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Original Article

Genotype × Sex Interaction Effects on Carcass Traits of Three Strains of Commercial Broiler Chickens

S.O. OLAWUMI*, S.O. FAJEMILEHIN and S.S. FAGBUARO

Department of Animal Production and Health Sciences, Ekiti State University, P.M.B. 5363, Ado-Ekiti, Nigeria

*Corresponding author's email: olawumisimeon@yahoo.com

ABSTRACT

The aim of this study was to rank commercial broiler chicken breeds vis-à-vis their sexes based on their carcass evaluation at 56days of age. The strains were Marshall, Arbor Acre and Hubbard, and the traits considered were live weight, dressing weight and percent, eviscerated weight, carcass weight and percent, breast muscle, back muscle, thigh, drumstick, head, neck, wing and leg weights. Other traits measured were wing and leg lengths, edible giblets and abdominal fat. There was highly significant ($P<0.01$) strain x sex interaction effects on all the traits evaluated with the exception of leg length, liver, gizzard and abdominal fat. Males and females of Marshall broilers recorded superior and higher ($P<0.01$) mean values in almost all the traits than the sexes of the other two strains. The obtained results indicate that most carcass traits are breed and sex dependent. In addition, the result showed that both sexes of Marshall broilers produced greater chicken proportions than Arbor Acre and Hubbard broilers. Therefore, important interventions to increase animal proteins consumption in this country, both sexes of Marshall broilers could be raised, and also for maximum profit for stockholders and processing industries.

Keywords: Trait, strain, carcass %, dressing % and sex

INTRODUCTION

White meat such as chicken meat according to Jaturasitha et al. (2008) is superior to red meat in health aspects because of its comparatively low content of fat, cholesterol, and more importantly for men, Iron. Chicken meat is unique in that its price is comparatively low, easy to partition into smaller parts and no religious restriction against its consumption (Jaturasitha, 2004). There are several factors affecting the productive and carcass performance of broiler chickens, and these include breed or strain, sex, nutrition, housing and stocking rate. Genotype according to Jaturasitha et al. (2004a) and Chaosap and Tuntirisoottianli (2006) plays a major role in carcass fatness while, Klonti et al. (1998) found significant breed influence on meat quality traits especially muscle fibre and sizes.

Literature is replete with information regarding breed effect on carcass characteristics. It was reported that breed significantly affected live weight (Shalin and Elazeem, 2005; Musa et al., 2006; Jaturasitha et al., 2008), carcass weight (Ojedapo et al., 2008; Olawumi and Fagbuaro, 2011), breast and leg muscle weight (Musa et al., 2006), fat and edible giblets weight (Musa et al., 2006; Ojedapo et al., 2008) and back and drumstick weights (Ojedapo et al., 2008) of broiler chickens. Some previous studies also observed significant sex effect on live weight (Shahin and Elazeem, 2005) and carcass traits (Meckley et al., 1980; Wiseman and Lewis, 1998; Shahin and Elazeem, 2005; Ojedapo et al., 2008) of broiler chicken breeds.

While separate effects of breed and sex on carcass characteristics had been widely reported in literature, their interactions have not been given much attention. This refers to the ranking of breeds and sexes on a scale of performance in respect of those traits measured. Andrews et al. (1975) and Tarrago and Puchal (1977) found significant strain x sex interactions on live weight. In contrast, Shahin and Elazeem (2005) and Ojedapo et al. (2008) observed insignificant strain x sex interactions on carcass traits of broiler chickens. The latter results implied that there was absence of joint effect of breed and sex on birds' performance, that is, the two factors acted independently of each other. Furthermore, Ajayi and Ejiofor (2009) reported significant genotype x sex effect on live weight and body linear measurements in broiler breeds. In addition, Shahin and Elazeem (2005) found significant sex x diet interactions on carcass fat and boneless carcass (meat) but an insignificant breed x sex and breed x diet interactions on proportions of total muscle, total meat and total fat weights. The present investigation was aimed at finding the strain and sex of broiler chickens with superior carcass value in order to rank them. Breed

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x sex interaction effects refers to the ranking order of the breeds' performance based on their sexes. The existence of interactions between breed and sex would indicate the presence of sexual dimorphism in carcass evaluation within and between breeds. Specifically, the study will reveal among other things:

a. breed with superior carcass value
b. sex within breed with superior carcass value
c. sexes between breeds with superior carcass value.

MATERIALS AND METHODS

Study location

The study was carried out at the Animal Breeding Unit, Teaching and Research Farm, Ekiti State University, Ado-Ekiti between September, 2010 and December, 2010. Ado-Ekiti is situated along latitude $7^0 31^1$ and $7^0 49^1$ North of the Equator and longitude $5^0 71^1$and $5^0 27^1$East of the Greenwich meridian. The city falls under Derived Savannah zone. The city enjoys two separate seasonal periods namely, Rainy (May-October) and Dry (November-April) seasons.

Management and experimental birds

A total number of 150 broiler day-old chicks, that, is 50 chicks each of Arbor Acres, Mashall and Hubbard were purchased from local hatcheries and raised on deep litter in separate pens for 56days (8weeks). The chicks were brooded using coal pot to supply heat for the first three weeks of life. Antibiotics and vitamins were administered as and when due. Also, vaccines against Infectious Bursae and Newcastle diseases were given at specified age intervals. Their beddings are made up of dry wood shavings to prevent coccidiosis outbreak and high level of hygiene was maintained throughout the experimental period to ensure unhindered conducive environment for growth, and to lower death rate. The birds were fed *ad libitum* with starter mash (1-4weeks) containing 3000Kcal/KgME, 22%CP and finisher feed (5-8weeks) containing 3100Kcal//KgMe, 21%CP.

Data collection

At exactly 56 days of age, 10birds (5males, 5females) from each breed were randomly selected after starving them overnight. The birds were numbered and weighed individually to obtain live body weight, and thereafter, slaughtered, bled, scalded and plucked. After the removal of feathers, the carcasses were eviscerated and dissected manually into various parts such as breast muscle, back muscle, drumstick, thigh muscle, wings, legs and giblets (heart, liver and gizzard). The different parts were measured using sensitive scale and tape rule, and were expressed in grammes and centimetres, respectively.

Statistical analysis

Data collected were subjected to analysis of variance and the differences between means for breed x sex interactions were separated by Duncan New Multiple Range test as per SAS (2001).

The appropriate statistical model used was:

$$Y_{ijk} = \mu + G_j + S_i + (GS)_{ij} + \varepsilon_{ijk}$$

Y_{ijk}= observation of the k^{th} population, of the j^{th} genotype and i^{th} sex

μ= common mean

G_j= fixed effect of j^{th} genotype (j=3)

S_i = fixed effect of i^{th} sex (i=2)

$(GS)_{ij}$= fixed genotype x sex interaction effects

ε_{ijk}= random error

RESULTS

Table 1 showed the least square means for strain x sex interaction effects on carcass traits of broiler chicken breeds. There was highly significant ($P<0.01$) breed x sex interaction effects on live weight, dressing weight, dressing percent, eviscerated weight, carcass weight and carcass percent.

Table 2 also presented strain x sex interaction effects on carcass proportions. There was highly significant ($P<0.01$) breed x sex interactions on breast muscle weight, back muscle weight, thigh weight, drumstick weight, head weight, neck weight, wing weight, wing length and leg weight.

Furthermore, least square means showing breed x sex interactions on edible giblets and abdominal fat were given in Table 3. There was no significant ($P>0.05$) strain x sex interaction effects on all giblets with the exception of heart weight.

DISCUSSIONS

The result of this study indicates that live weight in broiler chickens was breed and sex dependent, that is, birds' body weight vary according to their sexes. In this study, males and females of Marshall recorded significantly ($P<0.01$) higher mean values than the other two breeds' sexes. It implies that both sexes of Marshall broilers recorded the highest live weight at 56 days when compared to Arbor Acre and Hubbard chickens. The former therefore, could be described as having superior genetic potentials for meat yield since the males and females of the breed gave higher mean values than the males and females of the latter. The lowest mean values were obtained for females of Arbor Acre and Hubbard. The results indicate that live weight is dependent on interaction between breed and sex of broiler chickens, and this was consistent with the findings of Ajayi and Ejiofor (2009) and Razuki et al. (2011) who reported significant breed x sex interactions on body weight of chicken breeds, but contradicted those of Ojedapo et al. (2008) who found no significant strain x sex interactions on live weight.

With regard to dressing weight, males and females of Marshall broilers had highest mean values than both sexes of Arbor Acre and Hubbard chickens. This also implies that this trait is breed and sex dependent, and that Marshall performed better, and superior to other two breeds at the same age, and under uniform management conditions. On dressing percent, both sexes of the three breeds recorded similar mean values except Arbor Acre males which had the least. In the current study, eviscerated weight of broiler chicken breeds was also breed and sex dependent, that is, significant differences were observed among breeds, and between sexes within the breeds. Males and females of Marshall were found to have highest mean values than other two breeds.

Table 1. Least square means showing strain x sex interaction effects on live weight and carcass traits of broiler chickens

Traits	Breeds						P-value
	Marshall		Hubbard		Arbor Acre		
	M	F	M	F	M	F	
Live weight (g)	2320^{a}	2310^{a}	2190^{ab}	1850^{b}	2170^{ab}	1850^{b}	0.001
Dressing weight (g)	2200^{a}	2140^{a}	2040^{ab}	1730^{b}	1940^{ab}	1740^{b}	0.001
Dressing percent (%)	94.60^{a}	92.60^{a}	93.26^{a}	93.46^{a}	89.34^{b}	94.06^{a}	0.001
Eviscerated weight (g)	1960^{a}	1870^{a}	1780^{a}	1500^{b}	1690^{ab}	1500^{b}	0.001
Carcass weight (g)	1820^{a}	1770^{a}	1680^{ab}	1400^{b}	1560^{ab}	1390^{b}	0.001
Carcass percent (%)	78.28^{a}	76.62^{a}	76.66^{a}	75.70^{a}	71.60^{b}	75.10^{a}	0.001

^{ab} means along rows with different superscripts are significantly different (P<0.01); NS= Non-significant (P>0.05)

Table 2. Least square means showing breed x sex interaction effects on carcass proportions of broiler chicken breeds

Traits	Breeds						P-value
	Marshall		Hubbard		Arbor Acre		
	M	F	M	F	M	F	
Breast muscle weight (g)	549.60^{a}	492.0^{ab}	447.60^{abc}	376.0^{c}	406.0^{bc}	391.0^{bc}	0.001
Back weight (g)	333.20^{a}	326.60^{ab}	315.60^{abc}	262.20^{bc}	298.40^{abc}	252.80^{c}	0.001
Thigh weight (g)	257.20^{a}	251.0^{a}	223.0^{ab}	193.0^{b}	229.60^{ab}	184.80^{b}	0.001
Drumstick weight (g)	248.80^{a}	224.80^{ab}	211.0^{ab}	161.20^{c}	206.0^{b}	169.20^{c}	0.001
Head weight (g)	57.60^{a}	46.80b^{c}	48.0^{bc}	42.20^{c}	50.20^{b}	45.40b^{c}	0.001
Neck weight (g)	128.20^{a}	117.60^{ab}	110.40^{abc}	100.80^{bc}	110.40^{abc}	85.60^{c}	0.001
Wing weight (g)	190.0^{a}	180.20^{a}	171.0^{ab}	147.80^{b}	171.0^{ab}	147.0^{b}	0.001
Wing length (cm)	25.60^{a}	23.08^{ab}	23.46^{ab}	19.88^{c}	24.12^{ab}	22.16b^{c}	0.001
Leg weight (g)	99.80^{a}	82.0^{b}	90.0^{ab}	62.60^{c}	89.0^{ab}	63.80^{c}	0.001
Leg length (cm)	7.26	6.40	7.40	6.50	7.46	7.14	NS

^{abc} means along rows with different superscripts are significantly different (P<0.01); NS= Non-significant (P>0.05)

Table 3. Least square means showing breed x sex interaction effects on edible giblets and abdominal fat of broiler chicken breeds

Traits	Breeds						P-value
	Marshall		Hubbard		Arbor Acre		
	M	F	M	F	M	F	
Liver weight (g)	45.40	44.20	42.20	43.60	41.40	37.80	NS
Gizzard weight (g)	45.40	44.60	44.80	40.60	45.20	42.40	NS
Heart weight (g)	10.80^{ab}	11.20^{a}	10.80^{ab}	9.20^{b}	9.80^{ab}	9.20^{b}	0.001
Abdominal fat weight (g)	22.80	21.80	19.20	23.60	19.60	19.80	NS

^{ab} means along rows with different superscripts are significantly different (P<0.01); NS= Non-significant (P>0.05)

In addition, carcass weight and carcass percentage differed between sexes, within and between breeds. As usual, Marshall still recorded highest mean values in carcass weight than Arbor Acre and Hubbard birds. The former was good and superior to the latter in this trait, and the obtained result disagreed with Ojedapo et al. (2008) who observed non-significant strain x sex interactions on carcass weight. The obtained results so far revealed that breed and sex acted jointly on birds' carcass performance, and that males and females of Marshall breed were better in terms of growth and slaughter traits than the other two breeds.

Pertaining to carcass proportions, males and females of Marshall breed recorded significant higher mean values than other two breeds. The results indicate that males and females of Marshall produced more meat from breast, back, thigh and drumstick parts. In fact, the females of Arbor Acre and Hubbard had lowest mean values in all these traits. The result contradicts that of Ojedapo et al. (2008) who reported an insignificant strain x sex interactions on shank, thigh and drumstick weights. This same trend was observed for head weight, neck weight, wing weight, wing length and leg weight.

This study on chicken parts indicate that all these traits are breed and sex dependent, that is, breeds differ in carcass proportions, and that these differences are strongly connected to their sexes. In the present study, males and females of Marshall were superior in all the traits measured, while females of Arbor Acre and Hubbard appeared to be the poorest in terms of meat yield. However, no significant (P>0.05) breed x sex interactions was indicated for leg length in this study.

There was no significant (P>0.05) breed x sex interactions on liver weight and gizzard weight in this study. Both sexes within and between breeds recorded similar mean values, and this corroborates the findings of Ojedapo et al. (2008) who found insignificant strain x sex interactions on these traits. As regards heart weight, significant breed x sex interactions were found between sexes, within and between breeds. Males and females of Marshall, males of Arbor Acre and Hubbard were superior to females of Arbor Acre and Hubbard. There was no significant breed x sex interactions on abdominal fat, that is, breed and sex acted independently on this trait.

In general, the significant strain differences in live weight and carcass traits of broilers observed in this study implies that these three broiler chicken breeds have different ancestors, that is, they have different genetic constitutions.

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CONCLUSIONS

- This study revealed that most carcass traits are breed and sex dependent.
- Males were found to be heavier than females within and between breeds.
- Males and females of Marshall broilers ranked highest in most of the traits considered for evaluation.
- The study revealed that Marshall breed significantly weighed more than the other two breeds at 56th day, and that the commercial limbs of its females represented more of the carcass than even the males of the other two breeds.
- The three broiler strains have different ancestors and genetic constitutions judging from the obtained results in this study.

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