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Influence of strain on some production traits, egg characteristics, fertility and hatchability of guinea fowl (*Numida meleagris*) in Togo

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ABSTRACT

The study was conducted to determine the influence of guinea fowl (*Numida meleagris*) strains on some production traits, egg characteristics and reproduction traits. A total of 192 guinea fowls of 38 weeks of age, from the four feather colors (Pearl, Isabelle, Lavender and Black) were alloted into 4 crossing groups with three replicates of 16 birds each including 4 males and 12 females. Data were collected during 12 weeks on the following parameters: feed intake (Fi), hen egg production (HEP), egg weight (EW), albumen weight (AW), yolk weight (YW), shell weight (SW), egg length (EL), egg width (EWd), shell thickness (STk), egg fertility and hatchability. The data collected were analysed using ANOVA test of R 4.0.1 software while the difference among the strains were estimated with Tukey's test. The results indicated that the Pearl (40.27g) and the Black (41.13g) had recorded the highest egg weight and the higher egg length was attributed to the Pearl, the Black and the Lavender strain with the value of 48.93 mm, 49.91 mm and 49.05 mm respectively. Isabelle strain recorded the best HEP (63.49 %). For the reproduction traits the Pearl and the Isabelle strains had obtained the highiest fertility with 82.77 % and 73.75 % respectively. The others parameters were not significantly influenced by the strain. In conclusion the Pearl and the Isabelle would be the best strains to improve guinea fowls reproductive traits in Togo.

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1. INTRODUCTION

The guinea fowl (*Numida meleagris*), descended from the wild species of Africa and this naming originates from Guinea which is part of the west coast of Africa (Nwagu & Alawa, 1995). This bird is most expanded in the northern region (Savana) of Togo and provides significant animal protein and an important income for rural poeple. The guinea fowl rearing in Togo is mainly praticed in semi-intensive systems in which the birds have a poultry house for the night while they are free with access to the branyard grazing area during the day (Soara et *al.*, 2020). Thus, these unselected populations of guinea fowl are free to mate randomly and constitute an immense treasure of variable genotypes (Yeasmin et *al.*, 2003). The systematic of this bird is based on several phenotypic characteristics including helmet shape, color and shape of wattles, plumage

according to Embury (2001). Based on the helmet shape, Van Niekerk et *al.*, (2022) described 9 varieties while three domestic varieties of guinea fowl (Pearl, Lavender and White) are recognised across the world in relation to feathers color. The Pearl gray helmeted guinea fowl is the most widespread variety in Africa. In terms of phenotypic and genetic diversity of guinea fowl, several strains originated from these three main strains originally domesticated. Chrysostome (1995) identified several guinea fowl varieties such as Gray, Lilac, Isabelle, Chamoise, Albino, Multicolored and Black in Benin. Morever, Bouda (2017) identified 12 strains based on feathers color including those already mentioned by Chrysostome. However, more studies has been carried out around the world, particularly in Africa to evaluate the different guinea fowl varieties and to improve the sustainable exploitation of these genetic resources. So, Fajemilehin (2010) in Nigeria, characterized guinea fowl using morphostructural index for the purpose to improve genetic data for guinea fowl. In Ghana Duodu et *al.*, (2018), found that the Pearl guinea fowls have the potential of providing very good body weight, egg weight, hen day egg production, fertility rate and survival than the Black, the White and the Lavander strains. Obike et *al.*, (2011) compared egg production performance and egg quality traits of Pearl and Black guinea fowl in a humid rainforest zone of Nigeria and concluded that the Pearl had a better egg production than the Black.

Knowledge of the genetic characteristics of guinea fowl is necessary to have a database on the genetic diversity of guinea fowl strains in Africa, particularly in Togo, in order to allow its better exploitation in animal production by small farmers and to conserve natural resources in conservancies close to communal areas. Thus, the purpose of this study was to avaluate egg production and reproductive performance of differents strains of guinea fowl reared in Togo.

2. METHOD

2.1 Experimental area

The study was carried out at AYODELE farm, with geographical coordinates of 6 ° 22´15.65´´N and 0 ° 58´07.35´´ E, located in Badja (Ave Prefecture), a village located at 47 km northwest of Lome (Togo).

2.2 Experimental disign

In the study, four strains (Pearl, Isabelle, Lavender and black) of guinea fowl, obtained from the experimental flock of the Regional Center of Excellence on Avian Sciences of the University of Lome, Togo. A total of 192 birds of 38 weeks of age including 48 birds belonging to each strain. The choice of these birds was made in way to have a statistically similar weight for all strains at the start. The population of each strain was replicated into 3 groups of 16 birds per group including 4 males and 12 femeles in a completely randomise design. Birds were reared on deep litter pens during 12 weeks after an adaptation period of 2 weeks and were submitted to the same prophylactic treatment. Feed provided during the experimental period was formulated to reply the nutritional needs of guinea fowl breeders (table 1). Water and feed were provided *ad libitum* throughout the study period. Feed intake, body weight, egg quality, fertility and hatchability were recorded.

Table 1. Diets composition and macronutrient levels

Ingredients	Laying diet (%)
Maize	56
Wheat bran	11
Fish meal	7
Soybeans	14
Shell	6
Dresh	4
Layer Concentrated	2
TOTAL	100
Calculated components	
ME[1] (kcal/kg)	2803.30
Crude protein	17.02
Calcium	2.34
Phosphorus	0.67
Methionine	0.36
Lysine	0.88
Methionine + Cysteine	0.59

[1]*Metabolisable energy (ME)*

2.3 Feed intake and body weight assessing

Feed were daily weight before given in order to determine the birds feed intake. The birds were weighted at the beginning and the end of the study to determine the average body weight of the parental strains crossed.

2.4 Egg characteristics assessing

Eggs were collected daily for all the study period. However, egg quality traits of the four strains were measured on a weekly basis. The external traits measured include, individual Egg Weight (EW), Shell Weight (SW), Egg Length (EL), Egg Width (EWd) and Shell Thickness (STk). Egg length, egg width and shell thickness were mesured using vernier caliper. For the internal egg quality traits, a total of 30 eggs from each strain were randomly sampled and used for this purpose. To measure the internal traits, each sampled egg was first broken out gently in a petri and weighed with electronic scale. The internal egg quality traits measured were Yolk Weight (YW), Albumen Weight (AW).

2.5 Fertility and hatchability assessing

The eggs collected from each strain group during the production period were tagged and stored at 16 - 18°C and 60 - 70 % relative humidity. After 7 days of storage, eggs was incubated artificially in the same incubator using an average temperature of 37.2 - 37.8 ° C and 60 – 70 % relative humidity. Eggs were candled on the nineth and twenty fourth days of the incubation period to rule out respectively infertile eggs and eggs with dead embryos. At hatching, the keets were enumerate by strain to evaluate the hatching rate.

2.6 Parameters Measured

Parameters measured included: Feed intake (Fi), egg production (HEP), egg fertility and hatchability. The various parameters studied were calculated according to the formulas:

$$Fi = \frac{Feed\ provided - Feed\ refusals}{Number\ of\ guinea\ fowl} \quad (1)$$

$$HEP = \frac{Number\ of\ eggs\ laid}{Total\ number\ of\ hen} \times 100 \quad (2)$$

$$\%\ Fertility = \frac{Total\ number\ of\ fertile\ egg}{Total\ number\ of\ egg\ set} \times 100 \quad (3)$$

$$\%\ Hatchability = \frac{Total\ number\ of\ guinea\ keets\ hatched}{Total\ number\ of\ fertile\ egg} \times 100 \quad (4)$$

2.7 Data Analysis

Data obtained were expressed as mean ± standard error (SE) of mean and processed with the statistical software package R 4.0.1. ANOVA model was used to analyse the effects of strain on body weight, feed intake, egg characteristic, fertility and hatchability. If the p-value was statistically significant ($p<0.05$), further comparisons among groups were made according to Turkey's test.

3. RESULTS AND DISCUSSION

3.1 Body weight, hen egg production and feed intake of four guinea fowl strains

The body weight, hen egg production and feed intake of Pearl, Isabelle, Lanvender and Black guinea fowl are presented in table 1.

Table 2. Average body weight, feed intake and hen egg production of four guinea fowl strains

Parameters	Strain				P-value
	Pearl	Isabelle	Lavender	Black	
AWf (g)	1429.21^{b} ± 13.12	1346.57^{a} ± 14.29	1321.86^{a} ± 7,81	1403.19^{b} ± 9.26	P<0.0001***
AWm (g)	1465.13^{b} ± 13.86	1397.57^{a} ± 7.13	1400.17^{ab} ± 30.28	1419.47^{ab} ± 10.99	0.0383 *
HEP (%)	45.76^{ab} ± 6.63	63.49^{b} ± 4.56	26.01^{a} ± 5.10	37.59^{a} ±7.53	0.000772 ***
Fi (g)	76.69^{ab} ± 5.13	83.15^{ab} ± 4.08	68.61^{a} ± 2.32	90.23^{b} ± 6.51	0.0176 *

Fi = Feed intake; AWf = Average weight of female; AWm = Average weight of male; HEP = Hen egg production. ^{a,b} different superscripts in the same row indicate significant difference ($p<0.05$).

The results showed significant differenes ($p<0.05$) in body weight among the four guinea fowl strains. The pearl recorded significantly ($p<0.05$) higher body weight followed by Black, Isabelle and Lavender. According to egg production, the highest hen day egg production was obtained from Isabelle followed by Pearl where Black and Lavender had the lowest egg production. The result obtained in terms of feed intake showed significant differences ($p<0.05$) among the four strains of

guinea fowl. The Black guinea fowl recorded the highest feed intake, followed by Isabelle, Pearl and Lavender.

The highest body weight of the Pearl and the Black suggests that the feed consumed is used to produce meat. It suppose that the Pearl and the Black have a good ability to convert the feed nutrients into meat production. These results supported the report of Duodu et *al.*, (2018) that the pearl guinea fowl had significantly higher body weight compared to the Lavender, the White and the Black. In the same way Houndonougbo et *al.*, (2017) reported the highest body weight of Pearl guinea fowl over White, Bonaparte, Black and Lavender strains.

The Isabelle guinea fowl egg production performance suggests that this strain mobilizes the energy provided by the diet to produce eggs. This phenomenon explains the relatively low body weight of the Isabelle compared to the Pearl and black strains. Statistically Isabelle and Pearl guinea fowl have similar average egg production. This similarity in egg production of Isabelle and Pearl guinea fowl can be explained by the genetic links between the two strains. According to Dams (1996), the Isabelle guinea strain derived from crossing Pearl hen with Isabelle cock thus, the good egg production performance of the Isabelle was obtained from its Pearl parent. This egg production performance of the Pearl is in agreement with the findings of Houndonougbo et *al*., (2017) in Benin. Duodu et *al*., (2018) by studing production traits of the Pearl, White, Lavender and Black strains in Ghana reported the higher egg production of the Pearl compared to the others.

The relatively higher amount feed consumption of Black and Pearl guinea fowl might be linked to the higher body weight of these two strains. Concerning the Isabelle strain, the high feed consumption is linked to the high egg production recorded for strain. This variation in feed intake is linked to the production capacity of the strains, either in meat or egg. This high feed consumption of Pearl and Black guinea fowl was also reported by Houdonougbo et *al.*, (2017) with a higher body weight of Pearl guinea fowl among the strains studied by these authors. The correlation of feed consumption with body weight obtained for Black and Pearl guinea fowl is in agreement with the results obtained by Das et *al.*, (2021). The authors noted that the Lavender strain had recorded the highest body weight among Pearl and white guinea fowl. This variation the performance of the strains may be linked to the breeding environment of the study and the adaptation of different strains of guinea fowl in agroecological zones.

3.2 Egg characteristcs of four guinea fowl strains

The results of Egg weight (EW), Albumen weight (AW), York weight (YW), Shell weight (SW), Egg length (EL), Egg width (EWd) and Shell thickness (STk) of four guinea fowl strains are summarized in table 3.

Table 3. Egg characteristics of the four guinea fowl strains

Parameters	Strains				P-value
	Pearl	Isabelle	Lavender	Black	
EW (g)	$40.27^{ab} \pm 0.42$	$38.31^{a} \pm 0.78$	$39.56^{ab} \pm 0.11$	$41.13^{b} \pm 0.74$	0.0188*
AW (g)	19.02 ± 0.47	18.13 ± 0.65	18.59 ± 0.44	19.04 ± 0.77	0.668 ns
YW (g)	12.35 ± 0.34	11.65 ± 0.28	11.52 ± 0.23	12.52 ± 0.39	0.937 ns
SW (g)	7.48 ± 0.22	7.13 ± 0.21	7.27 ± 0.13	7.88 ± 0.26	0.0997 ns
EL (mm)	$48.93^{ab} \pm 0.28$	$48.13^{a} \pm 0.52$	$49.05^{ab} \pm 0.40$	$49.91^{b} \pm 0.22$	0.0241*
EWd (mm)	37.79 ± 0.23	37.38 ± 0.17	37.27 ± 0.06	37.62 ± 0.34	0.355 ns
STk (mm)	0.39 ± 0.02	0.39 ± 0.03	0.36 ± 0.04	0.39 ± 0.03	0.793 ns

^{a,b} different superscripts in the same row indicate significant differences ($p<0.05$) ; ns : no significant
EW = Egg Weight ; AW = Albumen Weight ; YW = Yolk Weight ; SW = Shell Weight ; EL = Egg Length ; EWd = Egg Width ; STk = Shell Thickness.

Except egg weight and egg length, there was no significant difference in egg characteristics of the four guinea fowl strains. The Black produced significantly ($p<0.05$) heavier eggs than those the others. It followed by the egg from Pearl and Lavender guinea fowl which had similar weight and Isabelle with lower egg weight. The Black produced significantly ($p<0.05$) highest egg length than that of Isabelle.

The result shown that Black guinea fowl laid heavier and longer egg. These eggs quality obtained from the Black is attributed its body weight. So there is a positive correlation between guinea fowl body weight and egg weight. Oke et *al.*, (2012) reported that positve correlation between body weight of guinea fowl and their egg weight. Similarly Shuaibu et *al.*, (2019) reported a positive correlation between guinea fowl body weight and weight and length of egg by comparing quality traits of Pearl and Belgium guinea fowl strain. Our results are in range of the report of Obike et *al*., (2011), but the egg weight recorded by these authors for the Pearl and the Black (37.67 g and 37.91 g) are lower than those of our study. This difference should be linked to the feed provide to the birds. Nowaczewski et *al.*, (2008) also obtained heavier egg with french broiler guinea fowl

compared to Polish local guinea fowl. According to albumin weight, york weight, shell weight, egg width and shell thickness there is no difference from the four strains. Our results are in agreement of the report of Zagbede et *al.*, (2019) in the study on the egg Qualities of Pearl, White, Black and Lavender guinea fowls.

3.3 Fertility and hatchability of four guinea fowl strains

The guinea fowl fertility was significantly ($p<0.05$) affected by the strain. Egg fertility was higher in Pearl and Isabelle guinea fowl than in Lavender and Black guinea fowl (figure 1). According to hatchability from fertile eggs was more favourable in Pearl and Isabelle than Lavender and Black strains but statistically there was no significant strain effect on the hatchability (figure 2).

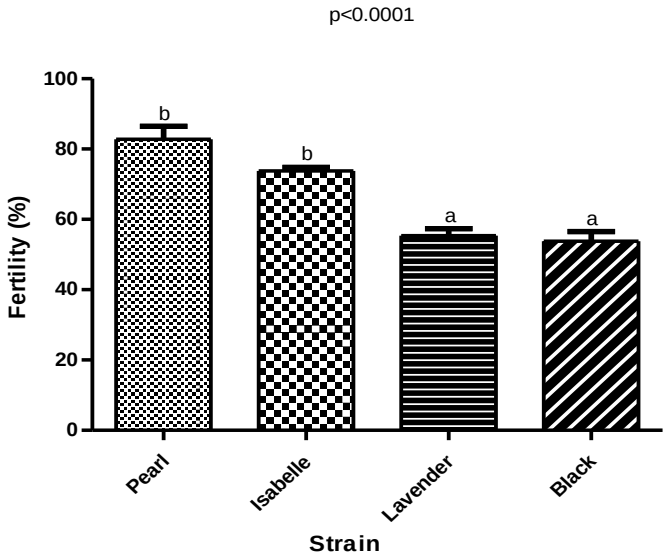

Figure 1. Fertility of the four guiena fowl strains

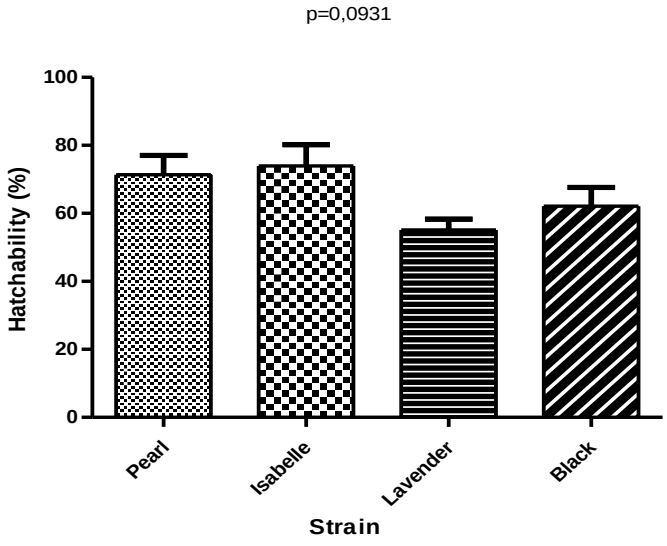

Figure 2. Hatchability of the four guiena fowl strains

The best fertility is recorded with Pearl (82.77 ± 3.65 %) and Isabelle (73.75 ± 1.03 %) strains when compared with Lavender (55.35 ± 2.03 %) and Black (53.76 ± 2.74 %) strains. This fertility of Pearl is in agreement with the report of Duodu et *al*., (2018) that, genetically the Pearl guinea fowls are the best fertile egg producer. Bernacki et *al.*, (2012) by studying the reproductive performance of Pearl and White strains revealed this best fertility of Pearl (91.7 %) guinea fowl eggs. The similarity of fertility in Pearl and Isabelle is linked to the genetic link between these two guinea fowl strains. According to Dams (1996), the Isabelle strain inherited the better reproductive performance

from its female parent which is the Pearl. The lower fertility of the Lavender and the Black could be linked to their male performance in terms of quality of semen produce. Thus, Houndonougbo et *al*., (2017) found that Black strain is a poor quality semen producer.

According to hatchability, better hatching results from fertiles eggs were obtained for Isabelle (73.99 ± 6.25 %) and Pearl (71.34 ± 5.67 %) guinea fowl when compared with Lavender (55.14 ± 3.16 %) and Black (62.09 ± 5.50 %) strains. Bernacki et *al.*, (2012) reported also the best hatchability on fertile eggs of Pearl (74.2 %) compared to White (65.7 %) strain. In contrary Duodu et *al*., (2018) obtained significant higher hatchability for Black (37.5 %) guinea fowl followed by Pearl (29.1 %) where similar hatching percent were observed for both White (21.9 %) and Lavender (24.0 %) strains. In the same way Obike et *al.*, (2014) obtained better hatchability from fertile eggs with Black than Pearl strain. These variabilities observed in the fertility and hatchability between the strains would be linked to several factors including the agroecological zone of the study, diet and rearing conditions.

4. CONCLUSION

In this experiement the strain was effected significantly body weight, egg weight, hen day-egg production and fertility. From these result, it is concluded that the Pearl and the Black guinea fowl have the potentiel of improving very good boby weight, egg weight. Regarding reproductive traits including hen-day egg production, fertility and hatchability Isabelle and Pearl strains have presented better performance than others. However, in Isabelle guinea fowl hen-day egg production was significantly greater than in other strains. The pearl strain shown mixed potentialities which can be used for both meat and egg production. In perspective, more investigation should be done on intergeneric crosses between these strains to obtain improved progeny either for meat or egg production.

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