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Genotype-Dependent Sexual Dimorphism in Growth Performance, Feed Efficiency, and Survivability of Dual-Purpose and Layer Chickens Under Tropical Production Systems

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A B S T R A C T

Sexual dimorphism plays a pivotal role in shaping growth performance, feed efficiency, and survivability in poultry production systems, particularly under tropical conditions where environmental stressors may influence genotype expression. This study investigated sex-linked performance differences among three commercially relevant chicken strains—Noiler, Aco Black, and Isa Brown—during the first eight weeks of rearing under Nigerian tropical conditions. A total of 360 day-old chicks (60 males and 60 females per strain) were raised in a completely randomized design. Growth parameters including weekly body weight, body weight gain, feed intake, feed conversion ratio (FCR), and mortality were recorded and analyzed using analysis of variance. Significant strain and sex effects were observed across most performance indices. Noiler males exhibited the highest growth performance, achieving a final body weight of 1201.86 g, total weight gain of 1149.14 g, and the most efficient FCR (2.31). However, this rapid growth was accompanied by the highest mortality rate (50% in males), indicating compromised survivability. In contrast, Isa Brown birds recorded the lowest growth performance (female final weight: 682.60–697.20 g) but achieved the highest survival rate (up to 100%). Aco Black demonstrated intermediate growth (male final weight: 916.00 g) with high survivability (96–100%), reflecting balanced dual-purpose potential. The magnitude of sexual dimorphism varied among strains, with males consistently outperforming females in growth traits by week eight. Overall, the results highlight a trade-off between accelerated growth and survivability, underscoring the need for sex-specific and strain-oriented management strategies to optimize poultry productivity under tropical production systems

INTRODUCTION

Poultry production remains a cornerstone of global food security, supplying affordable and high-quality animal protein through meat and eggs (Mottet and Tempio, 2017). Chickens are the most widely reared poultry species owing to their rapid growth, adaptability to diverse environments, and high reproductive efficiency. In Nigeria, the poultry sector contributes substantially to household nutrition, employment, income generation, and rural livelihoods (FAO, 2021). As demand for poultry products continues to rise, optimizing growth performance and survivability has become increasingly important for improving productivity and economic returns under tropical production systems.

Genetic diversity among chicken strains and inherent biological differences between sexes are major determinants of productivity, growth patterns, and reproductive performance (Ahmad et al., 2019). Sexual dimorphism, defined as the physiological and morphological differences between males and females of the same species, is widely documented in poultry and significantly influences growth rate, body weight, feed efficiency, and mortality (Mignon-Grasteau et al., 2000; Zerehdaran, 2015). Typically, males exhibit faster growth and superior feed conversion compared to females, enhancing market weight attainment and profitability (Adedibu and Ayorinde, 2011). However, the magnitude and expression of sexual dimorphism vary across genotypes.

Commercial layer strains such as Isa Brown are primarily selected for egg production, displaying marked sex differences in reproductive output (Yakubu et al., 2020). In contrast, improved dual-purpose strains like Noiler and Aco Black are bred for both meat and egg production, presenting intermediate growth and reproductive traits. Although numerous studies have examined broilers and layers independently, limited comparative research has evaluated sex-based performance differentials among improved dual-purpose and exotic strains under tropical climatic conditions.

This study therefore aimed to assess the influence of sexual dimorphism on growth performance and survivability of Noiler, Aco Black, and Isa Brown chickens reared under tropical Nigerian conditions, providing evidence to inform genotype selection and sex-specific management strategies.

LITERATURE REVIEW

Experimental Site

The experiment was conducted at the University of Abuja Teaching and Research Farm, Nigeria, located within the Guinea Savanna agro-ecological zone (annual rainfall: 1000–1500 mm; temperature: 26–30°C; relative humidity: 60–70%).

Experimental Animals and Management

A total of 360day-old chicks comprising: 120 Noiler, 120 Aco Black and 120 Isa Brown were used in the study. Each strain consisted of 60 males and 60 females. Birds were reared for eight weeks under standard management practices. Commercial diets were provided as recommended for poultry birds

(NRC 1994) ad libitum. Routine vaccination and biosecurity measures were strictly maintained.

Experimental Design

A completely randomized design (CRD) was adopted with sex nested within strain. Males and females were housed separately within each strain to avoid behavioral interference. The Birds were grouped by sex within each strain, ensuring equal chances of exposure to treatment. Experimental groups included 60 males and 60 females each of Noiler, Aco Black, and Isa Brown, with sexes kept in separate enclosures.

METHODOLOGY

Data Collection and Measurements

The following parameters were recorded: Initial and final body weight (g); Body weight gain (BWG); Average daily weight gain (ADWG); Total feed intake (TFI) Average daily feed intake (ADFI); Feed conversion ratio (FCR); Mortality (%) and Survival rate (%).

Statistical Analysis

Data was analyzed using ANOVA to determine significant differences in performance and survivability among strains and between sexes. Means were separated using Duncan multiple range test. The analysis was done using SPSS 14 software (SPSS 2011), while descriptive statistics was used to determine the survivability of birds.

RESULTS

Weekly Growth Trends

Clear sexual dimorphism was observed across strains. Males consistently achieved higher body weights than females throughout the eight-week period. Noiler males demonstrated the highest growth rate, reaching 1201.86 g at week eight. ISA Brown females recorded the lowest final body weight (697.20 g). Aco Black birds exhibited moderate growth patterns, with some mid-stage fluctuations.

Although Aco Black females temporarily exceeded male weight at week five, this divergence was not sustained, and males regained higher growth trajectories by week eight. The magnitude of sexual dimorphism increased progressively with age, particularly in the Noiler strain.

Table 1. Effect of Sexual Dimorphism on Body Weight (G) From 0–8 Weeks

Age (weeks)	Aco M	Aco F	Noiler M	Noiler F	Isa M	Isa F	SEM
0	50.10^{a}	48.50^{ab}	52.71^{a}	47.30^{ab}	43.60^{bc}	39.90^{c}	0.77
1	88.60^{b}	81.90^{b}	109.00^{a}	106.90^{a}	75.20^{b}	73.50^{b}	2.47
2	162.90^{bc}	158.50^{b}	198.00^{ab}	221.80^{a}	139.30^{b}	139.30^{b}	5.39
3	270.00^{bc}	165.30^{e}	399.14^{a}	320.30^{b}	232.40^{cd}	193.30^{de}	11.22
4	418.00^{bc}	301.70^{d}	526.29^{a}	442.10^{b}	355.10^{cd}	288.90^{d}	12.51
5	529.90^{b}	566.30^{b}	813.00^{a}	401.60^{c}	475.50^{bc}	381.50^{c}	20.38
6	677.00^{b}	600.20^{bc}	939.43^{a}	860.40^{a}	677.70^{b}	527.50^{c}	21.02

7	830.90^{c}	678.40^{de}	1069.86^{a}	925.00^{b}	719.10^{d}	633.60^{e}	20.14
8	924.00^{b}	748.60^{c}	1201.86^{a}	997.50^{b}	938.90^{b}	697.20^{c}	22.70

abcdeMeans in the same row with different superscripts differ significantly ($p<0.05$)

Productive Performance Indices

Significant strain- and sex-related differences were observed in body weight, feed intake, feed conversion ratio (FCR), and survivability. Noiler chickens achieved the highest body weights and most efficient FCR (2.31 in males), but also recorded the highest mortality (31.67%), with male Noilers experiencing 50% loss. In contrast, Isa Brown showed the lowest body weight (682.60 g in females) and FCR but the highest survivability (98.3%). Aco Black displayed intermediate performance, with moderate growth and low mortality (1.67%).

Sexual dimorphism was pronounced: males consistently outperformed females in growth and feed utilization across strains. However, survivability favored females, particularly in Isa Brown and Aco Black, where female mortality was negligible.

Table 2. Influence of Sexual Dimorphism on Productive Performance

Parameters	Aco M	Aco F	Noiler M	Noiler F	Isa M	Isa F	SEM
Initial Weight (g)	50.10^{ab}	48.55^{b}	52.71^{a}	47.11^{bc}	43.60^{cd}	39.90^{d}	0.77
Final Weight (g)	916.00^{c}	770.46^{d}	1201.86^{a}	1000.11^{b}	941.70^{bc}	682.60^{e}	23.01
TFI (g/bird)	2398.85^{d}	2425.08^{c}	2651.88^{a}	2614.17^{b}	2262.37^{e}	2226.95^{f}	20.79
ADFI (g/bird)	42.84^{d}	43.31^{c}	47.36^{a}	46.68^{b}	40.40^{e}	39.77^{f}	0.37
BWG(g)	865.90^{c}	721.91^{d}	1149.14^{a}	953.00^{b}	898.10^{bc}	642.7^{e}	22.73
ADWG (g)	15.46^{c}	12.89^{d}	20.52^{a}	17.02^{b}	16.03^{bc}	11.48^{e}	0.41
FCR	2.81^{c}	3.41^{d}	2.31^{a}	2.74^{c}	2.54^{bc}	3.47^{d}	0.07
Mortality (%)	3.33	0.00	50.00	13.33	0.00	3.33	-

abcdefMeans in the same row with different superscripts differ significantly ($p<0.05$)

TFI: Total feed intake
ADFI: Average daily feed intake
BWG: Body weight gain
ADWG: Average daily weight gain
SEM: Standard error of mean
FCR: Feed Conversion Ratio

Table 3. Survival Rate (%)

Strain	Male	Female
Aco Black	96	100
Noiler	50	86
Isa Brown	100	96

DISCUSSION

The present findings confirm that sexual dimorphism significantly influences early growth performance in chickens, irrespective of strain. Male superiority in body weight aligns with established physiological mechanisms, including androgen-driven muscle hypertrophy, enhanced protein deposition, and higher anabolic efficiency (Tixier-Boichard et al., 2012; Yakubu et al., 2020).

The pronounced growth performance of Noiler males reflects the strain's genetic orientation toward meat production. Conversely, ISA Brown exhibited comparatively lower growth rates, consistent with its selection history for reproductive performance rather than rapid tissue accretion (Gandarillas et al., 2025).

Interestingly, temporary mid-growth fluctuations observed in Aco Black birds suggest potential genotype–environment interactions. Growth plasticity during intermediate stages may reflect adaptive metabolic adjustments to environmental conditions. However, long-term trends reaffirm male dominance in growth trajectory (Benyi et al., 2015).

These findings support broader evidence that sex accounts for a substantial proportion of phenotypic variance in poultry body weight. From a production standpoint, failure to account for sex-based growth differences may lead to suboptimal feed allocation, inefficient stocking strategies, and inaccurate market-age predictions (Jubril et al., 2023)

This study on the productive performance highlights the dual influence of strain and sex on productive efficiency and survivability in chickens. Noiler excelled in growth traits, confirming its suitability as a meat-type strain, but its high mortality rate raises concerns under tropical management. Similar findings were reported by Alene et al. (2024), where exotic fast-growing strains in Ethiopia outperformed local chickens in weight gain but showed poor survival.

The vulnerability of Noiler to stress is consistent with Melesse et al. (2011), who linked rapid growth to heightened sensitivity to heat and disease challenges. Isa Brown, though least productive in terms of growth, demonstrated strong survivability and low feed intake, reflecting its genetic orientation toward laying efficiency and adaptability (Mottet and Tempio, 2017). Aco Black, balancing moderate growth and high survivability, presents a viable dual-purpose option for smallholder systems.

Sexual dimorphism was evident in growth parameters, with males surpassing females in body weight and feed efficiency, corroborating the role of testosterone in stimulating protein accretion and muscle development (Madilindi et al., 2018; Tagirov and Golovan, 2015). Increased feed intake in males aligns with greater metabolic demand (Maniatis et al., 2013).

However, the higher mortality in males, particularly among Noilers, reflects their metabolic stress and lower resilience, a trend also documented by Yuan et al. (2024) and Gafar et al. (2022). Female resilience, likely supported by estrogen's immunoenhancing effects (Sola-Ojo et al., 2011), explains their stronger survivability across strains.

Overall, these findings reinforce the importance of sex-specific and strain-oriented management. While male Noilers are suitable for rapid meat production, their survival challenges necessitate improved housing, nutrition, and veterinary care. Conversely, Isa Brown and Aco Black females offer resilience for resource-limited settings, supporting sustainable production goals.

CONCLUSIONS AND RECOMMENDATIONS

Sexual dimorphism exerts a significant influence on early growth performance in improved and exotic chicken strains reared under tropical conditions. Males consistently outperformed females in body weight across strains, with the greatest divergence observed in the Noiler genotype. Integrating sex-specific growth considerations into breeding programs and management strategies can enhance productivity and improve decision-making in tropical poultry production systems.

FURTHER STUDY

This research still has limitations, so further research is needed related to the topic of Genotype-Dependent Sexual Dimorphism in Growth Performance, Feed Efficiency, and Survivability of Dual-Purpose and Layer Chickens Under Tropical Production Systems in order to perfect this research and increase insight for readers.

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