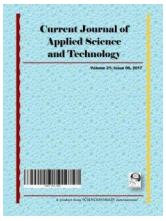

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Influence of Strain on Production and Some Other Traits of Indigenous Guinea Fowls (*Numida meleagris*) in Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Author AD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SYA and JKKA managed the analyses of the study. Author CGK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted to investigate the influence of strain on production traits, egg fertility, hatchability, dressing percentage, survival and docility of indigenous Guinea fowls in Ghana. A total of 700 keets (F_1 generation) hatched from four strains of indigenous Guinea fowls were randomly picked from a large population at a day old and reared for 32 weeks. At 8th weeks, after mating, 600 keets (300 males and 300 females) were used for the study. The birds were separated into four strains (Pearl, Lavender, White and Black). Based on their numbers, the Pearls were replicated ten times, both Lavender and White five times each and the Black four times in a completely randomise design. There were 25 birds per replicate. In total there were 250 Pearls (125 males and 125 females), 125 Lavenders (62 males and 63 females), 125 Whites (63 males and 62 females) and 100 Blacks (50 males and 50 females). Data were analysed using the General Linear Model (GLM) procedure of SAS. The results showed that at 8th week the Pearl and the White had significantly

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($p<0.05$) higher body weight and daily weight gain. However, at 16th, 24th and 32th week body weight was significantly ($p<0.05$) highest in Pearl strain. Age at first egg was significantly ($p<0.05$) earlier in the Lavender than the Pearl, White and Black but delayed in the Pearl. Again, the Pearls were significantly ($p<0.05$) superior in egg weight, percentage hen day egg production and fertility. No significant differences were observed in post-brooding daily weight gain, feed intake, FCR, docility by heterophil/lymphocyte ratio and post-brooding survival of the strains. Hatchability was significantly ($p<0.05$) higher in the Black. The White strain had significantly ($p<0.05$) better dressing percentage. Pre-brooding survival was significantly ($p<0.05$) higher in the Pearls and lower in the Black. Lavender was docile ($p<0.05$) as compared to the other breeds. It was concluded that given the same treatment, the Pearl strain had the potential to perform fairly well in most of the traits studied, hence are recommended for higher production while the Black strain should be used for hatchability and the Lavender for docility improvement.

Keywords: Survival; body weight; reproduction; docility; traits.

1. INTRODUCTION

Guinea fowls are kept primarily for both meat and egg. The birds are an essential part of rural communities and are produced for varied purposes, including sacrifices, dowry and gifts [1]. They are suppliers of good quality but cheaper sources of animal protein to the rural people of Ghana. They are relatively ahead of the village chickens regarding production cost, premium quality meat, ability to scavenge for insects and grains, heat tolerance, self-protection against predators and resistance to common poultry parasites and diseases [2]. Due to its delicacy and high nutritional value, many researchers have shown interest to study the performance of guinea fowls under different climatic conditions in different parts of the world under both traditional and intensive management conditions. Unfortunately, the demand for guinea fowl in Ghana is very high, but supply continues to decrease on a daily basis. So far, the production or supply of guinea fowl in Ghana is over 60%, which is below the demand from consumers [3]. The major constraints of Guinea fowl production in Ghana are unimproved breeding stock, seasonal change effects, high keets mortality rate, malnutrition, poor production and reproductive performance of the strains [4]. Different strains within breeds of animals have been reported to have great significant variation in performance, especially, on growth [5]. The local strains of Guinea fowls in Ghana are not an exemption. Annor et al. [6] commented that the demand for improved Guinea fowl keets is high, but there is no known source of supply in the country. The far lower growth performance of local Guinea fowls compared to the growth performance displayed by the improved birds in Europe is attributed to inadequate studies to improve local strains genetically [7]. Hence, the present investigation was carried out to study the influence of strain on production traits, egg fertility and hatchability, dressing percentage, survival and docility of indigenous Guinea fowls in Ghana to help breeders, commercial farmers and smallholder farmers to select strains with higher genetic merit for breeding to archive higher productivity and economic returns.

2. MATERIALS AND METHODS

2.1 Experimental Location

The study was conducted at the Poultry Section of the Animal farm of the Department of Animal Science Education, University of Education, Winneba, Mampong-Ashanti campus, Ghana, from 2016 to 2017. Mampong-Ashanti lies in the transitional zone between the Guinea savanna zone of the north and the tropical rainforest of the south of Ghana along the Kumasi-Ejura road. Mampong lies on latitude 07˚ 03' N and longitude 01˚ 24'W on an altitude of 289.7 m above sea level. The rainfall pattern is bimodal, with the major rainfall season occurring from April to July with 1000mm of rainfall while the minor season occurs from August to November with 350 mm of rainfall. The average daily temperature is between 25°C and 30°C and the average relative humidity of the area is 70% [8].

2.2 Experimental Birds and Design

A total of 700 keets (F_1 generation) hatched from four strains of indigenous Guinea fowls were randomly picked from a large population at a day old and reared for 32 weeks. The chicks were taken to a brooding room immediately for brooding. The Guinea fowl keets were kept at a temperature of 35°C with the adequate drinker and feeder spaces. The light was provided for 24 hours during brooding to avoid pilling and death. The temperature was reduced gradually at the

rate of 35°C on weekly basis as brooding progressed. The chick phase lasted for 4 weeks (28 days).

At 8th week, after mating, 600 (300 males and 300 females) individuals were obtained and used for the study. The birds were separated into four strains (Pearl, Lavender, White and Black). Based on the number per strain, the Pearls were replicated ten times, both Lavender and White five times and the Black four times in a completely randomise design. There were 25 birds per replicate. In total there were 250 Pearls (125 males and 125 females), 125 Lavenders (62 males and 63 females), 125 Whites (63 males and 62 females) and 100 Blacks (50 males and 50 females).

2.3 Housing, Feeding and Medication

At the end of the chick phase, they were randomly distributed and raised on a slated wooden floor pen partitioned into 20 compartments with each measuring 3m x 4m and housing 30 keets. The birds were reared under similar managerial conditions. They were fed a similar diet containing 22% of crude protein (cp) and 2950 kcal/kg metabolisable energy for the 1-8th week. Between 8-20th week the diet contained 20% of crude protein (cp) and 2800 kcal/kg metabolisable energy (ME) and during laying 17.5% of crude protein (cp) and 2780 kcal/kg metabolisable energy. Feed and water were given *ad libitum*. The experimental birds were vaccinated against coccidiosis at 10, 23, 30, 44 and 60 days, newcastle at 16, 49 and 112 days and fowl pox at 84 days. Livesol was used to control worms at three months interval.

2.4 Parameters Measured

Parameters measured included: growth performance, egg production, egg fertility and hatchability, dressing percentage, survival and docility.

Body weight (g/bird) was taken at a day-old and every two months with the use of electronic balance. Body weight gain (g/bird) was calculated by subtracting the initial weight from the final weight.

The age at which birds within each variety group laid the first egg was considered the age at first egg. Eggs were sampled and weighed. Hen-day egg production was calculated as the percentage of the number of eggs laid to the number of hen days (Number of laying days x Number of birds alive).

Feed intake was calculated as the difference between the initial feed offered to birds and the feed left over. Feed conversion ratio (FCR) was computed as the feed intake divided by the total weight gain.

Arithmetically, $\text{FCR} = \frac{\text{Total feed intake (g)}}{\text{Total weight gain (g)}}$

The percentage egg fertility was calculated by expressing the total number of fertile eggs as a percentage of the total number of eggs set. The percentage hatchability was also determined by expressing the total number of eggs hatched as a percentage of the total number of fertile eggs.

At the end of 32 weeks (8 months), ten males and ten females from the Pearl, five males and five females from the Lavender, five males and five females from the White and four males and four females from the Black groups were randomly selected for slaughter and their dressing percentage calculated as the ratio of the carcass weight to the live weight.

Survival was defined as a trait of offspring and was grouped into two, Pre-brooding survival: survival from a day old to 8th weeks = survival100%; died=0. Post-brooding survival from 8 to 32th week = survival100%; died=0 [9].

Docility was measured in two ways. The first method was the use of cage score on a scale of 1 to 4 [10] which was measured as follows: 1. Non-aggressive or docile (walks slowly, can be approached closely by humans, not excited by human presence). 2. Slightly Aggressive (runs along boundaries, will stand in the corner if humans stay away. 3. Moderately Aggressive - (runs along boundaries, look for exits and will run eagerly if humans move closer). 4. Very Aggressive (excited in human presence, runs into boundaries, hitting gates and walls of the cage, avoids humans etc). Measurement of Heterophil/lymphocyte ratio [11] was the second method. A blood sample was drawn from each of the birds for heterophil/lymphocyte test at Mampong Government Hospital laboratory.

2.5 Data Analysis

The data collected were analysed using the General Linear Model (GLM) procedure of Statistical Analysis System (SAS for Windows,

version 7). The means were separated by using the probability of difference (PDIFF) procedure of SAS [12].

The model considered was: Y_{ij}= μ + B_i + e_{ij} where: Y_{ij} = performance of the i^{th} bird at a particular age: μ=overall mean common to all observations: B_i= fixed effect of i^{th} strain (i=1, 2, 3, 4): e_{ij}=error term that cannot be explained.

3. RESULTS AND DISCUSSION

3.1 Effect of Guinea Fowl Strains on Production Traits

Body weights at 8, 16, 24 and 32th weeks were significantly different ($p<0.05$) among the strains where the Pearl and the White strains had the highest weight at 8th week, but the Lavender and the Black did not differ significantly from each other at this age (Table 1). 16th and 24th weeks showed a similar trend where the Pearls were significantly ($p<0.05$) superior to their counterparts regarding body weight but the other three strains did not differ significantly from one another. Though at 32th week the Pearls were significantly ($p<0.05$) heavier than their contemporaries, the White and the Lavender at this age were heavier than the Black, but the two did not differ significantly ($p<0.05$) from each other. This means that body weight and body weight gain of indigenous Guinea fowls increased rapidly among the Pearls as compared to the Lavender, White and the Black [13]. This suggests that the Pearl adequately utilised the feed they consumed and converted the nutrients into body weight development. The lower body weight observed among the Lavender, White and the Black in the present study might be due to the genetically slower growth rate characterised with these birds. The mean body weights of the four strains of local Guinea fowl obtained in this study, concerning the increase in body weight, is in agreement with the findings of Mandal et al. [14] who reported that the Pearl and the White strains had significantly higher body weights as compared to the Lavender and the Black strains.

Regarding the Pre brooding daily weight gain, the Pearls were significantly ($p<0.05$) superior to the Lavender and the Black but not the White and the gains between the Lavender, White and the Black were not significantly ($p>0.05$) different (Table 1). The significant differences in body weight gain may be attributed to the variation in genetic potentials of the keets from the different strains [15]. The significant difference in body weight gain which occurred only in 8th week (pre brooding daily weight gain) in this study is in agreement with the findings of Singh et al. [5] who reported significant ($p<0.05$) difference in body weight gain of keets within the pre-brooding stage.

The Pearls produced eggs which were significantly ($p<0.05$) heavier than that of the Lavender, White and the Black followed by the eggs from the Lavender but the egg weight of the White and the Black did not differ significantly. Again, the Pearls were outstanding ($p<0.05$) in terms of percent hen day egg production followed by the Lavender and the White and the Black having the least. Differences in egg weight in the present study could be attributed to variation in body weight of the strains studied because egg size is usually related to the body size of the laying hens [16]. The significantly heavier mean egg weight produced by the Pearl strain compared to the Lavender White and the Black is in line with the findings of Obike et al. [16].

3.2 Effect of Strain on Reproductive Performance

Results from the study (Table 2) showed that age at first egg laying was significantly ($p<0.05$) earlier in the Lavender as compared with the Pearl, White and the Black strains. The significant differences in age at first egg observed in this study is in line with the findings of Bernacki et al. [17] whose results showed that the Lavender strain lay eggs earlier than the Pearl, White and the Black strains. Fertility was higher ($p<0.05$) among the Pearl strain and lower among the White strain. The Lavender and the Black strain recorded intermediate values. The significant difference observed regarding age at first egg and fertility might be due to genetic variations between the four strains of Guinea fowls considered in this study. This means that in terms of age at first egg and fertility the Pearls are superior to their counterparts (the Lavender, the White and the Black strains). This is in accordance with the observation made by Konlan et al. [18] who reported that the Pearls lay earlier with higher fertility as compared to their counterparts.

Percent hatchability was significantly ($p<0.05$) higher in the Black strain compared to the other three strains (Table 1). This was also significantly higher in the Pearl strain than in the Lavender and the White, however, similar percentages

were observed for both the Lavender and the White strains. The differences in hatchability of the current study could be attributed to the strain effects. This observation agrees with the finding of Fajemilehin et al. [19] who observed higher hatchability in the Black strain compared to the other three strains.

3.3 Influence of Strain on Dressing Percentage

Concerning dressing percentage, the Whites were outstanding ($p<0.05$) with the highest percentage regarding the values of the other strains. This shows that the Whites are superior as compared to the other three genotypes. The next to the Whites were the Pearl and the Black which had similar scores better than the scores of the Lavender group. The outstanding performance of the Whites could be attributed to the strain effect. Kerketta and Mishra [20] associated the variation in dressing percentages observed in different studies with the birds'strain, diets, management system and carcass dressing methods. Significant differences was observed among the strains in this experiment justifies that there was an effect of variety on dressing percentage [14].

3.4 Influence of Strain on Docility Traits

Cage score docility measurement was significantly ($p<0.05$) better in the Lavender compared to the other three genotypes which had similar values. The average docility score of 3.03, obtained in this study is above the average score of 2.6 on a scale of 1 to 4 in the genetics of grasscutter [20]. The birds in this study were in-between score 3 and 4 (i.e. moderately aggressive and very aggressive). The observed difference in docility score is an indication that the White, Pearl and the black are moderately aggressive. However, the Lavender was observed to be quite docile. The outstanding

Table 1. Effect of Guinea fowl strains on production traits

Body weight	Pearl	Lavender	White	Black	SEM	*P*-value
Day old, g/bird	24.5	24.8	25.1	25.7	0.35	0.09
8 Weeks, g/bird	430^{a}	398^{b}	416^{a}	357^{b}	15.9	0.01
16 Weeks, g/bird	768^{a}	695^{b}	714^{b}	694^{b}	14.5	0.01
24 Weeks, g/bird	1520^{a}	1440^{b}	1470^{b}	1430^{b}	14.4	0.01
32 Weeks, g/bird	1730^{a}	1640^{bc}	1680^{b}	1590^{c}	18.4	0.01
Pre brooding daily weight gain						
0-8 Weeks, g/bird	6.76^{a}	6.22^{b}	6.52^{ab}	5.53^{b}	0.27	0.01
Post brooding daily weight gain						
8-16 Weeks, g/bird	6.82	6.59	6.54	6.79	0.21	0.54
16-24 Weeks, g/bird	12.7	12.6	12.6	12.3	0.21	0.7
24-32 Weeks, g/bird	3.59	3.18	3.52	2.84	0.25	0.1
Egg production						
Egg weight (g)	41.31^{a}	40.13^{b}	38.29^{c}	38.76^{c}	0.14	0.01
Hen day egg production (%)	66.66^{a}	56.13^{b}	57.50^{b}	51.19^{c}	0.74	0.01
Feed intake						
24 Weeks, g/bird	54.2	52.1	53.7	53.4	0.95	0.24
Feed conversion ratio						
24 Weeks g/bird	4.43	4.26	4.33	4.44	0.11	0.5

^{abc} *Means bearing different superscripts in the same row are different at p<0.0, SEM= standard error of means, p = probability of main effects*

Table 2. Effect of strain on reproductive performance

Reproductive performance	Pearl	Lavender	White	Black	SEM	*p-value*
Age at first egg, days	212^{b}	192^{a}	208^{b}	211^{b}	2.25	0.01
Fertility, %	56.0^{a}	53.8^{b}	30.9^{d}	48.0^{c}	1.08	0.01
Hatchability, %	29.1^{b}	24.0^{c}	21.9^{c}	37.5^{a}	1.92	0.01

^{abcd} *Means bearing different superscripts in the same row are different at p<0.05, SEM= standard error of means, p = probability of main effects*

Table 3. Effects of strains on carcass characteristic, docility and survival of the four strains of local Guinea fowls

Parameters	Pearl	Lavender	White	Black	SEM	*P*-value
Carcass						
Dressing (%)	62.81[b]	57.66[c]	68.90[a]	62.86[b]	1.67	0.02
Docility						
Cage score	3.11[a]	2.66[b]	3.24[a]	3.11[a]	0.08	0.01
Heterophil-lymphocyte ratio	0.04	0.04	0.03	0.03	0.02	0.24
Survival						
Pre-brooding survival (%)	86.8[a]	75.8[b]	70.0[b]	50.6[c]	3.64	0.01
Post-brooding survival (%)	94.2	97.3	90.7	100	2.71	0.19

[abcd] *Means bearing different superscripts in the same row are different at p<0.05.*
SEM= standard error of means

performance of the Lavender over the scores of the Pearl, White and the Black strains concerning docility agrees with the findings of Mandal et al. [14] who indicated that the Lavender is moderately aggressive as compared to the other three genotypes. However, this results disagree with the findings of Amberg et al. [21] for pearl and white, that theyare quite docile than the lavender Guinea fowls.

3.5 Influence of Strain on Pre-brooding Survival

Pre-brooding survival was significantly ($p<0.05$) higher in the Pearl strain and lower in the Black strain. The higher pre- brooding survival of the Pearl strain in the present study might be due to the insusceptibility nature of the Pearl strain in the juvenile stage. Guinea fowl keets are more susceptible to most parasites and diseases which affect the production of other poultry species such as chickens and other species [14].

4. CONCLUSION

From these result, it is concluded that that the Pearl Guinea fowls have the potential of providing very good body weight, body weight gain, age at first lay, egg weight, hen day egg production, fertility rate and survival relative to the other strains. However, Blacks are superior regarding hatchability. The Lavender is most docile and easy to manage as compared to the other breeds. Based on this study, it is recommended to the breeders, commercial farmers and smallholder farmers that, to achieve higher genetic gain the Pearl variety should be used for production. A crossbreeding among the strains may also be recommended to take advantage of heterosis and complementarity.

ETHICAL APPROVAL

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee".

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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