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Effect of strain and sex on productive performance and carcass traits in some broiler chickens

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Abstract

This study was aimed to investigate the effect of strain and sex on productive performance and carcass traits of commercial hybrids Ross 308 and Cobb at 35 days age. A total number of three hundred 1-day old chicks (150 chicks per each hybrid) were purchased and reared under similar environmental, hygienic and managerial conditions until slaughter. All chicks were weighed individually at 35 days of age. The growth performance traits included; body weight, body weight gain, feed consumption and feed conversion ratio, and the carcass characteristics of both hybrids were measured. The results indicated that the Ross hybrid had the highest body weight and body weight gain at 35 days of age compared to Cobb. Sex significantly influenced body weight gain ($P<0.05$) with higher means in males than females. There were significant genotype × sex interaction effects on body weight gain. The genotype of the hybrid (Ross 308 and Cobb 500) and sex had significant effect on the body weight at 35 days the old The hybrid Ross 308 was superior on Cobb 500 in dressing percentage and weight carcass. The male is the superior of the in the body weight, carcass weight and dressing percentage ratio than female. The results also showed live weight of Ross and Cobb (1983.75 and 1878.13 g), carcass weight (1470 and 1410.13 g) and dressing percentage (74.69% and 74.89%) respectively.

Keywords: strain, sex, Ross 308, Cobb 500, productive performance.

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1. Introduction

Poultry egg and meat are important sources of high-quality proteins, minerals and vitamins to balance the human diet. Specially developed breeds of meat type chicken are now available with traits of quick growth and high feed conversion efficiency. This due to the advancing in genetic engineering programs for broiler chicken breeding, making the chicken meat sector efficient in producing protein of high biological value (Nogueira *et al*., 2019). Though intensive genetic selection for fast growth in broiler chickens has dramatically shortened the growing period, some undesirable correlated selection responses such as excessive feed intake and consequently extreme carcass fatness have also occurred (Richards *et al*., 2003). There are several factors affecting the productive and carcass performance of broiler chickens, such as breed or strain, sex, nutrition, housing and stocking rate (Akinsola *et al*., 2019). Many reports indicate that genotype affects body weight, body weight gain, feed intake, and feed conversion ratio of broiler chickens (Enaiat *et al*., 2010; Taha *et al.*, 2011; Udeh *et al*., 2015). The strain and age interaction showed that Cobb 500 had the highest dressing percentage, and Hubbard Classic had the highest breast percentage at 42 and 28 days of slaughtering, respectively (Badar *et al*., 2021). Husna *et al*. (2017) found that mortality rate was slightly minimum for Hubbard Classic (3.5%) followed by Cobb-500 (4.0%), Lohman Meat (4.5%) and Ross Broiler (4.7%). On the other hand, Sarker *et al*. (2001) and Rokonuzzaman *et al*. (2015) reported that strain had no adverse effect on livability of the birds. Also, Hossain *et al*. (2011) stated that there were no significant differences (P>0.05) of mortality in different strains. Based on the above, we hypothesized that there are differences among strains of broiler chickens available in the market; hence, the aim of the present study was to evaluate the differences in performance and carcass yield of two strains of broiler chicken, besides estimating their growth parameters.

2. Materials and methods

2.1 Study location, birds and experimental design

This study was carried out at poultry breeding farm, poultry production department, faculty of agriculture, Ain Shams University during the period from 2nd June to 7st July, 2021. A total number of three hundred in one-day-old chicks (150 chicks per each hybrid) were provided by department of poultry production, faculty of agriculture, Ain Shams University. The sex ratio for each hybrid was 1:1. All chicks were reared under the similar environmental, hygienic and managerial conditions. All chicks were fed a commercial starter diet (mash) from 1 to 10 days of age, a commercial grower diet (crumb) from 11 to 24 days of age and commercial finisher diet (crumb) from 25 day of age until slaughter (Almaraa poultry feed). Feed and water for all birds were provided *ad libitum*. All diets meat the

nutrient requirements for broilers according to NRC (1994). The specification of the feed offered is given in the Table (1).

Table (1): Characteristics of administered feed.

Specification	Starter	Grower	Finisher
Metabolized	3102	3188	3271
Crude Protein (%)	23	21	19
Crude Fiber (%)	2.3	2.7	2.2
Calcium (%)	1.12	0.93	0.86
Phosphorus (%)	0.51	0.45	0.43
Sodium (%)	0.18	0.17	0.17
Chloride (%)	0.24	0.21	0.21
Vitamin A (µL/kg)	15000	12500	11250
Vitamin D3(µL//kg)	5000	5000	5000
Vitamin E (mg/kg)	80	60	55

2.1.1 Data collection

2.1.1 Growth performance

Initial and final body weight was individually measured using top loaded scale balance. Body weight gain (BWG) for each replicate was calculated according to the following equation:

$$\text{BWG} = \text{final body weight} - \text{initial body weight}$$

Feed intake (FI) for each replicate was calculated as the difference between the amount of feed supplied to the birds and the amount of feed that remained at the end of each feeding period. Feed conversion ratio (FCR) was calculated using following formula:

$$\text{FCR} = \frac{\text{Feed intake (kg)}}{\text{Weight gain (kg)}}$$

Dead birds were recorded daily then mortality rate was calculated on weekly basis as a percentage of the initial number.

2.2.2 Carcass traits

At 35 days of age, 10 males (5 Ross and 5 Cobb) and 10 females (5 Ross and 5 Cobb) 20 birds in total (one bird per replicate) were randomly selected to determine the carcass traits. After slaughtering, each bird was hanged in a bleeding funnel for 3 minutes, birds were then scalded, de-feathered and eviscerated, and then the dressing percentage was calculated. After slaughter, de-feathering and evisceration, whole carcasses of broilers were dissected according to the method described by (Wang, 2000). Each carcass was divided into breast muscles, thigh and lower thigh (leg) muscles, wings with skin, neck without skin, neck skin, skin with subcutaneous fat, and abdominal fat. In addition, the heart, liver and gizzard (giblets) were separated during evisceration. Individual carcass components and giblets were weighed and their percentages in eviscerated carcass with neck (carcass components)

or in pre-slaughter weight (giblets) were calculated.

2.2.3 Statistical analysis

The experimental data were analyzed using the SAS software (2001) and a two-way ANOVA was performed to determine the main effects (strain x sex) and their interactions. When there were interactions, the factors were unfolded, and when there was no interaction, the factors were analyzed separately. Averages were compared applying the Duncan test for the strains and the F test for the sex. The differences were considered as significant at 5% and 1% probability. The modal generated was fitted for the effects of strain and sex their interaction:

$$Yijk= \mu + S_i + X_j + (SX)_{ij} + e_{ijk}$$

Where: Y is the dependent variable, μ is the grand mean, S_i is the fixed effect of the strain (i= 1, 2); X_j is the fixed effect of the sex (j= 1, 2); $(SX)_{ij}$ is the interaction between strain and sex and e_{ijk} is the random error term.

3. Results and Discussion

3.1 Growth performance

The statistical analysis of the obtained data (Table 2) revealed that strain of broiler chick that reared under the same hygienic, managerial and environmental conditions had a significant effect on body weight, body weight gain and feed consumption. Where, Ross hybrid hand the highest body weight, body weight gain, and feed consumption compared with Cobb hybrid at 35 days of age. Also, sex of broiler chicks significantly affected body weight, body weight gain feed consumption and feed conversion. Male broiler chicks gained more weight, consumed more feed and had best feed conversion ration compared with female at 35 days of age. In the presented study these results are agreed with Badar *et al*. (2021) who reported that Ross 308 had significantly higher ($p<0.05$) weekly body weight and weight gain than the other three strains throughout the rearing period. Also, Jawasreh *et al*. (2019) found that the final body weight of Ross broilers was significantly higher than Cobb broilers at 28 days of age. Kadlec *et al*. (2012). The Ross 308 line a higher body weight on all observed control days to market weight compared to Cobb 500. On the other hand, Pascalau *et al.* (2017) found that body weight of Cobb500 chicks were significantly higher than Ross 308 chicks at 42 days of age by about 78.56 g. In terms of mortality rate, data presented in Figure (1) showed that mortality rate of Cobb female and male was significantly higher than Ross female and male.

Table (2): Means and (SE) of body weight (BW) body weight gain (BWG) feed consumption (FC) and feed conversion (FCR) of broiler breeding from different strains, males and females.

Item	Sex	Strain		Overall sex	Probability		
		Ross	Cobb		Strain	Sex	Strain * Sex
BW	Male	2127.33±25.02	1870.04±49.5	1998.69[a]	*	**	**
	CV (%)	7.90	17.76				
	Female	1647.6±52.5	1682.63±54.92	1665.11[b]			
	CV (%)	18.85	19.31				
	Overall strain	1917.45[a]	1788.05[b]				
BWG	Male	2086.48±24.37	1836.42 ±23.83	1967.70[a]	**	**	**
	CV (%)	7.57	8.0				
	Female	1655.23±20.32	1677.66 ±21.64	1666.44[b]			
	CV (%)	7.26	7.63				
	Overall strain	1890.45[a]	1760.30[b]				
FC	Male	3378.22±16.38	2994.25±19.46	3195.84[a]	**	**	**
	CV (%)	3.14	4.01				
	Female	2839.30±8.35	2973.56±12.99	2906.43[b]			
	CV (%)	1.74	2.86				
	Overall strain	3133.26[a]	2984.33[b]				
FCR	Male	1.63±0.02	1.64±0.02	1.75[a]	NS	*	NS
	CV (%)	8.08	9.14				
	Female	1.72±0.02	1.78±0.02	1.63[b]			
	CV (%)	7.58	7.49				
	Overall strain	1.71	1.67				

[a,b] Means with different superscripts within the same column are significantly different (p<0.05). NS= non-significant means, *= probability (P<0.05), **= probability (P<0.01).

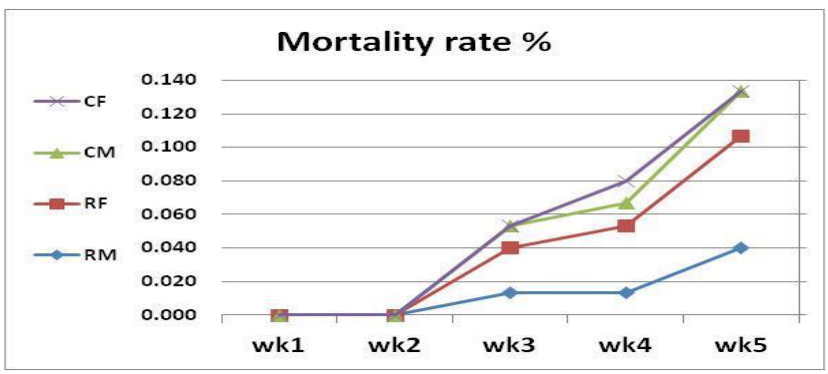

Figure (1): Mortality (%) of two strains of male and female broiler chickens.

3.1.3 Carcass traits

Data in Table (3) showed that strain of broiler chick had no effect on body weight of broiler selected for slaughter, while the sex of broiler chicks had a significant effect on body weight before slaughter. The weight of males was significantly higher than females. Also, the interaction of sex × strain had a significant effect on body weight of broilers before slaughter. Where, the live weight of Ross male or female were higher than Cobb female on the other hand, sex, strain and the interaction of sex × strain had no effect on the percentages of carcass, edible and inedible of broiler chicks at 35 days of

age. The obtained results are agreed with Vieira and Moran (1998) evaluated the carcass yield of 49-day-old chickens from four different breeds and found no difference in the carcass yield. Moreira *et al*. (2003) verified no difference in the yield of carcass between Ross and Cobb breeds. On the other hand Benyi *et al*. (2015) reported that the sex had significant effects on all the carcass traits measured except breast. Isidahomen *et al*. (2012) reported that male chickens had significantly higher slaughter weight, carcass weight, and dressing percentage than females. Hristakieva *et al*. (2014) showed that male Cobb 500 which was superior to male Ross 308 of lives weight.

Table (3): Means and (SE) of live body weight, carcass percentage, edible percentage and inedible percentage.

Item	Sex	Strain		Overall sex	Probability		
		Ross	Cobb		Strain	Sex	Strain * Sex
L.BW	Male	2223.75±43.13	1970.0±75.33	2096.89[a]	NS	**	**
	CV %	3.88	7.65				
	Female	1743.75±13.0	1786.25±44.41	1765.0[b]			
	CV %	1.49	4.97				
	Overall strain	1983.75	1878.13				
Carcass (%)	Male	74.50 ±1.61	76.22 ±1.78	75.67	NS	NS	NS
	CV %	3.06	4.66				
	Female	74.89 ±0.46	73.53 ±2.0	73.98			
	CV %	0.87	5.45				
	Overall strain	74.69	74.89				
Edible (%)	Male	77.96 ±1.61	79.46 ±1.64	78.96	NS	NS	NS
	CV %	2.92	4.14				
	Female	78.49 ±0.52	77.16 ±1.79	77.60			
	CV %	0.94	4.63				
	Overall strain	78.23	78.31				
Inedible (%)	Male	0.22 ±0.02	0.21 ±0.01	0.22	NS	NS	NS
	CV %	12.86	14.08				
	Female	0.22 ±0.01	0.23 ±0.02	0.21			
	CV %	3.29	15.38				
	Overall strain	0.22	0.22				

[a,b] Means with different superscripts within the same column are significantly different (p <0.05). NS= non-significant means, **= probability (P<0.01).

The effects of strain, sex and their interaction on carcass cuts of broiler chicks are illustrated in Table (4), The results indicated that strain, sex and their interaction had no effect on the percentages of breast, major breast muscles, wing and neck of both broiler chicks' hybrids at 35 days of age, while the sex and the interaction of sex × strain had a significant effect on minor breast muscles and drumstick percentage of broiler chicks. Where, female broilers had the highest value of minor breast muscles and lowest drumstick percentage compared with male broilers. Our results were agreed with Moreira *et al*. (2003) who verified no difference in the yield of carcass or cuts between Ross and Cobb breeds. Moro *et al.* (2005) compared the productive performance of Ross and Cobb breeds with two Embrapa breeds and no significant difference was

detected at the age of 56 days for any productive parameter. On the contrary, Badar *et al*. (2021) Studied slaughter performance of the four broiler strains. Slaughtering weight, dressing % and breast % were significantly affected by the genetic strains. Ross-308 showed significantly higher ($p<0.05$) slaughter weight, dressing and breast percentages. Slaughtering age showed a significant effect on slaughter weight and breast percentage. Slaughter weight and breast percentage were higher at 42 and 28 days of slaughtering, respectively.

Table (4) Effect of strain, sex and their interaction on carcass cuts % of Ross and Cobb broiler chicks at 35days of age (mean ±SE).

Item	Sex	Strain		Overall sex	Probability		
		Ross	Cobb		Strain	Sex	Strain * Sex
Breast (%)	Male	12.10 ±0.62	10.39 ±0.93	11.22	NS	NS	NS
	CV2 %	10.26	18.91				
	Female	11.75 ±0.49	12.70 ±0.24	12.23			
	CV2 %	8.36	3.86				
	Overall strain	11.91	11.54				
Major (%)	Male	10.17 ±0.41	8.54 ±0.93	9.36	NS	NS	NS
	CV2 %	8.19	21.83				
	Female	9.62 ±0.41	10.50 ±0.25	10.06			
	CV2 %	8.58	4.32				
	Overall strain	9.89	9.52				
Minor (%)	Male	1.89 ±0.22	1.85 ±0.08	1.87[b]	NS	*	*
	CV2 %	22.96	8.86				
	Female	2.15 ±0.12	2.20 ±0.08	2.17[a]			
	CV2 %	11.24	7.03				
	Overall strain	2.02	2.02				
Thigh (%)	Male	7.17 ±0.37	6.28 ±0.20	6.73	*	NS	*
	CV2 %	10.25	6.5				
	Female	6.91 ±0.27	6.51 ±0.06	6.71			
	CV2 %	7.95	1.78				
	Overall strain	7.04[a]	6.39[b]				
Drumstick (%)	Male	5.10 ±0.10	5.25 ±0.25	5.16[a]	NS	*	*
	CV2 %	3.83	9.44				
	Female	5.05 ±0.05	4.50 ±0.11	4.77[b]			
	CV2 %	2.06	4.93				
	Overall strain	5.05	4.88				
Wing (%)	Male	3.85 ±0.15	3.89 ±0.08	3.87	NS	NS	NS
	CV2 %	7.9	4.08				
	Female	3.68 ±0.08	4.03 ±0.15	3.85			
	CV2 %	4.38	7.63				
	Overall strain	3.96	3.76				
Neck (%)	Male	2.84 ±3.50	3.31 ±0.18	3.12	NS	NS	NS
	CV2 %	7.73	9.68				
	Female	2.88 ±.032	2.72 ±0.12	2.8			
	CV2 %	19.55	7.35				
	Overall strain	2.86	3.02				

[a,b] Means with different superscripts within the same column are significantly different ($p<0.05$). NS= non-significant means, *= probability ($P<0.05$).

The strain and age interaction showed that Cobb 500 had the highest dressing percentage, and Hubbard Classic had the highest breast percentage at 42 and 28 days of slaughtering, respectively. In addition, Marcu *et al*. (2013) reported significant strain effects on slaughter yield and percentages of breast and thigh as well as meat to bone ratio from the breast and thigh percentage was significantly higher in Cobb 500 than other strains. In terms of broiler giblets, data in Table (5) showed that broiler strain, sex and their interaction had no

effect on the percentages of liver, gizzard and total giblets. While, broiler sex and strain × sex interaction had a significant effect on heart percentage, the heart percentage of male broiler was significantly higher than female. Our results were agreed with Arafat (2016). Reported the component percentage of liver and gizzard were not significant different ($p > 0.05$) between breeds of the Arbor Acer, Cobb 500, Hubbard f15 and Ross 308. Benyi *et al*. (2015) showed the sex had significant effects on giblet traits measured heart weights. On the other hand Abo Ghanema, (2020). Liver percentage was significantly higher in Cobb 500 than Ross 308, Avian 48 and A.A (4.26 vs. 3.95, 3.80 and 3.95% respectively).

Table (5): Giblets (%) of two strains of male and female broiler chickens.

Giblets (%)	Sex	Strain		Overall sex	Probability		
		Ross	Cobb		Strain	Sex	Strain * Sex
Liver	Male	2.03 ±0.13	1.75± 0.14	1.84	NS	NS	NS
	CV2 %	9.06	15.54				
	Female	2.21 ±0.12	2.17±0.20	2.18			
	CV2 %	7.68	18.2				
	Overall strain	2.12	1.96				
Gizzard	Male	1.05 ±0.11	1.01 ±0.08	1.02	NS	NS	NS
	CV2 %	12.86	15.07				
	Female	1.12 ±0.05	1.09 ±0.09	1.1			
	CV2 %	7.31	18.02				
	Overall strain	1.09	1.53				
Heart	Male	0.39 ±0.04	0.45 ±0.02	0.43[a]	NS	*	*
	CV2 %	14.5	10.62				
	Female	0.33 ±0.02	0.37 ±0.02	0.36[b]			
	CV2 %	11.35	10.6				
	Overall strain	0.36	0.41				
Giblets	Male	3.46 ±0.0	3.21±0.18	3.29	NS	NS	NS
	CV2 %	0	11.01				
	Female	3.60 ±0.06	3.63±0.28	3.62			
	CV2 %	2.36	15.45				
	Overall strain	3.53	3.42				

[a,b] Means with different superscripts within the same column are significantly different ($p<0.05$). NS= non-significant means, *= probability ($P<0.05$).

5. Conclusion

The two broiler strains have different ancestors and genetic constitutions judging from the obtained results in this study. Males were found to be heavier than females the study revealed that Ross strain significantly weighed more than the Cobb strain during the experimental period.

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