* (2011) reported significant strain differences in body weight at different ages among broiler chickens.

According to FAO (2012), growth/quantitative traits are generally the dimensions of different body parts and live weight which are directly related to production parameters. It then means that growth in animals is evaluated from the component parts and body weight of the animal. These traits (body length, shank length, breast width, keel length, wing length etc and body weight) may vary with genotype and sex and may also be influenced by the method of data analysis (Assan, 2015). Some authors inferred that characterization of animal genetic resources depends on the knowledge of the variation of growth traits (Abera and Tegene, 2011; Ferra *et al.*, 2010), which are also important production and selection criteria (Bene *et al.*, 2007).

In Nigeria today, broiler production is one of the most popular enterprises for both small and medium scale farmers in the rural and urban areas. There arises the need to continually evaluate and determine the performance of the different broiler strains

since performance evaluation forms the initial step in any meaningful genetic improvement programmes as well as identification of strains most suited for particular environment for increased production output.

The objective of this study was therefore to estimate the production traits (body weight, linear body, carcass and economics of production) of three broiler strains (Marshal, Hubbard and Ross) reared in a humid tropical environment.

Materials and methods

This research was conducted at the Poultry unit of the Teaching and Research farm of Michael Okpara University of Agriculture, Umudike located on latitude 05°29 N and longitude 07°33 E. Umudike is on an elevation of 122 m above sea level and located in tropical rain-forest zone of Nigeria, which is characterized by annual rainfall of about 2177 mm; monthly ambient temperature ranges of 22-33°C and relative humidity of 50-95 % depending on the season.

Experimental animals and management

A total of 150 day-old broiler chicks (Marshal, Hubbard and Ross) were purchased from a reputable hatchery in Ibadan, Nigeria. Two weeks to the arrival of the birds, the brooder house was washed, disinfected and allowed to dry. On arrival, anti-stress preparations were administered to enable the chicks recover from transportation stress. The birds were brooded for 2 weeks and were transferred to deep litter pens afterwards. Antibiotics and anticoccidial drugs were administered at relevant periods. All routine vaccination and management procedures were strictly followed. Wood shavings were used as litter materials. Feed and water were given to the birds *ad libitum*. The experiment lasted for 8 weeks.

After brooding, each of the strain was replicated into four with 12 birds per replicate. Measurements were taken on the following parameters:

Growth performance traits

Initial weight: weight of the birds at the beginning of the experiment taken with the aid of a weighing scale

Final weight: weight of the birds at 8 weeks taken with the aid of a weighing scale.

Daily weight gain:

Final weight – initial weight

Number of birds/56 days

Average daily feed intake:

Quantity of feed given (g) – leftover

Number of birds/56 days

Feed conversion ratio:

Average daily feed intake (g/bird)

Average daily weight gain (g/bird)

Linear body parameters

Body length: distance between the base of the neck and pygostyle.

Keel length: length of the cartilaginous keel bone, from the v-joint to the end of the sternum.

Shank length: beginning of hock joint to the last ring before the tarsal or meta-tarsal digit.

Wing length: distance from the shoulder joint to the extremity of the terminal

phalange.

Breast width: region of the largest breast expansion when positioned ventrally.

Thigh length: beginning of the fibula to the hock joint.

Drumstick length: length of femur bone.

Carcass evaluation

At the end of the experiment, two birds per replicate were randomly selected for carcass yield. The birds were deprived of feed over night to avoid gut fill, weighed and killed by slitting the jugular vein. The birds were defeathered after immersing them in hot water, plucked and eviscerated. The dressed birds were weighed to obtain dressed weight before cutting into parts – breast, shank, wing, thigh, drumstick, neck and back, which were weighed separately according to Scott *et al.* (1969). Dressed weight, slaughtered weight, cut parts and internal organs were expressed as percent of live weight.

Economics of production

Cost of production analysis of each strain was determined at the end of the finisher phase to compare the profitability of the strains. The parameters measured were:

Cost/kg feed = proportion of each ingredient in the diet x cost/kg of ingredient

Table 1: Growth performance parameters of Hubbard, Marshall and Ross broiler strains

Parameter	Strains of chicken		
	Hubbard	Marshall	Ross
Initial weight (g)	38.25 ± 2.04	35.00 ± 2.03	37.50 ± 2.04
Final weight (g)	1432.45 ± 2.00 ^c	1861.14 ± 1.08 ^a	1714.44 ± 2.01 ^b
Daily weight gain g/bird/day	24.90 ± 0.00 ^b	32.61 ± 0.00 ^a	31.73 ± 0.00 ^a
Daily feed intake g/bird/day	84.40 ± 2.02	88.70 ± 2.00	86.90 ± 2.04
FCR	3.39 ± 0.07 ^b	2.76 ± 0.05 ^a	2.74 ± 0.05 ^a

^{abc} = means along each column differ significantly (P<0.05). SE = standard error of mean

Body weight and linear body parameters of Hubbard, Marshall and Ross strains

The least square means plus their standard errors of body weight and linear body measurements at 2 – 8 weeks of age of Hubbard, Marshall and Ross are presented

in Table 2. Significant (p<0.05) differences existed among the strains in body weight and linear traits except for SL and WL. Researchers have reported substantial effect of genotype on body weight and linear body traits (Olawumi *et al.*, 2012; Yahaya *et al.*,

Table 2: Body weight and linear body parameters of Hubbard, Marshall and Ross broiler strains from 2 – 8 weeks

Parameters										
Week	Strain	BW (g)	BL (cm)	KL (cm)	SL (cm)	WL (cm)	BSW (cm)	TL (cm)	DL (cm)	
2	Hubbard	294.78±10.62 ^b	20.09±0.17 ^b	6.60±0.10 ^b	4.20±0.07	11.51±0.14	5.30 ± 0.08 ^a	4.18 ± 0.08 ^b	5.18 ± 0.11 ^b	
	Marshall	369.04±12.59 ^a	21.22±0.21 ^a	7.80±0.12 ^a	4.34±0.08	11.94±0.16	5.51 ± 0.12 ^a	5.99 ± 0.10 ^a	6.84 ± 0.13 ^a	
	Ross	335.73±10.39 ^a	21.95±0.17 ^a	6.86±0.10 ^{ab}	4.04±0.07	11.31±0.13	4.19 ± 0.10 ^b	5.55 ± 0.08 ^a	6.64 ± 0.11 ^a	
4	Hubbard	640.49±27.06 ^b	25.89±0.25 ^b	9.05±0.13	5.66±0.08	14.27±0.16	7.05 ± 0.12 ^a	7.35 ± 0.10	9.03 ± 0.15	
	Marshall	785.89±33.04 ^a	26.72±0.30 ^a	9.46±0.15	5.38±0.10	14.96±0.20	6.45 ± 0.14 ^a	7.15 ± 0.12	9.06 ± 0.18	
	Ross	788.45±26.48 ^a	27.14±0.24 ^a	9.79±0.12	5.44±0.08	15.04±0.16	5.09 ± 0.11 ^b	7.53 ± 0.10	9.52 ± 0.14	
6	Hubbard	1060.74±47.82 ^b	30.01±0.39 ^b	10.33±0.16 ^b	6.37±0.08	17.45±0.21	7.27 ± 0.15	8.51 ± 0.15 ^b	10.12 ± 0.17 ^b	
	Marshall	1327.23±58.63 ^a	31.29±0.48 ^a	12.02±0.19 ^a	6.49±0.10	18.55±0.25	7.48 ± 0.18	9.82 ± 0.18 ^a	11.58 ± 0.20 ^a	
	Ross	1431.13±46.16 ^a	31.65±0.38 ^a	12.64±0.15 ^a	6.76±0.08	18.67±0.20	7.58 ± 0.14	10.37 ± 0.14 ^a	12.16 ± 0.16 ^a	
8	Hubbard	1432.44±59.46 ^b	33.25±0.39 ^b	13.35±0.25 ^b	7.66±0.10	20.53±0.30	9.32 ± 0.16	11.18 ± 0.16	12.10 ± 0.21 ^b	
	Marshall	1861.14±73.40 ^a	35.63±0.48 ^a	14.31±0.30 ^a	7.81±0.12	21.05±0.37	9.25 ± 0.20	11.71 ± 0.20	13.95 ± 0.26 ^a	
	Ross	1814.44±58.09 ^a	35.85±0.38 ^a	14.86±0.24 ^a	7.80±0.10	21.06±0.30	9.47 ± 0.16	11.83 ± 0.16	14.09 ± 0.20 ^a	
Average	Hubbard	857.03±20.72 ^b	26.81±2.09	9.65±1.06 ^b	5.79±0.52	15.49±1.36	7.06 ± 0.59	7.69 ± 0.90	9.16 ± 1.00	
	Marshall	1092.57±21.58 ^a	28.72±2.20	10.70±1.12 ^{ab}	5.97±0.55	16.63±1.44	7.17 ± 0.62	8.67 ± 0.95	10.36 ± 1.06	
	Ross	1092.41±21.58 ^a	28.88±2.20	11.04±1.12 ^a	6.01±0.55	16.51±1.44	7.04 ± 0.62	8.82 ± 0.95	10.61 ± 1.06	

^{ab} = means along each column differ significantly (P<0.05). SE = standard error of mean, BW = body weight, BL = body length, KL = keel length, SL = shank length, WL = wing length, BSW = breast width, TL = thigh length, DL = drumstick length.

2012). Marshal and Ross strains were significantly similar ($p>0.05$) and differed ($p<0.05$) from Hubbard in body weight at all the ages. The values recorded for body weight among the strains increased progressively with age of the birds. Differences in body weight among broiler strains established in this study have previously been reported (Razuki *et al.*, 2011; Taha *et al.*, 2011; Obike *et al.*, 2015; 2016). Udeh *et al.* (2015) reported that the body weights of Arbor Acer and Marshal were significantly ($p<0.05$) superior to that of Ross broilers at weeks 1, 2, 3 and 4. However, the researchers noted similarity of body weight in weeks 5 – 7 for Marshal and Ross. At 8 weeks of age, Amao *et al.* (2011) noted significantly ($p<0.05$) heavier weight for Ross compared to Marshal, which contradicts our finding. Ojedapo (2013) gave mean values for body weight which ranged from 374.78 g – 1981.34 g at week 2 – 8 in Marshal. This is slightly higher than the mean values (369 g – 1092.57 g) observed in this study for Marshal.

Marshal and Ross were also significantly ($p<0.05$) superior to Hubbard in BL (week 2, 4, 6 and 8), KL (week 6 and 8), TL (week 2 and 6) and DL (week 2, 6 and 8). For BSW, Hubbard and Marshal had wider ($p<0.05$) breast width proportion than the Ross strain. Significant differences in linear body measurements have also been reported (Olawumi *et al.*, 2012; Yahaya *et al.*, 2012). Obike *et al.* (2016) found that Arbor Acer strain had significantly ($p<0.05$) longer body length, shank length, keel length, wing length, drumstick length and wider chest circumference in relation to the Cobb strain. Significant strain effect on breast girth and shank length was reported by Ajayi and Ejiofor (2009). As observed with body weight, the linear body traits measured increased progressively

with age in this study. Pingel *et al.* (1990) reported that age was the major determinant of growth and physiological development in chicks. Obike *et al.* (2016) also observed increase in body traits of broilers as they advanced in age. The results obtained in this study implied existence of genetic differences in growth rates among the three commercial strains. It is in consonance with earlier report of differences in growth pattern within species

(Deeb and Lamont, 2002). The higher performance of Marshal and Ross suggests that the strains might be most suitable to rear in our study area.

Carcass and economics of production indices

Table 3 presents the means and standard errors of carcass traits of the broiler strains evaluated. Significant ($p<0.05$) strain effects were observed in live weight, defeathered weight, dressed weight, breast, wing and shank. Marshall recorded superior and higher mean values in live weight (1818.75 g), defeathered weight (1643.75 g), dressed weight (1359.39 g) and percent breast (18.44) than Ross and Hubbard but was similar in dressed weight and percent wing with Ross. Hubbard and Ross strain had significantly ($p<0.05$) higher mean value for percent shank in comparison with the mean recorded for the Marshal strain. Strain effect has been previously reported to influence carcass characteristics (Musa *et al.*, 2006; Ojedapo *et al.*, 2008). Mendes *et al.* (1994) observed significant strain effect on carcass yield and percentage of breast meat in four broiler strains. Olawumi and Fagbuaro (2011) evaluated the productive performance of Marshall, Arbor Acer and Hubbard broilers, and reported that the Marshall genotype was superior to Arbor Acer and Hubbard in live weight, carcass weight, dressed weight, eviscerated weight, breast muscle weight, back muscle weight,

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thigh muscle weight, drumstick and heart weight. This report is in agreement with our findings except for drumstick, thigh and back which did not differ statistically among the broiler strains used in our study. On the contrary, Ojedapo *et al.* (2015) investigated carcass traits of broiler strains

(Cobb and Marshall) slaughtered at 4, 6 and 8 weeks respectively and reported that the Cobb significantly ($p < 0.05$) outperformed the Marshall in all the carcass and visceral organ characteristics assessed. These results confirm that genetic potential is a major determinant of carcass yield.

Table 3: Carcass characteristics of Hubbard, Marshall and Ross broiler strains

Parameter	Strains of chicken		
	Hubbard	Marshall	Ross
Live weight (g)	1500.00 $\pm$ 102.68 ^c	1818.75 $\pm$ 125.76 ^a	1653.13 $\pm$ 102.68 ^b
Defeathered weight (g)	1375.00 $\pm$ 96.79 ^b	1643.75 $\pm$ 118.54 ^a	1487.50 $\pm$ 96.79 ^b
Dressed weight (g)	1062.50 $\pm$ 105.93 ^b	1359.38 $\pm$ 129.74 ^a	12800.00 $\pm$ 105.93 ^b
Breast (%)	13.95 $\pm$ 1.19 ^b	18.44 $\pm$ 1.19 ^a	16.92 $\pm$ 1.46 ^b
Wing (%)	12.80 $\pm$ 0.59 ^a	10.25 $\pm$ 0.72 ^b	10.37 $\pm$ 0.59 ^b
Drumstick (%)	10.16 $\pm$ 0.51	11.73 $\pm$ 0.63	11.66 $\pm$ 0.51
Shank (%)	5.35 $\pm$ 0.27 ^a	4.43 $\pm$ 0.33 ^b	5.59 $\pm$ 0.27 ^a
Thigh (%)	12.44 $\pm$ 0.81	11.84 $\pm$ 0.99	12.69 $\pm$ 0.81
Neck (%)	7.31 $\pm$ 0.49	5.79 $\pm$ 0.60	7.08 $\pm$ 0.49
Back (%)	14.72 $\pm$ 0.86	14.23 $\pm$ 1.05	15.53 $\pm$ 0.86

^{abc} = means along each column differ significantly ($P < 0.05$). SE = standard error of mean

The economics of production analysis of the three broiler strains is as indicated in Table 4. Significant differences ($p < 0.05$) were also observed among the strains for the cost-benefit traits analyzed. The cost of feed consumed per bird as well as cost per unit weight gain was less for Marshall and Ross compared to Hubbard. However, the Marshall strain generated more revenue (₦1460.91/bird) and gross profit (₦666.52/bird) followed by Ross (₦1321.55/bird; ₦538.25/bird). Hubbard had the least values for revenue

(₦1115.36/bird) and gross margin (₦347.46). Similar results indicating significant variations in cost of production analysis of broiler strains have been reported (Yakubu *et al.*, 2010; Obike *et al.*, 2015; 2016). Iqbal *et al.* (2012) reported that the overall performance of Hubbard strain seemed better as the birds gained more body weight, gave better FCR, least mortality and least cost per kg live broiler produced as compared to Ross, Arbor Acer and Hybro PN strains. Our result indicates that rearing Marshall could be more profitable to farmers in our environment.

Table 4: Economics of production of Hubbard, Marshall and Ross broiler strains

Parameter	Strains of chicken			SEM
	Hubbard	Marshall	Ross	
Cost/kg feed (₦)	110.00	110.00	110.00	0.29
Cost of feed consumed (₦)	546.39 ^a	519.90 ^b	525.30 ^b	3.84
Feed cost/weight gain (₦/bird)	372.90 ^a	303.60 ^b	301.40 ^b	11.74
Revenue (₦/bird)	1115.36 ^c	1460.91 ^a	1321.55 ^b	54.61
Gross margin (₦/bird)	347.46 ^c	666.52 ^a	538.25 ^b	50.99

^{abc} = means along each column differ significantly ($P < 0.05$). SEM = standard error of mean

Conclusion

It was revealed in this study that broiler strain showed significant influence on growth performance, growth rate, carcass characteristics and economics of production indices. Marshall recorded higher mean values and showed superiority over Ross and Hubbard in almost all the growth performance, carcass and economics of production traits measured. The Marshall strain also yielded more revenue and gross margin followed by the Ross. Marshall could be recommended to farmers in our study area as strain of choice with faster growth and superior carcass yield for maximum economic return.

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