Journal of Science and Technology, Vol. 31, No. 3 (2011), pp 42-47 42

http://dx.doi.org/10.4314/just.v31i3.5

RESEARCH PAPER

EFFECTS OF NAKED-NECK AND FRIZZLE GENES ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF CROSSBRED COCKERELS.

J. K. Hagan[1], K. Adomako[2] and O. S. Olympio[2]
[1] *Animal Science Dept., University of Cape Coast;*
[2]*Dept. of Animal Sci., KNUST. Ghana.*
E-mail: kofihagan30@gmail.com

ABSTRACT:
An experiment was carried out to evaluate the performance of crossbred naked-neck and frizzle cockerel genotypes namely: (i) Na/naF/f, (ii) Na/naf/f (iii) na/naF/f and (iv) na/naf/f. These crossbred second generation cockerels were generated from a reciprocal crossing between crossbred heterozygous naked-neck (50% indigenous naked-neck and 50% Lohman Brown) and frizzle (50% indigenous frizzle and 50% Lohman Brown) stocks. One hundred and twenty (120), eight-week old crossbred cockerels (thirty each of the four genotypic groups) were randomly assigned to nine deep litter pens in a Completely Randomized Design for six weeks and their growth and carcass characteristics evaluated. The birds were provided with grower mash ad lib throughout the experimental period. At the end of the trial, 3 cockerels from each of the four genotypic groups were randomly selected and slaughtered and their carcass parameters determined. The results indicated that there was no significant genotype effect on both initial and final body weights. There were also no genotype effects on weight gain, feed intake, mortality and feed conversion ratio. With respect to carcass yield characteristics, the double heterozygous cockerels had significantly (P<0.05) higher values in terms of percent leg yield, breast yield, thigh yield, dressed weight and dressing percentage.

Keywords: *Frizzle, genotype, heterozygous, naked-neck, normal, phenotype*

INTRODUCTION

Cockerel (the egg type male chicks) production is becoming an indispensable component of family poultry development with the rapidly increasing trends of commercial layer farming (Huque *et al*., 2004). Under hot environments, cockerels (birds) do not reach their full genetic potential in terms of growth, body weight or carcass yields because their feathers hinder the dissipation of their excessively produced internal heat. It is against this background that the use of major heat-tolerant genes like naked-neck and frizzle is advocated (Horst and Mathur, 1992).

Incorporating the naked-neck (*Na*) and frizzle (*F*) genes in crossbreeding programmes to improve productivity in cockerels reared under hot, humid environment must be encouraged. (Horst and Mathur, 1992) observed that the naked-neck gene results in 40% less feather coverage overall, with the lower neck appearing almost naked. This considerably reduces the need for dietary nutrition to supply protein for feather production. The frizzle gene has also been reported to reduce the insulating properties of the feather cover (reduce feather weight) and make it easier for the bird to radiate heat from the body more efficiently.

The advantages of these genes in the single heterozygous state are one-half that in the single homozygous state, but producing cockerels homozygous for these genes is not commercially feasible because of poor hatchability (Merat, 1986). Therefore to ensure further reduction in feather coverage and thereby improving the insulating efficiency of the feathers, the two genes can be used in combination so as to elicit positive additive and interactive gene effect. It is against this background that this work was done to evaluate the effects of naked-neck and frizzle genes on the growth performance and carcass yield characteristics of the four crossbred cockerel genotypes.

MATERIALS AND METHODS

Generation of the crossbred cockerels

The four crossbred genotypic groups of cockerels (*Na/naF/f*, *Na/naf/f*, n*a/naF/f* and *na/naf/f*) used in this study were generated from a reciprocal crossing between crossbred heterozygous naked-neck (*50% indigenous naked-neck and 50% Lohman Brown*) and frizzle (*50% indigenous frizzle and 50% Lohman Brown*) stocks. The genotypes were second generation (F_2) offspring generated through *inter se* crossing between the F_1 offspring. Genotypes were identified according to the morphological expression of the naked-neck (Na) and frizzle (F) genes. Birds without any expression of the major genes were classified as normally feathered (na/naf/f).

Experimental Design

In this study, one hundred and twenty (120), eight-week old cockerels, 30 from each of the four genotypic groups (F_2 offspring) were assigned in a completely randomized design (CRD) experiment with genotypes as treatments. There were three replicates with ten (10) cockerels in each replicate group. The cockerels were kept at the Poultry Section of the Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi from May to July, 2007. The average minimum and maximum temperatures during the period of the experiment were 25.5^0C and 33.5^0C respectively, with a relative humidity of 75-80%.

Management Practices Carried Out During Rearing

The birds were kept in open-sided pens constructed with sandcrete blocks. There were twelve pens (10 cockerels in each pen) with each pen measuring 270cm by 165cm. The feed and water were supplied in 2.5kg capacity hanging feeders and 10L capacity plastic fountain drinkers respectively. The plastic drinkers were cleaned daily throughout the experimental period. The floor of the pens was made of concrete and covered with about 15 cm deep wood shaving which was changed every month.

The cockerels were fed commercial grower mash (obtained from Agricare Feeds Limited, Ghana) *ad lib* (Table 1). The amount of feed remaining in the morning was monitored in order to increase or decrease the quantity for the next day. Vitamin and mineral premix were supplemented in the water during the ninth week (after the birds have been grouped in the pens).

Table 1: Nutrient composition of the grower mash fed to the cockerels

Nutrient contents	Grower mash
Metabolizable energy, kcal, kg	2650
Crude protein, %	15
Crude fat, %	4
Lysine, %	0.75
Methionine, %	0.35
Calcium, %	1.0
Cystine, %	0.3
Phosphorus, %	0.45

Source: Agricare Feeds Limited, Ghana

Data Collection and Parameter Estimation

Body Weight Determination

Body weights (g) were taken weekly and the average body weight per genotype recorded. Weight gain was determined as the difference between final body weight and the initial body weight. Growth rate was therefore calculated as the weight gain divided by age (42 days).

Feed Intake and Feed Efficiency

Known amounts of feed (kg) were supplied to each group in each pen at the beginning of each week and the left-over at the end of the week was subtracted from the amount supplied at the beginning, to obtain the weekly feed intake. From the feed intake values obtained, and the relevant weight gains, the feed conversion ratio was estimated to be the ratio of kg feed consumed to kg weight gained.

Carcass Yield Determination

At the end of the 14 weeks, three cockerels from each of the four groups were randomly selected for slaughter and their carcass yield characteristics calculated. Before slaughter the cockerels were deprived of feed but not water for about 10 hours to ensure easy evisceration procedure. The following carcass yield parameters were taken: live weight, carcass (dressed) weight and percentage, blood weight (this is the difference between bird's live weight before slaughter and after it has been bled until blood stopped oozing out); and feather weight. Carcass weight was calculated as the weight of the carcass after the feathers, lower legs, heart, crop, pancreas, lungs, head, digestive and urogenital tracts had been removed. Carcass (dressing) percentage was calculated as the ratio of the carcass weight to the live weight.

Data analysis

The data obtained were subjected to one-way analysis of variance with genotype effect using GenStat (Discovery Edition). When significant differences among means were found, means were separated using least significant difference (lsd) test. The linear model below was used for the data analysis.

$$Yij = \mu + gi + \varepsilon ij$$

Where

Yij = performance of the jth cockerel of the ith genotypic group

μ = overall general mean common to all observations

gi = fixed effect due to ith genotype (i = 1, 2, 3, 4)

εij = random error effects peculiar to each observation

RESULTS AND DISCUSSION

Since cockerel rearing is gaining momentum, efforts must be made to reduce their rearing period so as to shorten the time they take to reach market weight. The crossbred cockerels in this study were kept for a period of up to fourteen weeks. There were no significant ($P>0.05$) genotype effects on both initial and final body weights (Table 2), an observation which disagrees with the findings of Mahrous *et al.* (2008) on impacts of naked-neck and frizzle genes on growth performance and imunocompetence that when the two genes are combined, heat dissipation is much improved as a result of the reduced feather mass and exposed skin cover, leading to a relatively higher heat tolerance thereby resulting in better weight gain under high ambient temperatures. Weight gain was also not significantly affected by genotype. This also disagrees with the findings of Younis and Cahaner (1999) who suggested the incorporation of the naked-neck and frizzle genes in birds that are to be reared under high ambient temperature conditions due to the positive gene-gene interaction between the naked-neck and frizzle genes on body weights and growth rates. They found the heterozygous naked-neck frizzle genotypes to be heavier than their siblings with different genotypes in terms of body weights. The temperature within which the study was carried out was not challenging enough (the average temperature recorded was 29.5^{0}C), hence the potential of the naked-neck and frizzle genes not fully realized.

Table 2: Growth performance of the crossbred cockerel genotypes from week 9 to 14

Parameters	Cockerel Genotypes				
	Na/naF/f	***Na/naf/f***	***F /f na/na***	***na/naf/f***	**±SEM**
Initial Body Weight, kg	0.92	0.92	0.91	0.92	14.29
Final Body Weight, kg	1.42	1.40	1.39	1.39	13.47
Weight Gain, g	474.6	473.6	473.6	473.7	0.98
Average Daily Gain, g	11.9	11.3	11.1	11.0	0.025
Apparent Feed Intake,kg	1.6	1.5	1.6	1.6	10.22
Feed Conversion Ratio	3.2	3.2	3.2	3.2	0.01
Mortality, %	7.6	8.2	7.8	8.9	0.03

In terms of mortality, there was no significant genotype effect. Post-mortem results however, did not show any signs of infection. Most of the deaths were as a result of cockerels pecking themselves thereby causing injury and eventually death. The results obtained for feed intake for the genotypes disagree with those of Mahrous *et al*. (2008) that the double heterozygous genotypes consumed significantly ($P<0.05$) more feed than the other genotypes expressing the heat-tolerant genes either in the single state or those that did not have the genes at all. They found the birds expressing the heat-tolerant genes consuming significantly more feed than their normally feathered counterparts. Galal and Fathi (2001) also concluded that under high ambient temperature (above 30^0C), the heat tolerant genes were associated with higher feed consumption compared with the normally feathered birds.

At elevated ambient temperatures as pertained in the tropics, faster heat dissipation by the naked-neck or frizzle genotypes permits sufficient feed intake resulting in higher growth rate. The results obtained showed no significant genotype effects on feed conversion. The insignificant difference between the single heterozygote and the normally feathered cockerels is in disagreement with the findings of Yalcin *et al*. (1997) and Patra *et al*. (2002) who conducted their work under similar ambient temperature conditions and concluded that under high temperatures, birds carrying the naked-neck gene had better feed conversion ratio than their normally feathered counterparts.

According to Merat (1986) the naked-neck and frizzle genes are most useful at high ambient temperatures of 30^0C and above where most of the advantages like higher growth rate, higher feed efficiency, slaughter yield and meat yield became pronounced. Horst (1989) also reported that the *Na* and *F* genes interacted well to improve the performance of stocks reared under heat stress. The crossbred cockerel genotypes in this study were, however, found to be better converters of feed (3.17-3.24) compared to developed breeds like Sonali (4.37) and Fayoumi (4.61).

The observation that the double heterozygous cockerels had significantly ($P<0.05$) lower feather weights than their counterparts (Table 3) was because the heat-tolerant genes are responsible for the reduction in feather weight thereby, facilitating better heat dissipation. Again the feather coverage of the naked-neck gene was further reduced by the inclusion of the frizzle gene.

The presence of *Na* and *F* alleles in both single and double heterozygous state significantly increased relative blood weight compared to their recessive counterparts (Table 3). Higher blood volume associated with birds carrying naked neck and frizzle genes may be due to higher haemoglobin concentration and packed cell volume associated with these genes (Luger *et al.*, 1998 and Raju *et al.*, 2004) as a consequence of greater oxygen demand. Also, the higher blood proportion associated with these genes may increase blood supply to organs and muscles.

Table 3: Mean Carcass Parameters of the Crossbred Cockerel Genotypes

Parameters	Cockerel Genotypes				
	Na/naF/f	*Na/naf/f*	*F /f na/na*	*na/naf/f*	±SEM
Blood, %	19.4[a]	17.3[a]	17.5[a]	12.7[b]	0.60
Breast, %	18.3[a]	14.1[b]	13.7[b]	14.9[b]	0.83
Leg, %	6.20[a]	3.30[b]	3.90[b]	3.50[b]	0.41
Wing, %	10.7	10.1	10.3	9.80	0.28
Thigh, %	28.8[a]	26.3[b]	26.5[b]	25.0[b]	0.25
Feather, %	10.3[b]	14.7[a]	14.6[b]	14.2[a]	0.40
Dressed wt, kg	1.1[a]	0.9[b]	0.9[b]	0.9[b]	5.95
Dressing, %	74.8[a]	70.5[b]	71.1[b]	71.5[b]	0.38
Live weight, kg	1.5[a]	1.4[b]	1.4[b]	1.4[b]	7.08

[ab]*Means in a row with different letters are significantly different at the 5% level.*

The insignificant ($P<0.05$) difference between the single heterozygous and the normally feathered cockerels in terms of carcass yield was in contrast with findings of Merat (1986) who found gains of 1.5-2.0 percent to 2.5-3.0 percent for *Na/Na* and *Na/na* as against their normally feathered *(na/na)* siblings. The higher percent breast, leg and thigh observed in the crossbred double heterozygous cockerels than their counterparts that expressed the genes in the single segregation state or their normally feathered counterparts confirm the findings of Younis and Cahaner (1999) that combining the naked-neck genes with another heat-tolerant gene like frizzle resulted in a very favourable additive effect on both productive and carcass yield characteristics. This was explained by Merat (1986) that less feather or reduced feather production leaves more protein for synthesis of other tissues (muscle and meat). Also reduced plumage ensures lower carcass fat content as a result of higher proportion of lipids being used for thermoregulation.

CONCLUSIONS

The findings of this research show that the presence of the naked-neck gene (*Na*) in combination with the frizzle gene (*F*) did not affect body weight and other growth characteristics; however there is a positive additive effect in terms of carcass yield. This is an indication that the potential of the naked-neck and frizzle genes are fully realized under hot and humid environments (above 30^0C).

REFERENCES

Galal, A. and Fathi, M. M. (2001). Improving carcass yield of chicken by introducing naked neck and frizzle genes under hot prevailing conditions. *Egypt Poultry Science, 21: 339-362*

Horst, P. (1989). Native fowl as a reservoir for genomes and major genes with direct and indirect effects on the adaptability and their potential for tropically oriented breeding plans. Archiv fur Geflugel Kunde, *53:93—101.*

Horst, P. and Mathur, P. K. (1992). Improving the productivity of layers in the tropics through additive and non-additive effects of major genes. *Proceedings, 19th World's Poultry Congress*, Amsterdam, the Netherlands, 2: 67.

Huque, Q. M. E., Mostari, M. P., Faruque, S. and Islam, M. R. (2004). Cockerel production: Strategy of family poultry development. *Proceedings of 3rd International Poultry Show and Seminar*, Worlds Poultry Science Association-Bangladesh branch, Dhaka, Bangladesh, Pages 1-7.

Luger, Y. D., Cahaner, A., Dotan, M., Rusal, M. and Hurwitz, S. (1998). Thermoregulation in naked neck chickens subjected to different ambient temperatures. *British-Poultry Science, 39:133-138.*

Mahrous, M., Galal, A., Fathi, M. M. and Zein, El-Dein, A. (2008). Impact of Naked Neck (Na) and Frizzle (F) Genes on Growth Performance and Immuno competence in Chickens. *International Journal of Poultry Science. 7 (1): 45-54.*

Merat, P. (1986). Potential usefulness of the Na (Naked Neck) gene in poultry production. *World Poultry Science Journal. 42:124 - 142.*

Patra, B. N., Bais, R. K. S., Prasad, R. B. and Singh, B. P. (2002). Performance of naked neck (Na) versus normally feathered colour broilers for growth, carcass traits and blood biochemical parameters in tropical climate, *Asian-Australasian Journal of Animal Sciences. 15:1776-1783.*

Raju, M. V. L. N., Shyam Sunderm, G., Chawak, M. M., Rama Rao, S. V. and Sadgopan, V. R. (2004). Response of naked neck (Nana) and normal (nana) broiler chickens to dietary energy levels in a subtropical climate. *British Poultry Science. 45:186-193.*

Yalcin, S., Testik, A., Ozkan, S., Settar, P., Celen, F. and Cahaner, A. (1997). Performance of naked neck and normal broilers in hot, warm, and temperate climates. *Poultry Science. 76 (7):930-937.*

Younis, R. and Cahaner, A. (1999). The effects of the naked neck (Na) and frizzle (F) genes on growth and meat yield of broilers and their interactions with ambient temperatures and potential growth rate. *Poultry Science. 78 (10):1347-1352.*