Full Length Article

EFFECT OF SEX ON GROWTH AND CARCASS CHARACTERISTICS OF COMMERCIAL BROILERS

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ABSTRACT

An experiment was conducted to study the effect of sex on growth pattern and carcass characters of commercial broilers. One hundred and twenty numbers of day-old chicks were wing banded, weighed and reared up to 40 days of age. The body weight was individually recorded from all the birds on 7, 14, 21, 28, 35 and 40 days of age to assess the influence of gender on body weight. At the end of the experiment 12 males and 12 females were subjected to slaughter studies to assess the carcass characters. The body weight between males and females were similar up to 14 days of age and thereafter, males recorded significantly ($p<0.01$) higher body weights on 21, 28, 35, 40 days of age, weighing 35.79, 107.69, 179.73, 211.88 g respectively higher than females. The ready-to-cook weight (%) and dressed carcass (%) were significantly ($p<0.05$) higher in males; whereas, New York carcass (%) was significantly ($p<0.05$) higher in females. Among the cut of parts, the drumstick percentage was significantly ($p<0.05$) higher in males, whereas, the wings percentage was significantly ($p<0.05$) higher in females. Among processing yields and losses, only shank & feet and abdominal fat (%) showed significant ($p<0.05$) difference between sexes; while, feather, blood, head, viscera, kidney and total offal yields had non-significant difference between sexes. Among giblets, only the heart yield was significantly ($p<0.05$) different between sexes with higher value in females. The results showed that the males attain marketable weight early, therefore can be marketed early. The males can be slaughtered earlier than females for producing specialized products from drumstick; whereas, females can be slaughtered early to harvest drumette.

Keywords: Commercial broiler, male and female, effect of sex, growth pattern, carcass characters

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INTRODUCTION

Commercial broiler farming has undergone a significant transformation, currently contributing over 50% of the total meat production in India. The intensive genetic selection that has been applied in commercial broiler breeding has led to remarkable advancements in traits such as growth rate and feed efficiency (Zuidhof and

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Schneider, 2014). As a result, the marketing age has been substantially reduced to just 35 days. In commercial broiler farming, it is common practice to rear straight-run broilers. Numerous studies have indicated that gender is among the various factors influencing growth rates, with males exhibiting faster growth and achieving marketing weight at an earlier stage. Previous studies have consistently demonstrated the significant impact of gender on various carcass characteristics like abdominal fat content, meat quality, carcass weight, as well as the weights of breast and leg muscles, edible giblets, back, and drumsticks (Madilindi *et al*., 2018, Ikusika *et al*., 2020, Kamporn and Deeden, 2022). However, the majority of these studies were conducted in other countries, often with sex-separate flocks. Studies on sex difference in growth rate and carcass characteristics will help in deciding the marketable age of males and females. Therefore, our current study was specifically designed to evaluate sex-related variations in both body weight and carcass characteristics among broilers raised in straight-run flocks. The findings from this research can be invaluable to breeders, farmers, and processors, aiding them in making informed decisions that can enhance their business operations. By comparing these traits, breeders can identify the most desirable qualities exhibited by each gender, facilitating product development tailored to consumer preferences. Moreover, a deeper understanding of sex differences in growth and carcass characteristics is essential for optimizing the utilization of different cut-up parts in the market.

MATERIALS AND METHODS

A total of 120, day-old commercial broiler chicks (Vencobb400Y) were utilized for this study. All chicks were wing-banded, individually weighed, and then randomly distributed into six replicates of straight-run groups. They were reared in a deep litter system of management. Throughout the study, the birds were provided with *ad libitum* access to feed. They received a broiler starter diet containing 23% crude protein (CP) and 3000 kcal metabolizable energy (ME) per kilogram from day-old to 7 days of age. Subsequently, from 8 to 21 days of age, they were fed a starter diet containing 22% CP and 3100 kcal ME/kg. Finally, from 22 to 40 days of age, they were given a finisher feed containing 20% CP and 3200 kcal ME/kg, following the guidelines of BIS (2007). Water and feed were available *ad libitum* to the birds, and standard management practices were followed commonly to all the birds. Individual body weights were recorded at 7, 14, 21, 28, 35, and 40 days of age. On the 40^{th} day, 24 birds (12 males + 12 females) were selected using a simple random sampling method for carcass studies. Humane slaughter was conducted, and various parameters were recorded, including pre-slaughter weight, processing losses (blood, feathers, head, and shank), New York dressing percentage, eviscerated carcass yield percentage, and ready-to-cook percentage. Organ weights, such as the heart (without pericardium), liver (without gall bladder), and gizzard (without inner horny lining), were also recorded. Carcasses were further divided to determine the weights of breast, back, wings, thighs,

and drumsticks, expressed as percentages of live weight. Additionally, the lengths of the small and large intestines and their respective measurements were recorded. The relative weights organs and the relative length of intestines were calculated using the following formulae.

$$\text{Relative organ weight} = \frac{\text{Weight of the organ (g)}}{\text{Live weight (g)}} \times 100 \quad (\%)$$

$$\text{Relative length of intestines} = \frac{\text{Total length of intestines (cm)}}{\text{Live weight (g)}} \times 100 \quad (\text{cm/g})$$

Statistical analysis by student's t-test using IBM SPSS Statistics software (Version 25) was performed to examine mean differences between genders.

RESULTS AND DISCUSSION

Body weight

The sex-separated body weight at different age of commercial broilers is given in the Table 1. During the first two weeks of the study (7 and 14 days of age), gender did not have any significant influence on weekly body weight. However, from 21 days onwards, there was a notable and statistically significant ($p < 0.05$) dimorphism observed, with males consistently exhibiting higher ($p < 0.01$) body weights than females. Most of the previous studies (Young *et al*., 2001, Kidd *et al*., 2005, Nascimento *et al.,* 2018, Kamporn and Deeden, 2022) confirmed this finding, although non-significant difference in carcass yield has also been reported earlier (Tanachai *et al.,* 2017; Suchon *et al.,* 2017). Benyi *et al*. (2015) have obtained mixed results of significant ($p < 0.05$) sex differences in body weight in Cobb strain broilers on days 21 and 35; while, Ross strain broilers showed significant ($p < 0.05$) differences only on day 21, with no significant differences on day 35. The other studies have reported similar sex differences at the end of the experiments, including Ross strain broilers on day 42 (Young *et al*., 2001), Ross strain at 55 days (Kidd *et al*., 2005), Ross 308 and 708 strains at 48 days (Da Costa *et al*., 2017) and Avian48 and Cobb strains on day 35 (Madilindi *et al*., 2018; Tanachai *et al.,* 2017). The main factor on gender differences in body weight and muscularity may be attributed to its pre-determination during embryonic development when the number of myofibres is established (Henry and Burke, 1998).

Weekly body weight gain

The difference in weekly body weight gain between males and females did not show statistical significance during the first (0-7 days; 0.33 g) and second (8-14 days; 6.99 g) weeks of the study (Fig.1). However, significant differences emerged during the third (15-21 days; 28.78 g; $p < 0.01$), fourth (22-28 days; 71.96 g; $p < 0.01$), fifth (29-35 days; 72.04 g; $p < 0.01$), and sixth (36-40 days; 32.15 g; $p < 0.05$) weeks of age. These findings partially align with those of Benyi *et al*. (2015), who observed significant ($p<0.05$) gender difference in body weight gain from days 8-21 and 22-35 in the Cobb strain, but not with the Ross strain during days 22-35. Kamporn and Deeden (2022) investigated average daily

gain in Arbor Acres, Ross 308, and Cobb 500 strains, finding significantly ($p<0.05$) higher gain in males compared to females during the fourth and fifth weeks of age, but not during earlier stages. A similar study by Abdullah *et al*. (2010) reported significantly ($p<0.05$) higher average daily gain in Lohman, Hubbard JV, Hubbard Classic, and Ross strains during the second, fourth, fifth, and seventh weeks of age. Shim *et al*. (2012) obtained similar results of sex differences ($p<0.01$) in a factorial study involving six commercial cross-broiler strains.

Processing yields

In this study, males exhibited significantly ($p<0.05$) higher live weights than females (Table 2). This difference was also reflected as significantly ($p<0.05$) higher dressed carcass, and ready-to-cook carcass yields in males. However, the New York dressed carcass yield was significantly ($p<0.05$) higher in females. Shim *et al*. (2012), who compared the interaction of strain crosses from 4 male and 3 female parent stocks with genders and found that hot and chilled carcass percentages were significantly ($p<0.05$) higher in males compared to females. Similarly, Olawumi and Fagbuaro (2011) recorded significantly ($p<0.05$) higher values of live body weight and eviscerated carcass weight in Arbor Acres, Mashall and Hubbard broiler strains. These findings are consistent with the results of the present study. Several earlier studies have also supported our results, confirming sex differences with males having higher slaughter weight (Isidahomen *et al*., 2012), carcass weight (Olawumi and Fagbuaro, 2011; Isidahomen *et al*., 2012; Shafey *et al*., 2013; Nascimento *et al*., 2018; Kamporn and Deeden, 2022), and dressing percentage (Isidahomen *et al*., 2012; Ikusika *et al*., 2020). However, few other researchers observed no gender effect on dressing percentage in their respective studies (Olawumi and Fagbuaro, 2011; Tanachai *et al*., 2017; Suchon *et al*., 2017).

Processing losses

Among the processing losses, loss in shank and feet (%) was significantly ($p<0.05$) higher in males; while that of abdominal fat was more in females. On the other hand, the losses due to feather, blood, head, viscera and kidney showed no sex difference in the present study (Table 2). The higher per cent abdominal fat in females compared to males has been reported earlier by several authors in Cobb (Benyi *et al*., 2015; Nikolova *et al*., 2007) Arbor Acres (Azahan *et al*., 2007) Hubbard Classic (Nikolova *et al*., 2007) and Ross (Kidd *et al*., 2005; Shafey *et al*., 2013; Madilindi *et al*., 2018) broilers. Whereas, Abdullah *et al*. (2010) did not record any sex difference for per cent abdominal fat in Lohman and Hubbard broilers. Higher fat accumulation in the abdominal fat pad in females compared to males is attributed to the impact of female hormones (Le Bihan-Duval, 1998)) and also the fact that females start to store fat earlier than males (Almasi *et al*., 2012). Contrast to the findings of the present study, earlier researchers have recorded significantly higher ($p < 0.05$) yield of shank in females and

significantly higher ($p < 0.05$) yields of head and neck in males (Isidahomen *et al*., 2012).

Cut-up parts

The percentages of drumsticks and wings exhibited significant ($p<0.05$) gender differences, with males having a higher drumstick percentage and females having a higher wings percentage compared to the opposite sexes (Table 3). The percentages of other carcass cuts, such as thigh, breast, back, and neck, in this study were not influenced by gender. Our findings confirm the findings of Young *et al*. (2001), Olawumi and Fagbuaro (2011), Isidahomen *et al*. (2012) and Shafey *et al*. (2013) who reported higher yields of drumsticks in males. A few earlier studies confirm the current findings of no gender influence on thigh (Shafey *et al*., 2013, Tanachai *et al*., 2017), breast (Shim *et al*., 2012; Shafey *et al*., 2013, Benyi *et al*., 2015, Tanachai *et al*., 2017), back (Shafey *et al*., 2013) and neck (Shafey *et al*., 2013) yields. However, the literature presents highly variable information on other cutup part yields. In contrast to our study, few studies have found significantly ($p < 0.05$) higher percentages of breast yield in males (Hassani-Vaslan, 2010; Isidahomen *et al*., 2012) and females (Merkley *et al*., 1980; Young *et al*., 2001; Kidd *et al*., 2005), higher thigh yield in males (Becker *et al*., 1981; Hassani-Vaslan, 2010; Olawumi and Fagbuaro, 2011; Isidahomen *et al*., 2012) and females (Madilindi *et al*., 2015), higher leg (Merkley *et al*., 1980; Shim *et al*., 2012; Benyi*et al*., 2015) and wing (Isidahomen *et al*., 2012; Shafey *et al*., 2013; Benyi *et al*., 2015 yields in males, higher back yield in males (Olawumi and Fagbuaro, 2011; Isidahomen *et al*., 2012), and higher neck yields in females (Madilindi *et al*., 2015).

Giblets weight and intestinal length

In the present study, we observed significantly ($p<0.05$) higher heart weight and significantly ($p<0.05$) longer small intestine and total intestines in females compared to males. However, gender did not have a significant influence on the weights of giblets, such as the liver and gizzard, or on the lengths of intestinal segments like the large intestine and caeca. These findings contrast with earlier studies, which reported varying results. Some studies found significantly ($p<0.05$) higher liver (Benyi *et al*., 2015; Madilindi *et al*., 2018), heart (Hassani-Vaslan, 2010; Madilindi *et al*., 2018), and gizzard (Benyi *et al*., 2015; Madilindi *et al*., 2018) weights in males, while others found similar weights of the liver, heart, and gizzard in both sexes (Olawumi and Fagbuaro, 2011). It is worth noting that information regarding the influence of sex on intestinal length is limited in the literature, making comparisons with our results not possible.

In can be concluded that the males can be marketed early with better live weight and dressed carcass weights and both sexes can be diversely utilized for the different cut-up parts in the processing and by-products industry.

Table 1. Body weight (g) of male and female commercial broilers at different age

Sex	7 days	14 days	21 days	28 days	35 days	40 days
Males	150.57 ±1.41 (n=113)	374.13 ±4.41 (n=110)	807.33 ±8.85 (n=109)	1290.44 ±11.93 (n=109)	1764.39 ±15.55 (n=107)	2162.65 ±18.27 (n=107)
Females	150.61 ±1.16 (n=107)	367.18 ±4.48 (n=106)	771.6 ±7.44 (n=104)	1182.75 ±9.73 (n=102)	1584.66 ±15.99 (n=102)	1950.77 ±16.19 (n=101)
t-statistic	0.03	1.26	3.5	7.8	8.7	9.59
Significance	NS	NS	p<0.01	p<0.01	p<0.01	p<0.01

NS – Not significant (P>0.05)

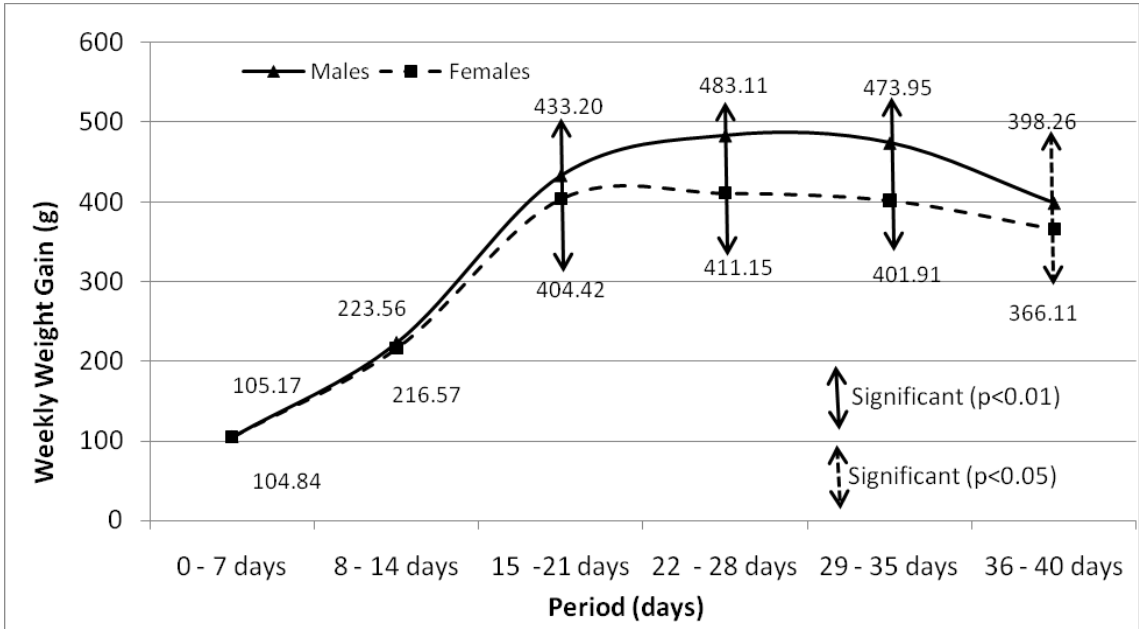

Fig. 1. Sex separated weight gain (g) during different periods in commercial broilers

Table 2. Carcass yields and cut-up parts of male and female commercial broilers at 40 days of age (n=12)

Sex	Live Weight	Processing yields (%)			Processing losses (%)							
		New York dressed carcass	Dressed carcass	Ready-to-cook carcass	Feather	Blood	Shank & feet	Head	Viscera	Kidney	Abdominal Fat	Total offal
Males	2404.77 ±98.55	89.98 ±0.59	70.87 ±1.03	75.48 ±0.92	7.80 ±0.54	2.22 ±0.16	3.96 ±0.31	2.87 ±0.14	11.32 ±0.46	0.24 ±0.02	0.72 ±0.06	29.13 ±1.03
Females	2119.36 ±118.06	90.04 ±0.67	68.06 ±0.56	72.79 ±1.25	7.22 ±0.48	2.74 ±0.24	4.95 ±0.44	3.05 ±0.18	12.9 ±0.86	0.26 ±0.03	0.81 ±0.04	31.94 ±1.56
t-statistic	2.07	2.11	2.23	2.07	0.82	1.9	2.17	0.85	1.7	0.73	2.67	2.07
Significance	P<0.05	p<0.05	p<0.05	p<0.05	NS	NS	p<0.05	NS	NS	NS	p<0.05	NS

NS – Not significant (P>0.05)

Table 3. Cut-up parts, organ yields and relative length of intestine organ yields of male and female commercial broilers at 40 days of age (n=12)

Sex	Cut-up parts (%)						Giblets (%)				Relative length of intestine (cm/g)			
	Drum-stick	Thigh	Breast	Back	Wing	Neck	Liver	Heart	Gizz-ard	Giblets	Small intestine	Large intestine	Caeca	Total Intestines
Males	12.57 ±0.41	10.79 ±0.72	36.58 ±1.16	27.57 ±1.05	7.20 ±0.22	5.28 ±0.34	1.97 ±0.13	0.60 ±0.04	1.93 ±0.13	4.61 ±0.25	7.79 ±0.37	0.44 ±0.04	0.75 ±0.05	8.90 ±0.42
Females	11.47 ±0.39	11.78 ±0.56	34.11 ±1.13	29.23 ±1.72	8.15 ±0.36	5.26 ±0.41	1.93 ±0.20	0.74 ±0.06	1.93 ±0.13	4.73 ±0.37	9.15 ±0.54	0.48 ±0.03	0.83 ±0.06	10.37 ±0.62
t-statistic	2.12	1.09	1.58	0.94	2.44	0.05	0.86	2.10	0.03	0.27	2.23	0.80	1.24	2.15
Significance	p<0.05	NS	NS	NS	p<0.05	ns	NS	P<0.05	NS	NS	p<0.05	ns	ns	p<0.05

NS – Not significant (P>0.05)

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