Evaluation of carcass characteristics and organ traits of two strains of broiler chickens

Akinyemi, O. F., Atansuyi, A. J., Adegbenro, M. and Chineke, C. A.
Department of Animal Production and Health, Federal University of Technology, Akure, P.M.B 704 Ondo State, Nigeria.
Corresponding Author:akinyemiof@futa.edu.ng ,+234 7030170237

Abstract

The high demand for poultry meat is due to its health benefits over red meat, including lower fat and cholesterol, affordable pricing, convenient portions, and no religious restrictions. Various strains of commercial broiler chickens are frequently imported into Nigeria, necessitating an investigation into how strain, sex, and age influence their carcass composition, abdominal fat deposition and organ traits. This study was conducted to investigate the effects of strain and sex on carcass and organ traits of broiler chickens at 6 and 8 weeks. Arbor Acres and Cobb-500 chicks (n=192) were divided into four groups by strain and sex, with three replicates each, and raised for 56 days at the Poultry Unit of the Teaching and Research Farm, The Federal University of Technology, Akure. At 6 and 8 weeks, 24 birds (2 per replicate) were randomly selected for carcass and organ evaluation. Data were analyzed using a completely randomized 2 x 2 factorial design. Male birds generally exhibited higher weights ($p<0.05$) than females in live weight, dressed weight, eviscerated weight, thigh, breast, and organ weights, highlighting the influence of sex hormones on growth and carcass composition. At week 6, Cobb-500 broilers showed higher ($p<0.05$) carcass and organ traits, but by week 8, no significant differences ($p>0.05$) were observed between strains. The findings suggest that at six weeks of age, strain plays a key role in chicken growth and carcass yield.

Keywords: Broiler strain; c; organ; sex; skeletal development.

Evaluation Des Caractéristiques De La Carcasse Et Des Organes De Deux Races De Poulets De Chair

Résumé

La forte demande en viande de volaille est due à ses bienfaits pour la santé par rapport à la viande rouge, notamment une teneur en graisses et en cholestérol plus faible, des prix abordables, des portions pratiques et aucune restriction religieuse. Plusieurs races commerciales de poulets de chair sont fréquemment importées au Nigeria, ce qui nécessite une étude sur l'influence de la race, du sexe et de l'âge sur la composition de la carcasse, la déposition de graisse abdominale et les traits organiques. Cette étude a été réalisée pour examiner les effets de la race et du sexe sur les caractéristiques de la carcasse et des organes des poulets de chair à 6 et 8 semaines. Des poussins Arbor Acres et Cobb-500 (n=192) ont été divisés en quatre groupes selon la race et le sexe, avec trois réplicats par groupe, et élevés pendant 56 jours à l'unité de volaille de la ferme pédagogique et de recherche de l'Université Fédérale de Technologie d'Akure. À 6 et 8 semaines, 24 oiseaux (2 par réplicat) ont été sélectionnés au hasard pour l'évaluation de la carcasse et des organes. Les données ont été analysées à l'aide d'un plan factoriel complètement randomisé 2 x 2. Les mâles ont généralement montré des poids plus élevés ($p<0,05$) que les femelles pour le poids vif, le poids habillé, le poids éviscéré, le poids des cuisses, des poitrines et des organes, soulignant l'influence des hormones sexuelles sur la croissance et la composition de la carcasse. À 6 semaines, les poulets Cobb-500 ont montré des caractéristiques de carcasse et d'organes plus élevées ($p<0,05$), mais à 8 semaines, aucune différence significative ($p>0,05$) n'a été observée entre les races. Les résultats suggèrent qu'à six semaines d'âge, la race joue un rôle clé dans la croissance des poulets et le rendement de la carcasse.

Mots-clés : Race de poulet de chair ; rendement de la carcasse ; organe ; sexe ; développement squelettique.

Introduction

The global demand for animal protein is rising, with poultry meat expected to see rapid growth in the coming decades. In Nigeria, poultry production from 180 million birds reached 45,000 metric tonnes in 2016 (Adeyonu *et al.*, 2021), driven by an increase in broiler chicken numbers. This sector growth offers opportunities

for small-scale producers across the value chain. Poultry meat is tender, economical, and a leading source of animal protein, with broilers having short production cycles (Ojo, 2002; Oluremi *et al.,* 2009). Many farmers engage in broiler production for income due to high demand, ease of learning, and success with exotic breeds (Ukwuaba and Inoni, 2012). While Akinyemi and Olawumi (2020) found no significant differences in broiler strains for carcass traits studied. However, Chukwuka *et al.* (2010) reported significant variations in strains and they were likely due to differences in geography, treatments, and slaughter age. Assessing carcass yield helps farmers improve profitability by identifying and marketing preferred parts and organs along the value chain. Carcass and fat deposition are influenced by sex and age (Ojedapo *et al.,* 2008), and consumers increasingly choose leaner meats like broiler chicken for health reasons. This study was aimed at evaluating the effects of strain and sex on broiler carcass and organ traits at 6 and 8 weeks of age.

Materials and methods

This research was conducted at the Poultry Unit of the Teaching and Research Farm and the Department of Animal Production and Health Laboratory, The Federal University of Technology Akure, Ondo State, Nigeria (latitude 07°16[1] and 07°18[1] N; longitude 05°09[1] and 05°11[1] E). There is a bimodal rainfall patterns which start from February-July and September-October with average rainfall of 1,556 mm per annum. The average ambient temperature is about 30-32°C with relative humidity of 80% (NCEI, 2018).

Experimental procedure

Management of Experimental birds and design

A total of 192 a-day-old chicks, consisting of 96 Arbor-Acres and 96 Cobb-500 broiler strains, were purchased from reputable farm in Ibadan, Oyo State, Nigeria. The chicks were randomly allocated to pre-tagged pens according to their strains and sexes, creating four groups with three replicates per group in a completely randomized 2 x 2 factorial design. They were raised intensively on a deep litter system, and the field experiment lasted for eight weeks (56 days). Throughout the study period, routine and occasional health management practices were strictly followed, with all necessary vaccinations and medications administered as needed. The experimental diets (crude protein = 22 and 20%; ME = 2,900 and 3,000 kcal/kg for starter and finisher feeds respectively) was formulated at the Feed Mill of the Federal University of Technology Akure (FUTA) Teaching and Research Farm, Ondo State, Nigeria. Feed and water were supplied *ad libitum* throughout the experimental period.

Data collection

Carcass characteristics

The birds were stunned, slaughtered, thoroughly bled, and carefully dissected into various parts to assess carcass yield. The evaluated carcass traits included live weight (LWT), dress weight (DWT), eviscerated weight (EWT), drumstick weight (DSW), shank weight (SWT), thigh weight (THW), back weight (BAW), breast weight (BRW), head weight (HWT), neck weight (NWT) and wing weight (WWT). ***Organ traits***

The organ traits data included liver weight (LIW), heart weight (HEW), lungs weight (LUW), spleen weight (SPW), gizzard weight (GIW), pancreas weight (PAW), proventriculus weight (PRW), and abdominal fat weight (AFW). All measurements were recorded in grams using an electronic precision balance (KD-KC-2000, 5 kg max).

Statistical analysis

Duncan's Multiple Range Test (DMRT) of the same statistical package was employed to separate the differences among the means at $p<0.05$ level of significance.

Results and Discussion

Effects of Strain and sex on Carcass Traits of experimental birds at 6th week

The results in table 1 shows the impact of strain and sex on the carcass traits of broiler chickens at 6 weeks. Significant strain differences ($p<0.05$) were observed, with Cobb chickens yielding higher values compared to Arbor Acres (AA), underscoring the importance of strain in influencing growth and carcass yield (Ojedapo *et al.,* 2007; Shim *et al.,* 2012; Benyi *et al.,* 2015). Sex also had a significant effect, with males consistently showing heavier weights than females across all parameters, reflecting the influence of sex hormones on growth and carcass

composition (Olawumi *et al.*, 2012; Shim *et al.*, 2012; Benyi *et al.*, 2015; Aboghanima, 2020).

Table 1 : Effects of strain and sex on carcass traits of experimental birds at 6th week

		Parameter										
Strain	Sex	LWT (g)	DWT (g)	EWT (g)	SWT (g)	DSW (g)	THW (g)	BRW (g)	BAW (g)	HWT (g)	NWT (g)	WWT (g)
AA		1295.50[b]	1169.92[b]	939.00[b]	56.83[b]	121.29[b]	130.81[b]	251.00[b]	172.68[b]	34.98[b]	64.87[b]	99.36[b]
Cobb		1840.61[a]	1650.59[a]	1387.26[a]	82.25[a]	208.11[a]	225.37[a]	443.09[a]	308.08[a]	58.28[a]	79.51[a]	164.61[a]
±SEM		30.60	30.84	28.10	2.64	7.78	7.47	15.43	11.91	1.83	3.50	5.37
P-VALUE		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	M	1655.58[a]	1502.97[a]	1243.17[a]	82.44[a]	192.21[a]	200.94[a]	386.66[a]	281.41	55.10[a]	81.27[a]	150.51[a]
	F	1480.52[b]	1317.54[b]	1083.09[b]	56.64[b]	137.19[b]	155.24[b]	307.43[b]	199.34	38.16[b]	63.11[b]	113.46[b]
	±SEM	30.58	30.82	28.09	2.64	7.78	7.47	15.42	11.90	1.83	3.50	5.36
	P-VALUE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a, b,]=means in the same column bearing different superscripts are significantly different ($p<0.05$), AA= Arbor Acre, Cobb= Cobbs-500, SEM= Standard error of mean, P Value= Level of significance, M=Male, F=Female, LWT=Live weight, DWT= Dressed weight, EWT=Eviscerated weight, SWT= Shank weight, DSW= Drumstick weight, THW= Thigh weight, BRW=Breast weight, BAW= Back weight, HWT= Head weight, NWT= Neck weight and WWT= Wing weight

Effects of strain and sex on organ traits of experimental birds at 6th week

The results in table 2 highlight the significant effects of strain and sex on organ traits in broiler chickens. Cobb-500 chickens had the highest yields, while Arbor Acres had the lowest, indicating genetic differences significantly affect organ traits (Olawumi *et al.*, 2012; Shim *et al.*, 2012; Obike *et al.*, 2020). The liver (LIW) of Cobb chickens was the largest, at 40.94g, consistent with prior studies reporting significant strain effects on organ weight. The gizzard (GIW) was the second-largest organ in Cobb chickens, weighing 37.65g, while the spleen (SPW) was the smallest, at 1.74g, both aligning with existing research (Olawumi *et al.*, 2012; Obike *et al.*, 2020). Cobb chickens also had a higher abdominal fat weight (24.57g) compared to Arbor Acres chickens (12.16g), reflecting genetic differences in fat deposition patterns, possibly influenced by selective breeding practices (Hartcher and Lum, 2019; Kang *et al.*, 2019; Kareem-Ibrahim, 2021). While sex did not significantly affect abdominal fat, other organ traits (LIW, SPW, LUW, GIW, PAW, PRW) were larger in males, suggesting a key role of sex hormones in organ development (Olawumi *et al.*, 2012; Shim *et al.*, 2012; Obike *et al.*, 2020).

Table 2: Effects of strain and sex on organ traits of experimental birds at 6th week

		Parameter							
Strain	Sex	AFW (g)	HEW (g)	LIW (g)	SPW (g)	LUW (g)	GIW (g)	PAW (g)	PRW (g)
AA		12.16[b]	6.98[b]	28.36[b]	1.36[b]	7.11[b]	26.76[b]	3.53[b]	6.47[b]
Cobb		24.57[a]	9.90[a]	40.94[a]	1.74[a]	12.29[a]	37.65[a]	4.40[a]	9.63[a]
±SEM		1.78	0.35	1.92	0.11	0.46	1.21	0.21	0.62
P-VALUE		0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00
	M	19.62	9.89[a]	40.41[a]	1.81[a]	11.55[a]	36.36[a]	4.42[a]	9.24[a]
	F	17.11	6.98[b]	28.89[b]	1.29[b]	7.85[b]	28.06[b]	3.51[b]	6.86[b]
	±SEM	1.78	0.35	1.92	0.11	0.46	1.21	0.21	0.62
	P-VALUE	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.01

[a, b] =means in the same column bearing different superscripts are significantly different ($p<0.05$), AA= Arbor Acre, Cobb= Cobbs-500,SEM= Standard
error of mean, P Value= Level of significance, M=Male, F=Female, AB FAT=Abdominal fat weight, HEW=Heart weight, LIW=Liver weight, SPW=
Spleen weight, LUW=Lung weight, GIW= Gizzard weight, PAW= Pancreas weight, PRW= Proventiculus weight

Effects of strain and sex on carcass traits of experimental birds at 8th week

Table 3 illustrates the effects of strain and sex on the carcass traits of experimental birds at 8 weeks. The results reveal non-significant strain differences ($p>0.05$) in the carcass traits. The obtained result was in agreement with previous findings (Makram *et al.*, 2010; Olawumi *et al.*, 2019; Akinyemi and Olawumi, 2020; Fasuyi *et al.*, 2020). However, specific performance observations indicated that the Arbor Acres (AA) strain numerically outperformed Cobb in live weight, dressed weight, eviscerated weight, shank weight, drumstick weight, breast weight, neck weight, and wing weight. Conversely, Cobb showed slightly higher numerical values in thigh weight, back weight, and head weight. Sex had a significant effect ($p<0.05$) only on shank weight at 8 weeks, with males exhibiting larger shank sizes than females (Shim *et al.*, 2012). The superior performance of males in shank weight suggests a greater responsiveness to sex hormones affecting skeletal development compared to female chickens (Obike *et al.*, 2020; Akinsola *et al.*, 2023).

Table 3: Effects of strain and sex on carcass traits of experimental birds at 8th week

		Parameter										
Strain	Sex	LWT (g)	DWT (g)	EWT (g)	SWT (g)	DSW (g)	THW (g)	BRW (g)	BAW (g)	HWT (g)	NWT (g)	WWT (g)
AA		2131.17	1896.47	1576.86	84.84	211.27	246.90	449.73	270.13	52.65	123.01	165.89
Cobb		2050.07	1887.42	1571.93	83.30	204.23	248.71	438.38	282.38	53.50	94.89	164.03
±SEM		67.47	62.54	56.23	2.74	8.06	11.44	20.35	11.11	1.70	16.18	4.99
P-VALUE		0.40	0.92	0.95	0.69	0.54	0.91	0.70	0.44	0.73	0.23	0.79
	M	2164.63	1960.35	1626.59	90.64[a]	216.53	255.28	442.70	277.24	54.87	122.17	168.19
	F	2016.60	1823.54	1522.20	77.50[b]	198.98	240.32	445.40	275.27	51.28	95.74	161.72
	±SEM	67.57	62.64	56.31	2.74	8.07	11.45	20.39	11.13	1.70	16.21	5.00
	P-VALUE	0.13	0.13	0.20	0.00	0.13	0.36	0.93	0.90	0.14	0.25	0.37

[a, b] =means in the same column bearing different superscripts are significantly different ($p<0.05$), AA= Arbor Acre, Cobb= Cobbs-500, SEM= Standard error of mean, P Value= Level of significance, M=Male, F=Female, LWT=Live weight, DWT= Dressed weight, EWT=Eviscerated weight, SWT= Shank weight, DSW= Drumstick weight, THW= Thigh weight, BRW=Breast weight, BAW= Back weight, HWT= Head weight, NWT= Neck weight and WWT= Wing weight

Effects of strain and sex on organ traits of experimental birds at 8th week

The study investigated the impact of strain on organ traits in broiler chickens, with a particular focus on abdominal fat weight (AFW). Results in table 4 showed a significant difference ($p<0.05$) in AFW between the Cobb-500 and Arbor Acres (AA) strains, with Cobb recording 31.22g compared to 14.30g for AA. This indicates that the Cobb strain has a higher abdominal fat deposit, highlighting strain-specific variations in fat accumulation (Olawumi *et al.,* 2012; Udeh *et al.*, 2015).
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Although not statistically significant, other organ traits tended to favor the Arbor Acres strain, suggesting it may have higher values for these parameters (Udeh *et al.*, 2015). At 8 weeks, there were non-significant sex differences ($p>0.05$) among organ traits, with females showing slightly larger AFW and proventriculus weight (PAW), while males had larger, though non-significant, values for heart weight (HEW), liver weight (LIW), spleen weight (SPW), lung weight (LUW), gizzard weight (GIW), and proventriculus weight (PRW

Table 4: Effects of strain and sex on organ traits of experimental birds at 8th weeks

		Parameter							
Strain	Sex	AFW (g)	HEW (g)	LIW (g)	SPW (g)	LUW (g)	GIW (g)	PAW (g)	PRW (g)
AA		14.30[b]	9.70	37.81	2.69	11.67	35.13	4.52	8.03
Cobb		31.22[a]	9.01	36.99	2.30	10.28	36.02	5.41	8.26
±SEM		4.97	0.44	1.59	0.19	0.57	1.28	1.01	0.43
P-VALUE		0.02	0.27	0.72	0.16	0.09	0.62	0.54	0.70
	M	19.01	9.65	38.15	2.52	11.49	36.72	4.26	8.34
	F	26.51	9.05	36.65	2.48	10.46	34.43	5.67	7.95
	±SEM	4.97	0.44	1.59	0.19	0.57	1.28	1.02	0.43
	P-VALUE	0.29	0.33	0.51	0.88	0.21	0.21	0.33	0.52

[a, b] =means in the same column bearing different superscripts are significantly different ($p<0.05$), AA= Arbor Acre, Cobb= Cobbs-500, SEM= Standard error of mean,

P Value= Level of significance, M=Male, F=Female, LWT=Live weight, DWT= Dressed weight, EWT=Eviscerated weight, SWT= Shank weight, DSW= Drumstick

weight, THW= Thigh weight, BRW=Breast weight, BAW= Back weight, HWT= Head weight, NWT= Neck weight and WWT= Wing weight

Conclusion

Broiler strain significantly influenced the growth, development, and carcass yield of chickens at 6 weeks of age, with notable strain and sex effects on carcass traits. Males generally exhibited heavier weights than females, emphasizing the possible role of sex hormones in growth and carcass composition. Cobb-500 broilers had the highest organ yields, indicating that genetic differences between strains significantly affect organ traits. Cobb chickens also showed higher abdominal fat weight compared to the Arbor Acres strain. The study concluded that Arbor Acres chickens were leaner and had better carcass quality than Cobb-500 chickens. At 8 weeks, Arbor Acres birds performed better in live weight, dressed weight, eviscerated weight, shank weight, drumstick weight, breast weight, neck weight, and wing weight compared to Cobb. Additionally, the study highlighted that while strain and sex independently affect organ traits, strain exerted a more pronounced influence on growth and carcass composition, offering valuable insights for poultry breeding and production strategies.

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