

AKSU Journal of Agriculture and Food Sciences 10(1) 65-77, 2026
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Sex-Age Interactions, Carcass Characteristics, and Logarithmic Regression Modelling in Broiler Chickens

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Abstract

This study investigated the effects of sex and age on morphometric traits, carcass characteristics, and the accuracy of logarithmic regression models for predicting body weight from body measurements in Ross 308 broiler chickens. Two hundred 4 week-old chicks (100 males and 100 females) were reared under standard deep-litter conditions in a completely randomized design until 8 weeks of age. At slaughter, males had slightly higher live weight (2585 g vs. 2565 g) and dressed weight (1777.5 g vs. 1660.5 g) than females, resulting in superior dressing percentages (68.78% vs. 64.73%) and breast yield (37.76% vs. 36.06%). Yields of other carcass cuts and offal percentages showed no significant sex differences ($p > 0.05$). Morphometric traits (body weight, body length, chest girth, shank, wing, thigh, and neck lengths) were significantly influenced by both sex and age ($p < 0.001$), with males consistently recording higher values. All measurements increased steadily from weeks 5 to 8. Significant sex \times age interactions were observed only for body weight and neck length. Logarithmic regression models ($Y = a + b \ln(X) + e$) effectively estimated live weight, particularly using chest girth, which proved the best predictor (adjusted $R^2 = 0.817$ in females). Body length and neck length also performed well, while shank, wing, and thigh lengths were poor predictors. Sex-specific models improved prediction accuracy for several traits. In conclusion, male broilers exhibited clear morphometric and carcass advantages. Chest

girth offers a reliable tool for farmers to monitor growth and improve production efficiency in Ross 308 broilers.

Keywords: Ross 308, Interaction, Carcass characteristics, Sex, Logarithmic modelling

1.0 Introduction

The poultry industry's contribution to food security, economic growth, and the availability of affordable, high-quality animal-source protein cannot be overstated (Rotimi, 2025; Sam and Udo, 2025). Broiler chickens are highly sought after globally due to their remarkable feed conversion efficiency, rapid growth rates, and easy management requirements (Rotimi, 2025; Purnomo *et al.*, 2024). These birds have undergone selective breeding to reach market-ready body weight within 4–7 weeks of age (Sam *et al.*, 2010; Purnomo *et al.*, 2024).

The Ross 308 broiler strain is especially prized for its meat production expertise, exceptional feed conversion ratio, and resilience (Bila, 2025; Purnomo *et al.*, 2024). Due to their accelerated development, these birds regularly reach marketable size by week six, meeting consumer demands for consistent performance (Bila, 2025; Purnomo *et al.*, 2024). However, sexual dimorphism, in which males and females of the same species differ in size, appearance, behavior, and physiological traits, has a significant impact on growth rates in Ross 308 broilers (Cygan-Szczegieliński and Bogucka, 2021; Berns, 2013; McPherson and Chenoweth, 2012; Jennifer *et al.*, 2021). In livestock, including broilers, sex also affects overall body growth and tissue weight distribution.

According to variables like sex, breed, farm management, pre-slaughter handling, and live weight at slaughter, broiler carcass characteristics vary significantly (Corazzin *et al.*, 2019). According to Hussein *et al.* (2019), dressing percentage, muscle yield, and the percentage of prime cuts are critical evaluation parameters that determine slaughter value. For broilers, a representative dressed weight of 74.81% has been reported, highlighting its significance as a crucial carcass quality indicator and the foundation for business dealings between producers, processors, and consumers (Shewita and Taha, 2018; Hussein *et al.*, 2019; Delgado-Pando *et al.*, 2021).

In broilers, morphometric measurements are trustworthy markers of growth potential and market value (Bila, 2025). Accurate body weight prediction and performance evaluation are made possible by characteristics like body length, wing length, shank length, breast girth, and neck length (Sam *et al.*, 2025; Udo *et al.*, 2025; Okon *et al.*, 1997; Ojedapo *et al.*, 2010). Due to expense, equipment scarcity, and bird stress, conventional scale-weighing is frequently impractical in environments with limited resources. In order to assist farmers and breeders, this study examined the combined effects of age and sex on carcass characteristics while creating distinct logarithmic models for determining body weight from morphometric measurements in male and female Ross 308 broilers.

2.0 Materials and Methods

2.1 Ethics Statement

This study adhered to the bioethics guidelines for poultry production outlined by Macer (2019), which address key aspects of broiler management, feed and water provision, and humane handling from the perspectives of both poultry breeders and researchers. Ethical approval was obtained from the Postgraduate Review Board of Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria (Approval No. AKSU-AGR-REC/2024/004).

2.2 Study Location

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Department of Animal Science, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus. The campus is located in the tropical rainforest zone of Nigeria (between latitudes 4°30'N–5°00'N and longitudes 7°30'E–8°00'E). The region experiences annual rainfall of 3,500–5,000 mm, mean monthly temperatures around 27.5°C, and relative humidity ranging from 60% to 90% (AKSG, 2022).

2.3 Experimental Animals and Management

A total of 200 day-old Ross 308 commercial broiler chicks (100 males and 100 females) were obtained from The Poultry Unit, Teaching and Research Farm of Department of Animal Science, Akwa Ibom State University, Nigeria. Chickens were sexed based on visible sexual dimorphism, primarily differences in comb size, shape, and redness. Birds were assigned to two treatment groups (male and female) in a completely randomized design (CRD), with five replicates of 20 birds each. They were reared on deep litter in standard housing. Morphometric measurements began in week 5 (finisher phase). Standard management practices were followed throughout, including strict biosecurity, regular sanitation, and a vaccination program against major diseases such as Newcastle disease, infectious bursal disease (Gumboro), fowl pox, fowl typhoid, and Marek's disease.

Feed and water were provided *ad libitum*. From week 5 until the end of the experiment at 8 weeks, birds were fed a commercial broiler finisher diet (Top Feeds Broiler Finisher, Premiere Feed Mills Company Limited, Nigeria) with 21% crude protein and 2,800 kcal/kg metabolizable energy. Clean, fresh drinking water was continuously available.

2.4 Data Collection

2.4.1 Morphometric Traits

Linear body measurements were taken in centimeters using a flexible tailor's tape, following the standardized procedures described by Sam *et al.* (2019). The traits measured were:

Body length (BL): Distance from the base of the neck to the base of the tail.

Wing length (WL): From the tip of the outstretched wing feathers to the shoulder joint (coracoid-humeral joint).

Shank length (SL): Straight-line distance along the tarsometatarsus from the hock joint to the base of the toes.

Breast girth (BG): Circumference around the fullest part of the breast, measured gently with the tape.

Neck length (NL): From the back of the head (occipital condyle) to the front edge of the shoulder bones (coracoids).

2.4.2 Carcass Evaluation

Carcass traits and offal weights were determined using the methods of Ojewole and Longe (1999). At the end of the experiment, two birds closest to the mean body weight were selected from each replicate (10 birds per sex group; 20 birds total). Birds were fasted overnight, weighed live, and then humanely slaughtered by jugular vein severance. After complete bleeding, they were scalded, defeathered, and eviscerated following standard procedures. The head, shanks, and neck were removed to obtain the dressed carcass.

Dressed weight was calculated as live weight minus the weight of the head, shanks, feathers, and intestines. Dressed percentage was expressed as:

$\% \text{ dressed weights} = (\text{dressed weight} / \text{live weight}) \times 100 \dots \dots \dots \text{Equation 2.1}$

Additional measurements were recorded in grams using a sensitive digital scale (S. Miller Digital Scientific Scale): Dressed Weight (excluding head, feet, visceral). Cut-up parts were expressed as percentages of dressed weight, while offal weights were presented as percentages of live weight.

2.5 Experimental Design

The study employed a completely randomized design (CRD) with two treatments (sex: male vs. female), five replicates per treatment, and 20 birds per replicate (total n = 200 Ross 308 broilers).

2.6 Statistical Analysis

Carcass and offal data were analyzed using an independent samples t-test to compare means between male and female groups (SPSS version 26, 2021). Morphometric data were subjected to factorial analysis of variance (ANOVA) to assess the effects of sex, as well as any potential interactions (though the design focused primarily on sex). Results are presented in tabular forms. Regression analysis was performed to examine relationships among phenotypic parameters, using a logarithmic growth prediction model:

$Y = a + b \ln(X) + e \dots \dots \dots \text{Equation 2.2}$

Where:

Y = the dependent variable (body weight)

a= the constant

b= regression coefficient

X= independent variable (e.g., morphometric trait)

ln= the natural logarithm, and

e =random error.

3.0 Results and Discussion

3.1 Carcass Traits of Ross 308 Broiler Chicken

The carcass characteristics of Ross 308 Broiler Chickens are displayed in Table 3.1. Results showed that males had a slightly higher live weight (2585 g) than females (2565 g), a better dressed weight (1777.5 g) than females (1660.5 g), and a dressed percentage (68.78% vs. 64.73%). While yields for the back, wing, drumstick, and thigh were fairly similar between the sexes, the breast yield was slightly higher in males (37.755%) than in females (36.062%).

This result is in line with recent findings in Ross 308 broilers, where sex separation increased male absolute weights and feed efficiency. However, despite obvious live weight differences, major carcass yields (breast, thigh, drumstick, and wing) did not exhibit any significant sex effects (Gonçalves *et al.*, 2022). According to Yuan *et al.* (2024), carcass composition and cut yields are similar under current genetics and management, even though males outperform females in live performance.

Table 3.2 presents the offal weights of Ross 308 Broilers chicken. The offal weights were expressed as percentages of live weight. Results show that there were no statistically significant differences ($p > 0.05$) between males and females. Males had neck at 4.585%, shank at 3.251%, liver at 1.856%, heart at 0.329%, and kidney at 0.194%. Females showed slightly higher values for neck (5.085%), liver (2.085%), heart (0.448%), and kidney (0.215%) and shank (3.241%).

These matches the results of Gonçalves *et al.* (2022), who examined Ross 308 broilers and discovered that sex only, had an impact on heart weight, which was higher in males. Other edible offal and viscera did not exhibit any significant differences, similar to the consistent results observed here for the majority of parameters.

Likewise, studies on various broiler lines often note that while absolute organ weights differ by sex, the proportions relative to live weight stay remarkably consistent, making processing more predictable across mixed flocks (Hussein *et al.*, 2019).

On the other hand, some research on other breeds or slower-growing lines occasionally reports small but significant sex effects on giblet yields, with females sometimes showing proportionally larger organs linked to metabolic variations (Yuan *et al.*, 2024).

Table 3.1: Carcass traits of Ross 308 broiler chicken

| TRAIT | MALE | FEMALE | SED | P-VALUE |
|-------------------------------------|--------|--------|--------|---------|
| Live Weight (g) | 2585 | 2565 | 43.012 | 0.688 |
| Dressed Weight (g) | 1777.5 | 1660.5 | 31.662 | 0.066 |
| Dressed % | 68.78 | 64.73 | 1.379 | 0.099 |
| Prime cut (% Dressed Weight) | | | | |
| Breast | 37.755 | 36.062 | 1.22 | 0.3 |
| Back | 16.287 | 17.21 | 0.771 | 0.353 |
| Wing | 11.815 | 12.145 | 0.554 | 0.611 |
| Drumstick | 16.622 | 16.751 | 0.748 | 0.879 |
| Thigh | 17.132 | 17.686 | 0.604 | 0.456 |

3.2 Effect of Sex, Age, and Sex-Age interaction on the Morphometry of Ross 308

Table 3.3 shows the main effect of age and sex as well as interactive effect of sex and age on body weight, body length, chest girth, shank length, wing length, thigh length and neck length of Ross 308 broiler chickens. It was observed that the main effect of sex and age were significant ($P < 0.005$) as well as the interactive effect of sex and age at $P \leq 0.001$ for body weight and neck length. Body length and chest girth are significantly affected by sex and age with $P \leq 0.001$. But interactive effect of age and sex had no significant difference ($P > 0.005$).

On average, males outperformed females across the board: higher body weight (2280.7 g vs. 2136.6 g), longer body length (24.76 cm vs. 23.40 cm), greater chest girth (36.76 cm vs. 34.93 cm), shank length (8.60 cm vs. 7.33 cm), wing length (8.60 cm vs. 7.33 cm), Thigh length (14.61 cm vs. 13.13 cm), and neck length (12.41 cm vs. 11.65 cm). These patterns reflect the typical nal boosts that drive stronger skeletal and muscular development (Amao, 2022; Bila *et al.*, 2025).

Age played a major role too, with all traits increasing significantly from week 5 to week 8. Body weight jumped from about 1773 g in week 5 to 2635 g by week 8, while body length grew from 22.6 cm to 25.5 cm, chest girth from 33.0 cm to 38.3 cm, and similar steady gains appeared in shank, wing, thigh, and neck lengths. This steady progression matches the rapid linear growth

expected in Ross 308 birds during this growth phases under good management condition (Aviagen, 2022; Mendes, 2009).

Looking at the sex-age interactions, males held consistent advantages week after week, for instance, by week 8, males reached 2641 g body weight and 15.0 cm tibia length compared to females' 2629 g and 13.35 cm, suggesting the growth trajectories run parallel but with males pulling ahead early on. This aligns closely with recent work showing males maintain superior frame dimensions throughout rearing, which supports better overall meat yield potential (Gonçalves *et al.*, 2022; Hussein *et al.*, 2019).

These observations fit well with Aviagen's guidelines for Ross 308, emphasizing that males often achieve higher structural traits by market age (Aviagen, 2022). Strong links between body weight and measurable traits like shank length, wing length, body girth, and chest girth also make these useful for weight estimation in flocks (Bila and Tyasi, 2022; Isaac *et al.*, 2024).

While some studies on slower-growing or alternative breeds note smaller sex gaps in morphometry, the pronounced differences here in Ross 308 stem from intensive breeding focused on rapid, uniform growth highlighting why sex-aware management can help optimize skeletal health and processing consistency (Yuan *et al.*, 2024; Benyi *et al.*, 2015).

Table 3.2: Offal's weight of Ross 308 broiler chicken as percentage of live weight

| TRAIT | MALE | FEMALE | SED | P-VALUE |
|--------------|-------------|---------------|------------|----------------|
| Neck | 4.585 | 5.085 | 0.285 | 0.221 |
| Shank | 3.251 | 3.241 | 0.506 | 0.986 |
| Liver | 1.856 | 1.988 | 0.133 | 0.428 |
| Heart | 0.329 | 0.448 | 0.028 | 0.52 |
| Gizzard | 1.825 | 1.873 | 0.507 | 0.934 |
| Kidney | 0.194 | 0.215 | 0.045 | 0.691 |

Table 3.3: Effect of sex, age, and sex-age interaction on the morphometry of Ross 308

| Sex | Age | BW (g) | BL (cm) | BG (cm) | SL (cm) | WL (cm) | TL (cm) | NL (cm) |
|------------|------------|-----------------------|---------------------|---------------------|---------------------|---------------------|----------------------|---------------------|
| Male | | 2280.7 | 24.763 | 36.762 | 8.6 | 8.6 | 14.612 | 12.413 |
| Female | | 2136.58 | 23.398 | 34.925 | 7.325 | 7.325 | 13.125 | 11.65 |
| ±SEM | | 15.044 | 0.154 | 0.167 | 0.095 | 0.175 | 0.152 | 0.147 |
| P-value | | 0.000 | 0.000 | 0.000 | 0.000 | 0.176 | 0.000 | 0 |
| | Week 5 | 1772.900 ^a | 22.600 ^a | 33.000 ^a | 7.750 ^a | 17.325 ^a | 13.450 ^a | 10.850 ^a |
| | Week 6 | 1918.550 ^b | 23.175 ^a | 34.875 ^b | 7.850 ^{ab} | 17.850 ^a | 13.750 ^{ab} | 11.500 ^b |
| | Week 7 | 2508.100 ^c | 25.000 ^b | 37.250 ^c | 8.050 ^{ab} | 18.650 ^b | 14.100 ^b | 12.525 ^c |
| | Week 8 | 2635.000 ^d | 25.545 ^b | 38.250 ^d | 8.200 ^b | 19.550 ^c | 14.175 ^b | 13.250 ^d |
| | ±SEM | 21.275 | 0.218 | 0.236 | 0.134 | 0.247 | 0.214 | 0.208 |
| | P-value | 0.000 | 0.000 | 0.000 | 0.089 | 0.000 | 0.071 | 0.000 |
| Male | Week 5 | 1912.1 | 23.5 | 34.9 | 8.4 | 17.45 | 14.1 | 10.7 |
| | Week 6 | 2057.2 | 24.35 | 36.05 | 8.5 | 17.9 | 14.4 | 11.5 |
| | Week 7 | 2512.5 | 25.1 | 37.3 | 8.7 | 18.8 | 14.95 | 13.25 |
| | Week 8 | 2641 | 26.1 | 38.8 | 8.8 | 19.9 | 15 | 14.2 |
| Female | Week 5 | 1633.7 | 21.7 | 31.1 | 7.1 | 17.2 | 12.8 | 11 |
| | Week 6 | 1779.9 | 22 | 33.7 | 7.2 | 17.8 | 13.1 | 11.5 |
| | Week 7 | 2503.7 | 24.9 | 37.2 | 7.4 | 18.5 | 13.25 | 11.8 |
| | Week 8 | 2629 | 24.99 | 37.7 | 7.6 | 19.2 | 13.35 | 12.3 |
| | ±SEM | 30.088 | 0.309 | 0.333 | 0.19 | 0.349 | 0.303 | 0.294 |
| | P-value | 0.000 | 0.006 | 0.006 | 0.991 | 0.848 | 0.856 | 0.000 |

SEM = Standard Error of Mean, BW = Body Weight, BG = Breast Girth, BL = Body Length, SL = Shank Length, WL = Wing Length, TL = Thigh Length, NL = Neck Length.

Table 3.4: Body weight prediction using Logarithmic Model

| Variables | Sex | Logarithm Equation | R | R ² | Adj.R ² | SEE | P-Value |
|-----------|--------|------------------------------|-------|----------------|--------------------|---------|---------|
| BL | Male | -9792.105 + 3763.616ln (BL) | 0.656 | 0.431 | 0.416 | 248.538 | <0.001 |
| | Female | -14255.593 + 4860.362ln (BL) | 0.885 | 0.783 | 0.777 | 210.973 | <0.001 |
| BG | Male | -15948.83 + 5059.212ln (BG) | 0.788 | 0.62 | 0.61 | 202.923 | <0.001 |
| | Female | -15116.969 + 4860.362ln (BG) | 0.907 | 0.822 | 0.817 | 191.231 | <0.001 |
| SL | Male | 1002.272 + 594.93ln (SL) | 0.14 | 0.02 | -0.006 | 326.098 | 0.389 |
| | Female | -2198.692 + 2179.849 ln (SL) | 0.349 | 0.122 | 0.099 | 424.506 | 0.027 |
| WL | Male | -4951.178 + 2480.238ln (WL) | 0.564 | 0.318 | 0.3 | 271.994 | <0.001 |
| | Female | -6889.712 + 3115.582ln (WL) | 0.543 | 0.295 | 0.277 | 380.282 | <0.001 |
| TL | Male | -621.794 + 1083.385ln (TL) | 0.252 | 0.063 | 0.039 | 318.722 | 0.117 |
| | Female | -2458.875 + 1786.339 ln (TL) | 0.256 | 0.065 | 0.041 | 437.945 | 0.112 |
| NL | Male | -2144.195 + 1763.191ln (NL) | 0.747 | 0.558 | 0.546 | 219.032 | <0.001 |
| | Female | -3494.899 + 2297.062ln (NL) | 0.455 | 0.207 | 0.186 | 403.455 | 0.003 |

SEE = Standard Error of Estimate, BW = Body Weight, BG = Breast Girth, BL = Body Length, SL = Shank Length, WL = Wing Length, TL = Thigh Length, NL = Neck Length.

3.3 Body Weight Prediction using Logarithmic Model

The logarithmic regression models in Table 3.4 offered a practical way to estimate body weight (BW) in Ross 308 broilers using simple morphometric measurements, revealing clear differences in how well each trait worked and how sex influenced the accuracy. The degree of reliability of the log equations was measured by Adjustable R² (Adj R²) and Standard Error of Estimate (SEE); higher Adj R² and lower SEE.

Results revealed that Chest Girth (CG) stood out as the strongest predictor. In females, it delivered excellent results (R = 0.907, R² = 0.822, adjusted R² = 0.817, SEE = 191.231 g, p < 0.001), while males still showed good performance (R = 0.788, R² = 0.620). Body length (BL)

followed a similar pattern, performing much better in females ($R = 0.885$, $R^2 = 0.783$) than in males ($R = 0.656$, $R^2 = 0.431$). Neck length (NL) was reasonably effective, especially for males ($R = 0.747$, $R^2 = 0.558$), though less so in females.

By comparison, shank length (SL), wing length (WL), and thigh length (TL) proved far less reliable. Many showed low R^2 values; for example, SL in males had almost no predictive value ($R^2 = 0.020$, $p = 0.389$), and TL often failed to reach significance in either sex. This suggests that limb measurements do not capture BW variation as effectively under a logarithmic approach.

These patterns are consistent with results reported by Bila (2025) & Küçüktopý *et al.* (2025), showing that characteristics related to body length and chest girth, tend to provide the most accurate BW estimates in broilers because they more directly reflect total muscle and skeletal mass. The non-linear growth in fast maturing strains such as Ross 308, where weight gains accelerate disproportionately to linear dimensions, can be explained by logarithmic transformations. According to Liswaniso *et al.* (2025) & Rotimi *et al.* (2025), sex-specific models increase accuracy because females frequently exhibit more consistent body proportions in particular traits, resulting in tighter fits.

These findings, however, contrast with some research on different breeds or genotypes, where shank or keel measurements occasionally show up as stronger predictors, perhaps as a result of breed-specific morphology or variations in management (Yahia *et al.*, 2026; Assan *et al.*, 2024).

4.0 Conclusion

Carcass yields were similar for both sexes, with males exhibiting advantages, despite the fact that sex affected absolute morphometric measurements. In Ross 308 broilers, chest circumference turned out to be a trustworthy indicator of body weight. This validates its useful application on farms for better marketing, management, and breeding choices. All things considered, these results showed the advantages of sex-specific rearing techniques and the use of straightforward modeling tools to boost the productivity of chicken production.

Acknowledgments

The authors express their sincere gratitude to the Dean of the Faculty of Agriculture, Akwa Ibom State University, for his unwavering support throughout this study. We are particularly thankful to the Head of the Department of Animal Science for kindly granting access to the poultry facilities at the Teaching and Research Farm. We also extend our deep appreciation to the committed staff of the Poultry Unit, whose technical expertise, diligent assistance, and valuable contributions were instrumental in the successful completion of this work.

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