INFLUENCE OF HAEMOGLOBIN POLYMORPHISM ON GROWTH AND CARCASS CHARACTERISTICS OF MUSCOVY DUCKS (*Cairina moschata*)

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ABSTRACT
The study was carried out to determine the influence of haemoglobin (Hb) type on growth and carcass traits of intensively reared Muscovy ducks. One hundred and twenty (40 per Hb type) ducklings obtained from a 1:6 mating of haemoglobin types AA, AB and BB were raised for 12 weeks and their growth parameters (body weight gain, feed intake and feed conversion ratio) and carcass characteristics (live weight, dressed weight, dressing percentage and major carcass cuts) monitored. Data obtained on growth and carcass characteristics were subjected to one-way Analysis of Variance in a Completely Randomized Design. Results showed that Hb AB had significantly ($p<0.05$) higher final body weight gain (2152.29g), least feed intake, and best feed conversion ratio (3.33) than the homozygous Hb polymorphs. Haemoglobin type of the ducks was found to be significantly ($p<0.05$) influenced the dressing percentage and weights of major carcass cuts. Dressing percentage obtained ranged from 71.14 to 64. 99%, Hb BB being significantly higher than AB but not different from Hb AA. The Hb BB was found to be significantly higher in relative weight of major cuts like breast, drumstick, thighs and shanks of the ducks. At the end of the experiment, it was concluded that the haemoglobin polymorph AB be selectively improved for body weight gains and Hb BB be selected for better carcass traits like dressing percentage ad weight of major carcass cuts.
Keywords: Haemoglobin polymorphism, Muscovy duck, Carcass traits, Growth performance.

INTRODUCTION

Muscovy Ducks (*Cairina moschata*) are the second most widely domesticated poultry species after chicken in Nigeria (NBS, 2012). Duck production is however, at a very rudimentary level, carried out by few individuals under the free-range system of management where they perform fairly well as good foragers and scavengers (Ebegbulem and Ekwere, 2021). Biochemical diversity or polymorphism is the occurrence of varieties attributed to biochemical differences which are under genetic control (Egena and Alao, 2014). This diversity has created an avenue for the genetic improvement of farm animals. Dafur *et al*. (2019) observed that haemoglobins are historically important for their part in the demonstration of relationship between genetic information and protein structure. Haemoglobin types have been associated with some performance traits in animals (Sam, 2012) reported that Hb AA was superior than other genotypes in body conformation traits of goats. Yakubu (2014) equally obtained higher body weight and heart girth in Hb AA compared to Hb AB sheep. Ebegbulem and Ugochukwu (2024) obtained fertility and hatchability rates of 77.92 and 68.98 % vs 75.20 and 55. 58% in the Hb BB and AA ducks respectively. The research was therefore designed to evaluate the influence of haemoglobin polymorphism on the growth performance and carcass characteristics of Muscovy ducks. It is hoped that the information obtained from this study would serve as a guide in breeding and genetic improvement of ducks in Nigeria.

MATERIALS AND METHODS

Study area

The study was carried out at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Nigeria.

Experimental animals and management

Forty-two adult Muscovy ducks whose haemoglobin types had been previously evaluated, comprising 36 females and 6 males were mated at a ratio of 1:6. There were three Hb types which formed the mating groups. Eggs collected from the mating groups were marked and set in artificial incubator at a temperature of 37.5 °C and relative humidity of 60%. One hundred and twenty ducklings (40 per Hb type) obtained from the parent stock were used for the experiment having four replicates of 15 ducklings per Hb polymorph. Ducklings were raised in deep litter house from day old to 12 weeks of age. Ducklings were fed *ad libitum* on a commercial starter diet (Vital Super) containing 23% crude protein and 3000 Kcal/kg ME from 0 – 6 weeks of age and a finisher diet (Vital Finisher) of 19% crude protein

and 2900 Kcal/kg ME from7 – 12 weeks of age. Clean drinking water was provided and other necessary medications.

Growth parameters

Body weight of ducklings was taken collectively and divided by number birds at day old to obtain initial body weight. Subsequently ducklings were weighed bi-weekly and recorded in kilograms using kitchen scale (Hana®). Daily feed intake was calculated by subtracting left over feed from amount offered. Feed conversion ratio was obtained by dividing feed intake by weight gain.

Carcass characteristics

At the end of the experiment, 3 ducks whose weights were close to the average weight for the replicate group, were picked from each replicate of Hb genotype, to ensure a fair representation, starved for 12 hours and slaughtered. Parameters measured were: Live weight (g), Dressed weight (after bleeding and defeathering) and dressing percentage. Carcass cuts were weighed: thighs, breast, drumstick, wings, back, and visceral organs.

Data analysis

Data obtained were subjected to a One-way Analysis of Variance in a Completely Randomized Design. Means with significant differences were separated using Duncans Multiple Range Test. Statistical Analysis was done using SPSS version 2022 package.

RESULTS AND DISCUSSION

Result of the growth performance of Muscovy ducks as influenced by their haemoglobin genotype is presented in Table 1. Haemoglobin genotype significantly ($p<0.05$) affected all growth parameters measured except initial body weight. Ducks of Hb AB were found to be significantly ($p<0.05$) higher than the homozygous Hb genotypes in final body weight, total weight gain and lower feed conversion ratio than the homozygous polymorphs. This observation is suggestive of an overdominance gene action where the combination of the two different gene types affords better performance than either of the homozygous gene pairs. Final body weights of Hb AA and AB ducks recorded in this study are similar to the values reported by Ebegbulem and Ekwere (2021) who reported 2295 and 1785g for male and female Muscovy ducks, respectively; but lower than 3903.75, 3355 and 3518.52 g reported by Hassan *et al*. (2018) in Muscovy, Pekin and Mullard ducks, respectively. The average final body weight (961.86 g) recorded for Hb BB genotype in this study is lower than values obtained by previous researchers (Raji *et al*., 2009; Yakubu *et al.*, 2011). Equally, final body weight values obtained in this research is at variance with the report of Lan and Worowan (2021) who obtained a range of 1637.86 – 1875.71 g in various plumage coloured Muscovy ducks. Differences observed could be attributed to differences in feed and breeds of ducks used for the studies. Nutrition and breed have been implicated to influence growth and body weight changes in farm animals (Ebegbulem *et al*., 2024). Knowledge of the feed conversion ratio (FCR) helps a farmer at make decisions geared towards lowering production cost and maximizing profit. Ducks of Hb AB type were shown to exhibit the best feed conversion ratio of 3.33 as against 9.69 and 10.06 by Hb AA and BB respectively. It is probable that Hb types AA and BB had timid and flighty members which wasted their feed, thereby giving erroneous feed intake values. Result obtained for Hb AB is close to FCR values (2.94 – 3.64) obtained by Hassa *et al*. (2018). Akob *et al*. (2023) observed that FCR was generally higher as ducks matured. The FCR values reported in the present study were however averages of day- old to finishing stage.

Result of the influence of haemoglobin polymorphism of ducks on their carcass characteristics is presented in Table 2. The Hb genotype significantly ($p<0.05$) influenced all carcass traits except the relative weights of the organs. Though Hb AA and BB were significantly higher than Hb BB genotype in live weight and dressed weight, Hb BB ducks however exhibited significantly ($p<0.05$) higher dressing percentage. The live weight range of 1157.40 – 1517.20g recorded in the present study is comparable to the range (1357 1373g) reported by Kokoszynski *et al*. (2019). Dressing percentages obtained in this study are similar to 69.60 – 70.4 % obtained by Kokoszynski *et al*. (2015), but higher than values (63.9 and 63.6 %) reported by Starcevic *et al.* (2021) for Pekin ducks reared intensively and semi-intensively respectively. Muscle tissue is the most valuable component in the carcass of animals. The weight of muscles in the poultry carcass is fundamentally accounted for by the weight of breast muscle and leg muscles (Kokoszynski *et al*., 2015). In this study, the breast muscle accounted for 0.92

– 1.64 % of the live weight of the ducks, whereas Kokoszynski *et al*. (2019) obtained 19.6 and 19.4% in male and female Pekin ducks. The ducks used in the previous study could have been subjected high

selection pressure in favour of breast muscles as against the ducks in the present study whose parents were unimproved. The Hb BB genotype was significantly ($p<0.05$) higher than the other polymorphs in relative weights of drumstick, thighs and shanks. This could be genetically explained that the A gene exhibited an epistatic effect on these traits. The Hb BB ducks equally presented higher proportion of gizzard to live weight than the Hb AA and AB. As reported by Kokoszynski *et al*. (2019), the high proportion of gizzard in the body of birds may be indicative of good muscle growth, which has a positive impact on digester particle size and consequently a better nutrient absorption. This could explain the greater dressing percentage and major carcass cuts weight recorded in this Hb genotype of ducks in this study.

Table 1: Influence of haemoglobin polymorphism on growth performance of Muscovy ducklings

	Haemoglobin types			
Parameters (Average/bird)	**AA**	**AB**	**BB**	**SEM**
Initial body weight (g)	33.00	33.00	33.00	0.00
Final body weight (g)	1314.71^{b}	2185.29^{a}	961.86^{c}	125.18
Total body weight gain (g)	1281.71^{b}	2152.29^{a}	928.86^{c}	125.18
Weekly weight gain (g)	106.81^{b}	179.36^{a}	77.40^{c}	10.43
Daily weight gain (g)	15.26^{b}	25.62^{a}	11.06^{c}	1.49
Total feed intake (g)	12405.00^{a}	7159.43^{c}	9346.29^{b}	485.78
Weekly feed intake (g)	1033.75^{a}	596.62^{c}	778.86^{b}	40.48
Daily feed intake (g)	147.68^{a}	85.23^{c}	111.27^{b}	5.78
Feed conversion ratio	9.686^{b}	3.33^{a}	10.06^{b}	0.78

^{abc} Means on the same row with different superscripts are significantly different ($p<0.05$)
SEM=Standard error of mean

Table 2: Carcass characteristics of Muscovy ducks as influenced by their haemoglobin polymorphs

	Haemoglobin types			
Parameters (Average/bird)	**AA**	**AB**	**BB**	**SEM**
Live weight (g)	1517.20^{a}	1452.20^{a}	1157.40^{b}	77.57
Dressed weight (g)	1020.80^{a}	943.80^{ab}	821.28^{b}	55.14
Dressing %	67.28^{ab}	64.99^{b}	71.14^{a}	1.21
Relative weights of major cuts (% live weight)				
Breast	0.92^{b}	0.93^{b}	1.64^{a}	0.14
Drum stick	0.53^{b}	0.50^{b}	0.75^{a}	0.05
Thigh	0.53^{b}	0.54^{b}	0.75^{a}	0.04
Shanks	0.24^{b}	0.24^{b}	0.38^{a}	0.22
Wings	0.83^{a}	0.88^{a}	0.77^{b}	0.01
Back	1.10	1.08	1.08	0.01
Neck	0.48^{a}	0.47^{a}	0.43^{b}	0.01

^{abc} Means on the same row with different superscripts are significantly different. SEM= Standard Error of Mean

CONCLUSION

The Hb BB was found to be significantly higher in relative weight of major cuts like breast, drumstick, thighs and shanks of the ducks. At the end of the experiment, it was concluded that the haemoglobin polymorph AB be selectively improved for body weight gains and Hb BB be selected for better carcass traits like dressing percentage ad weight of major carcass cuts.

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