Comparative Study Of Performance And Carcass Characteristics Of The Slow-Growing Naked Neck And The Commercial ISA Hubbard 15 Broiler Chickens

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Received:16/10/2023; Accepted:12/02/2024; Published:26/02/2024

Abstract
This comparative analysis investigates the growth performance and carcass characteristics between Naked Neck and Isa Hubbard 15 chickens, focusing on growth metrics such as live weight, whole and eviscerated carcass weights, adipose tissue, viscera, thigh and breast meat, and weights of liver, heart, neck, and gizzard. Isa chickens exhibited a higher live weight (2439.25g) compared to Naked Neck chickens (1534.30g), with corresponding disparities in whole carcass weight (2129.25g vs. 1340.30g) and eviscerated carcass weight (1610.40g vs. 960.95g). Additionally, Isa chickens demonstrated a greater accumulation of adipose tissue (107.00g) in contrast to Naked Neck chickens (37.25g), indicating a pronounced difference in fat deposition. Despite these significant differences in growth metrics and fat storage, organ weights such as the liver (32.25g for Isa vs. 33.00g for Naked Neck) and heart (13.95g for Isa vs. 13.05g for Naked Neck) showed minimal variation across breeds. These findings highlight the genetic and phenotypic distinctions that influence poultry production outcomes, emphasizing the importance of breed selection to meet specific production goals and market demands.

Keywords: naked neck, carcass yield, organs, Isa Hubbard

1. Introduction

The poultry industry is experiencing dynamic growth, driven by population expansion, rising purchasing power. The global population is projected to reach 9.8 billion by 2050 (Bazargani and Deemyad, 2024; KC et al., 2024). With this surge in population, along with socio-economic transformations such as urbanization, shifts in age demographics, and rising levels of affluence, the demand for poultry products is expected to double by 2050 (Kleyn and Ciacciariello, 2021; Scott and Vigo, 2023 Erdaw, 2023).

For much of the world's population, poultry meat plays a crucial role in the global diet, serving as a significant source of high-quality protein, essential amino acids, and various nutrients essential to human health, contributing to a balanced diet and the prevention of nutrition-related diseases (Connolly and Campbell, 2023; Vlaicu et al., 2023). Furthermore, Poultry meat is widely available and affordable, making it an important factor in the reduction of malnutrition and the promotion of food security worldwide (Chisoro et al., 2023; Okoko et al., 2023). This underlines its substantial nutritional importance in the contemporary world (Kheiralipou et al., 2023; Dong et al., 2024).

As a valuable source of low-fat protein, poultry meat is a vital component of global food security (Pius et al., 2021; Barbut and Leishman, 2022). However, its nutritional composition varies across species, muscles, and even analytical methods (Muroya et al., 2020; Baéza et al., 2022; Alessandroni et al., 2024), posing challenges in ensuring consistency and optimal nutritional value (Trithavisup et al., 2024). These variations are further influenced by factors like age, sex, farming practices, and diet (Dai et al., 2024).

Advances in rearing, feeding, slaughtering and packaging technology are improving efficiency and safety, making large farms more viable. While these developments have contributed to the rapid growth of the industry, they have also raised concerns about the sustainability of smallholder farmers and the industry's vulnerability to climate change, particularly temperature increases (Asare-Nuamah et al., 2021; Raihan, 2023; Effiong et al., 2024).

One key strategy is to focus on genetic improvements in thermotolerance, feed conversion efficiency and muscle development (Nawaz et al., 2024). However, optimising production often comes at the expense of meat quality and cost efficiency (Yami et al., 2024; Hajiyev et al., 2024).

Algeria, similar to numerous developing countries, has witnessed considerable advancement in its poultry industry, with the goal of attaining self-sufficiency. Nonetheless, obstacles related to quality control and mortality rates continue to exist. Ongoing research efforts are dedicated to resolving these challenges and investigating the prospects of local chicken breeds, which are appreciated for their flavor, resilience, and cultural importance (Vekić et al., 2023; Zidane et al., 2023; Blondeau et al., 2024; Tefaha et al., 2024).

The Na Na gene, also known as the naked neck gene, is showing great promise in improving the heat tolerance of poultry, which could provide a sustainable solution for hotter climates. climates (Naskar et al., 2015; Cassandro et al., 2023; Rachman et al., 2024).

The objective of this study is to compare carcass yield and weight performances (live weight development, daily weigh gains and some organs weights) of the local Algerian naked neck (NaNa) broilers to the commercial breed Isa Hubbard 15 ISA Isa) chickens.

2. Materials and methods

The animal studies took place at the Avian Research Unit of Mostaganem University. The research protocol incorporated 200 one-day-old chicks, divided into distinct groups: 100 chicks from the commercial strain (ISA Hubbard 15) and 100 chicks from the Naked Neck breed. All the birds were then uniformly distributed across two treatment groups, five replicates of 20 birds each. All groups have been carefully controlled to ensure consistency across all variables other than the direct experimental manipulations. Experimental broilers were reared in a controlled humidity environment with seasonal temperatures ranging from 22°C to 34°C and humidity between 70% and 78%. In this study, birds had free access, starting with a starter diet and progressing to a grower and then to finisher diet. Dietary protocols are formulated according to the 2012 nutritional guidelines of the Office National d'Aliments de Bétails (ONAB). Feed intake was taken daily, while body weights were recorded weekly. Twenty male birds from each treatment group, averaging 1800 g, were chosen for slaughter at various ages. Isa Hubbard 15 birds were slaughtered at 52 days, and Naked Neck birds at 126 days, to meet local market weight and age standards, accounting for the Naked Neck strain's slower growth compared to commercial strains. After slaughtering the animals according to Islamic practices, the live weight, whole carcass, eviscerated carcass, adipose tissue, viscera, thigh, breast, liver, heart, neck, and gizzard were weighed.

2.1. Statistical analysis framework

The experiment utilized a completely randomized design (CRD) for data collection, with the analysis of variance (ANOVA) employed to discern significant differences across treatment groups in terms of carcass measurements. Duncan's Multiple Range Test was subsequently used for detailed comparison between the means of these groups. The analysis also included single degree of freedom contrasts to assess the impact of dietary treatments on carcass characteristics such as weight of different body parts. The significance level for identifying statistically meaningful differences was set at $p < 0.05$, aligning the analysis with rigorous statistical standards for assessing variance in carcass measurements.

3. Results and discussion

3.1. Composition of diet

The poultry diet was strategically tailored from the "Starter" to "Finisher" phases based on ONAB guidelines to suit the chickens' developmental stages (Table 1). The starter diet was rich in maize (60.5%), soya bean meal (29.2%), and wheat bran (6%), supplemented with essential nutrients for early growth. As the chickens aged, the finisher diet increased in maize (68.7%) but reduced in soya bean meal (26.8%), reflecting a dietary shift towards energy efficiency and moderated protein intake suitable for mature birds.

Chemical analysis indicated a slight decrease in Dry Matter from the Starter (94.11%) to the Finisher (92.8%) phase, and a notable adjustment in protein content from 21.2% to 19%. This reduction in protein aligns with the lesser protein needs of older chickens. The most significant dietary change was in the reduction of lipid content from 1.91% in the starter diet to 1.12% in the finisher diet, optimizing the diet for the changing metabolic needs and ensuring a balanced nutrient intake for optimal growth and health.

Table 1. Ingredients and nutritional composition of the experimental diets

Components (%)	Starter	Growth	Finisher
Maize	62	64	68
Soybean Meal	28	26	22
Wheat Bran	5	5	7
Dicalcium Phosphate	2	2	1
Vitamin-Mineral Mix (CMV)	1	1	1
Methionine	1	1	1
Calcium Carbonate	1	1	0

Dry Matter	-	94.11	92.8
Protein	-	21.2	19
Lipids	-	1.91	1.12
Cellulose	-	3.8	3.25
Ash	-	5.36	5.25

3.2. Growth performances

The comparative growth analysis between male Naked Neck and male Isa Hubbard chickens over a 52-day period reveals significant disparities in growth performance (Table 02), underscoring the critical role of breed selection in poultry production strategies. Initially, Isa Hubbard males displayed a higher average weight (44.31g) at day 1 compared to Naked Neck males (31.7g), suggesting inherent genetic advantages in initial size and potentially growth efficiency. As the study progressed, Isa Hubbard males consistently outperformed Naked Neck males in terms of weight gain, culminating in a substantial difference by day 52, with Isa Hubbard males achieving an average weight of 2400.38g versus 1512g for Naked Neck males. This pronounced growth discrepancy highlights the Isa Hubbard breed's superior growth velocity and efficiency, likely attributable to genetic predispositions toward optimized feed conversion ratios and adaptability to the provided dietary and environmental conditions. Consequently, the selection between Naked Neck and Isa Hubbard breeds for meat production purposes should be informed by their respective growth performances, alongside considerations of feed efficiency, environmental suitability, and economic viability. The observed differences in growth trajectories between the breeds underscore the importance of tailored nutritional management and breed-specific care practices to maximize the productivity and sustainability of poultry farming operations.

This result corroborates earlier studies that have shown naked-neck chickens exhibit lower body weights compared to other groups (Desta, 2021). Additionally, research supports the notion that genetics play a role in growth performance, as naked-neck chickens not only have decreased body weights but also display differences in feed conversion ratios. This suggests intricate interplays among genetics, diet, and environmental factors (Hako and Yoniwo, 2023), which are essential for informed breed selection in poultry farming.

Table 2: Effect of strain of the Naked Neck compared to Isa male broiler on live weight development (grams)

Age (days)	Naked Neck	Isa Hubbard
Day 1	31.7 ± 3.42^{b}	44.31 ± 2.41^{a}
Day 10	110.84 ± 23.85^{b}	185 ± 14^{a}
Day 17	258 ± 23^{b}	440 ± 22^{a}
Day 24	510 ± 17^{b}	722 ± 75^{a}
Day 31	818 ± 22^{b}	1140 ± 74^{a}
Day 38	1092 ± 14^{b}	1653 ± 8^{a}
Day 45	1327 ± 29^{b}	2087 ± 41^{a}
Day 52	1512 ± 21^{b}	2400.38 ± 74^{a}

(n=20± standard deviation), Values in rows marked with different letters indicate significant differences between samples.

3.3. Weight gain

The growth disparities observed between male Naked Neck and Isa Hubbard chickens (Figure 01) over a 52-day period have been elucidated in the provided graph. Isa Hubbard males started stronger, with a significant weight gain spike between Days 24 to 31, reaching up to 400 grams, whereas Naked Neck males showed a more moderate increase, peaking at approximately 180 grams in the same timeframe. Notably, by Day 52, Isa Hubbard males exhibited a decline to 400 grams of weight gain, while Naked Neck males demonstrated a lesser decline to around 180 grams. These findings resonate with the metabolic disturbances described by Gonzales et al. (1998), where different strains exhibit variable metabolic rates and growth efficiencies. Our findings also align with Ghayas et al. (2020), Torrey et al. (2021) and Setiasih et al. (2024), who documented the quantitative and qualitative impacts of genetic selection on carcass composition, suggesting that the Naked Neck's sustained growth may be a result of such genetic factors. Moreover, van der Eijk et al. (2024) provide context on breed-specific mortality causes, which could be indirectly related to the growth patterns observed, where rapid early growth in breeds like Isa Hubbard may correlate with different health outcomes compared to breeds like Naked Neck. This complex interplay of genetics, growth rates, and health outcomes underlines the importance of a nuanced approach to poultry management and breed selection.

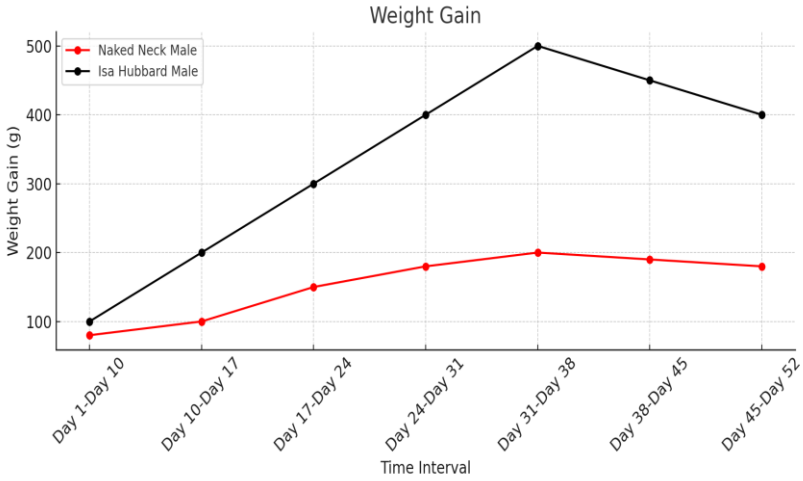

Figure 1: Effects of strain on weight (g) gain evolution in naked neck and Isa Hubbard broiler chicken breeds.

3.4. Carcass characteristics, parts, and viscera yields

The comparative analysis between Naked Neck and Isa Male chickens elucidates pronounced breed-specific phenotypic distinctions, particularly in terms of growth performance and carcass attributes (Table 3). The Isa Male phenotype, characterized by a live weight of 2439.25g, significantly surpasses the Naked Neck males, which exhibit an average live weight of 1534.30g. This disparity not only underscores the Isa Male's superior somatic growth but also highlights a genetic predisposition towards accelerated growth rates and enhanced carcass yield, critical determinants for meat production efficacy.

Moreover, the adiposity levels, evidenced by adipose tissue mass of 107.00g in Isa Males compared to 37.25g in Naked Neck males, delineate the Isa Male's propensity towards higher fat deposition. This trait, as elucidated by Benabdelmoumen et al. (2016) and Bengharbi et al. (2016), may modulate meat quality, affecting sensory attributes and consumer preferences. Conversely, the comparatively reduced adipose tissue in Naked Neck males posits this breed as a viable alternative for market segments prioritizing lean meat.

Further examination of carcass composition reveals Isa Males' pronounced efficiency in nutrient conversion, manifested in superior thigh and breast meat yields. This efficiency not only corroborates their genetic endowment but also portends potential for augmented economic returns within intensive aviculture operations, aligning with the observations of Nathaniel et al. (2023), Biazen et al. (2021) and Kokoszyński et al. (2022) regarding the impact of genetic lineage on growth and carcass phenotypes.

Despite the overt disparities in growth and adiposity, the homogeneity observed in liver, heart, and gizzard masses across both phenotypes suggests a uniform organogenesis process, potentially independent of the divergent somatic growth pathways. This aspect implies that notwithstanding the external phenotypic variance, internal organ development may adhere to a more conserved developmental trajectory (Yousuf, 2006; Stadig et al., 2017).

Table 3: Effect of naked neck and Isa Hubbard 15 strains on carcass, parts, and viscera yields

Weights (g)	**Naked Neck**	**Isa Hubbard**
Live	1534.30 ± 185.78^{b}	2439.25 ± 268.38^{a}
Whole Carcass	1340.30 ± 171.21^{b}	2129.25 ± 216.31^{a}
Eviscerated Carcass	960.95 ± 142.82^{b}	1610.40 ± 94.09^{a}
Adipose Tissue	37.25 ± 7.15^{b}	107.00 ± 22.93^{a}
Viscera	102.95 ± 13.11^{b}	274.75 ± 60.26^{a}
Thigh	91.50 ± 9.90^{b}	274.45 ± 52.51^{a}
Breast Meat	111.85 ± 31.09^{b}	292.35 ± 59.46^{a}
Liver	33.00 ± 2.07^{a}	32.25 ± 6.17^{b}
Heart	13.05 ± 1.53^{b}	13.95 ± 2.01^{a}
Neck	62.70 ± 11.86^{b}	101.10 ± 10.98^{a}
Gizzard	66.60 ± 4.46^{b}	65.00 ± 7.18^{a}

Conclusion

The investigation into breed-specific differences between Naked Neck and Isa chickens has highlighted notable advantages in growth and carcass yield for the Isa breed. The significant disparity in live weights and adipose tissue distribution emphasizes the Isa breed's enhanced growth efficiency and tendency towards fat accumulation. Conversely, Naked Neck chickens, with their leaner physique, present a preferred choice for markets that prioritize lean meat. The consistency in organ weights between the breeds points to a uniform organ development process, highlighting the distinct

impact of genetics on growth performance as opposed to organogenesis. These findings are pivotal for poultry production, suggesting that strategic breed selection, informed by an understanding of phenotypic and genetic characteristics, can improve production efficiency and meet varied market demands. This study makes a significant contribution to poultry science, establishing a foundation for subsequent research aimed at maximizing the economic and nutritional value of poultry meat

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