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Effects of strain and season on incubation parameters of Nigerian local guinea fowls

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ABSTRACT: The study was conducted to determine the effects of strain and season on incubation parameters of Nigerian local guinea fowls. A total of three thousand six hundred (3600) fertile eggs (400 eggs per strain in each of the three seasons; early rainy, late rainy and early dry) generated from 144 matured guinea fowls (120 guinea hens and 24 guinea cocks) were used to obtained the following parameters; number of eggs set (NOES), number of fertile eggs (NOFE), number of dead in shell (NODIS), number of eggs hatched (NOEH), fertility (%) and hatchability (%). Data generated for the study were subjected to multivariate analysis of variance (MANOVA) of SPSS 25 (2017) to determine the effects of season and strain on incubation parameters. The results of the study showed that Pearl strain had significantly higher ($p<0.001$) NOFE (320.00), NODIS (36.00), NOEH (274.89), fertility (80.00 %) and hatchability (85.91 %). Season wise, late rainy and early dry seasons had significantly higher ($p<0.001$) values on most incubation parameters observed. The interaction effect of strain and season on incubation parameters of guinea fowls was not significant, except on NOEH ($p<0.001$) where estimates obtained for Pearl at late rainy and early dry seasons had the highest values, while the least were observed in Lavender during early rainy, late rainy and early dry periods. In conclusion, Pearl strain of Nigerian local guinea fowl had the best results for incubation parameters during late rainy and early dry seasons than white and Lavender types.

Keywords: Guinea fowl, incubation parameters, season, strain.

INTRODUCTION

Guinea fowl had become one of the most important sources of egg and meat in sub-Saharan Africa. It provides a gamy meat that is very rich in protein and other essential nutrients, and its fat is mostly unsaturated (Smiecinska *et al*., 2022). Guinea fowl produces more eggs than local hen which is very rich in vitamin A due to its deeper yellowish yolk (Onyenweaku *et al*., 2018). Meats and eggs from this poultry species had higher consumer preference because they are very tastier. Therefore, the need to promote the production of this important poultry species through modern farming is highly demanding (Abdul-Rahman *et al*., 2019). There are two main species of guinea fowls in Nigeria; the crested guinea fowl which is found in rain forest zones and the helmeted guinea fowl found in the savannah. The commonly known strains of the latter (helmeted guinea fowl) are five, namely; Pearl; this has purplish gray plumage and is regularly dotted or splashed with white, Lavender; this has light gray plumage with dotted or white markings, white and black strains (NAERLS, 2004). Guinea fowl are seasonal breeders; this

is the reason why artificial incubation is not common (Okyere *et al*., 2022). According to Dahouda *et al*. (2008), local fowls are mostly used to incubate guinea fowl eggs because the hens lack good mothering ability. Natural incubation which is common among guinea fowl keepers does not contributes to many keets; this contributes to the underdevelopment of guinea fowl farming (Dahouda *et al*., 2008). Fertility and hatchability of guinea fowl eggs vary among breeds or strains. The success of the guinea fowl enterprise is wholly hinged on egg productivity, as well as its fertility and hatchability. In recognition of the importance of this poultry species, the current study aims at investigating the effects of some factors on incubation parameters of guinea fowl. This will help farmers to improve flock size there by increasing their income.

MATERIALS AND METHODS

Study area

This study was carried out at Dan Alkali farm in Kura Local Government Area of Kano State. Kura is 27 Km away from Kano City and lies at longitude 11˚ 46ˈNorth and latitude 8˚ 25ˈEast with a land area of 206 Km^2. The Local Government is semi-arid with unpredictable rainfall distribution and duration. It has four seasons: early rainy, late rainy, early dry and late dry seasons. The mean annual rainfall ranges between 134.4 mm and 140 mm (KNARDA, 2003).

Experimental animals and management

A total of one hundred and forty-four (120 females and 24 males) domesticated guinea fowls comprising of 3 different strains (48 each per Pearl, white and Lavender) were used for this study. The birds were sourced from local markets within Kano State, Nigeria and were within the age range of 4 – 6 months. Each strain of the local guinea fowls was replicated four times with 12 birds per replicate in complete randomized design (CRD). The experimental birds were maintained in a deep litter pen of 2.5 by 1.5 m size. In each pen, three nests of 20 x 20 x 20 cm were placed. Mating was done naturally at ratio 1 to 5. Fertile eggs were collected in three seasons; early rainy (April – June), late rainy (July – September) and early dry (October – December). In each season, one thousand two hundred eggs (four hundred eggs per strain) were collected. Commercial layer diet was fed throughout the experimental period (nine months) and clean water was supplied *ad libitum*.

Pre-incubation management

Before incubation, fertile eggs collected from hens of different strains were stored at 10ºC under refrigerator. Before storage, eggs with defects that are not suitable for hatching were sorted out, while the normal ones were fumigated with formaldehyde. Prior to setting into an incubator, fertile eggs were allowed to attain room temperature for some six hours.

Incubation management

The eggs were set in incubator setter with the broad end up because this position (broad end) contains the air space through which exchange of gasses take place during embryonic development. The temperature and relative humidity of the incubator were maintained at 37.5±0.3ºC and 60%, respectively. Turning was automated and on the 24th day of incubation, eggs were transferred to hatcher compartment where temperature and relative humidity of 37.0±0.3ºC and 70% were maintained till hatching. Candling was done twice; on 10th and 24th days of incubation to detect infertile eggs and early embryonic mortality, respectively. Immediately after hatching (on the 28th day of incubation), hatchability and dead in shell keets were recorded.

Data collection

Incubation parameters

Fertile eggs were determined by deducting the number of infertile ones from the total number of eggs set. Fertility was calculated as number of fertile eggs divided by total eggs set multiplied by 100, while hatchability was estimated as the number of eggs hatched divided by number of fertile eggs multiplied by 100.

Data analysis

Data generated for the study were subjected to multivariate analysis of variance (MANOVA) to determine the effects of genotype and season on incubation parameters using SPSS version 25 (2017). The model used was as follows:

$$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + e_{ijk}$$

Where: μ = Overall or population mean, Y_{ijk} = Incubation parameters, G_i = Effect of i^{th} genotype (strain) on incubation parameters of guinea fowl (i = 1, 2, 3), S_j = Effect of j^{th} season on incubation parameters of guinea fowl (j = 1, 2, 3), $(GS)_{ij}$ = Interaction effect of i^{th} genotype (strain) and j^{th} season on incubation parameters of guinea fowl (1, 2, 3, 4, 5, 6, 7, 8, 9), and e_{ijk} = Residual error.

Table 1. Effect of strain on incubation parameters of guinea fowl.

Factors	Parameters				Fertility (%)	Hatchability (%)
	NOES	NOFE	NODIS	NOEH		
Overall mean ± S.E.	400.00±0.00	299.00±0.96	35.59±0.39	251.96±0.79	74.75±0.24	84.34±0.37
Strain	NS	***	***	***	***	***
Pearl	400.00±0.00	320.00±1.66^{a}	36.00±0.67^{b}	274.89±1.37^{a}	80.00±0.42^{a}	85.91±0.64^{a}
White	400.00±0.00	307.00±1.66^{b}	49.00±0.67^{a}	248.00±1.37^{b}	76.75±0.42^{b}	80.80±0.64^{b}
Lavender	400.00±0.00	270.00±1.66^{c}	21.78±0.67^{c}	233.00±1.37^{c}	67.50±0.42^{c}	86.31±0.64^{a}

NOES = Number eggs of set, NOFE = Number of fertile eggs, NOEH = Number of egg hatched, NODIS = Number of dead in shell, NS = non-significant and *** = p<0.001.

Table 2. Effect of season on incubation parameters of guinea fowl.

Factor	Parameters				Fertility (%)	Hatchability (%)
	NOES	NOFE	NODIS	NOEH		
Overall mean ± S.E.	400.00±0.00	299.00±0.96	35.59±0.39	251.96±0.79	74.75±0.24	84.34±0.37
Season	NS	***	***	***	***	NS
Early Rainy	400.00±0.00	291.56±1.66^{b}	30.56±0.67^{b}	244.00±1.37^{b}	72.89±0.42^{b}	83.84±0.64
Late Rainy	400.00±0.00	304.56±1.66^{a}	37.56±0.67^{a}	254.78±1.37^{a}	76.14±0.42^{a}	83.70±0.64
Early Dry	400.00±0.00	300.89±1.66^{a}	38.67±0.67^{a}	257.11±1.37^{a}	75.22±0.42^{a}	85.49±0.64

NOES = Number Eggs of Set, NOFE = Number of Fertile Eggs, NODIS = Number of Dead in Shell, NOEH = Number of egg hatched, NS = non-significant and *** = p<0.001.

RESULTS

Table 1 shows the effect of strain on incubation parameters of Nigerian local guinea fowls. Strain had significant effect (p<0.001) on number of fertile egg (NOFE), number of dead in shell (NODIS), number of eggs hatched (NOEH), fertility (%) and hatchability (%). Pearl strain had the highest values (320.00, 36.00, 274.89 and 80.00%) for NOFE, NODIS, NOEH and fertility, respectively; while the least estimates (270.00, 21.78, 233.00 and 67.50%) for the same traits were recorded in Lavender guinea fowl. For hatchability (%), the results obtained for both Pearl and Lavender strains were similar, but significantly (p<0.001) higher than the value recorded in white (85.91±0.64 and 86.31±0.64 vs 80.80±0.64).

Table 2 shows the effect of season on incubation parameters of Nigerian local guinea fowls. It was observed to had significant effect (p<0.001) on number of fertile egg (NOFE), number of dead in shell (NODIS), number of egg hatched (NOEH) and fertility (%). For all the significantly affected traits, late rainy and early dry seasons had higher estimates, and their results were favorably comparable to each other (statistically similar), while the values obtained during the early rainy period had the least.

Table 3 shows the interaction effect of strain and season on incubation parameters of Nigerian local guinea fowls. Except number of egg hatched (p<0.05), there was no significant interaction effect of strain and season on incubation parameters of guinea fowl. The results of Pearl strain at late rainy and early dry seasons had the highest number of eggs hatched, while the estimates recorded for Lavender in early rainy, late rainy and early dry seasons had the least values.

DISCUSSION

Fertility and hatchability are the major determinants of hatcheries' productivity. These two important incubation parameters are derived from the number of fertile eggs (NOFE) and number of eggs hatched (NOEH). In this study, it was observed that Pearl strain of guinea fowl had significantly higher fertility and hatchability than white and Lavender, this could be the reason this strain predominates sub-Saharan Africa. Although, it was believed that white and Lavender strains mutated from the Pearl (Somes, 1996), but the improved fertility of the latter showed that they are well adapted to the tropical environment over the formers. This is the reason why equal number of eggs was taken in each strain to avoid any form of biasedness and also to justify the findings of the research. Singh *et al.* (2011) observed the effect of strain on fertility of guinea fowl and recorded about 10-12% more fertile eggs in Pearl than white. The earlier work of Ayorinde and Okaeme (1984) compared local genotypes of Nigerian guinea fowl such as Lavender, Pearl, black and white with exotic Golden Sovereign breeds where the authors recorded significantly higher percentage fertile eggs in Pearl than other strains. Similar work by Ebegbulem *et al*. (2017) on Pearl, black and cross bred

Table 3. Interaction effect of strain and season on incubation parameters of guinea fowl.

Factors	Parameters				Fertility (%)	Hatchability (%)
	NOES	NOFE	NODIS	NOEH		
Overall mean± S. E	400.00±0.00	299.00±0.96	35.59±0.39	251.96±0.79	74.75±0.24	84.34±0.37
Pearl x Early Rainy	400.00±0.00	308.67±2.88	30.67±1.16	261.67±2.37^{ab}	77.17±0.70	84.80±1.11
White x Early Rainy	400.00±0.00	303.33±2.88	43.00±1.16	242.33±2.37^{b}	75.83±0.70	79.80±1.11
Lavender x Early Rainy	400.00±0.00	262.67±2.88	18.00±1.16	228.00±2.37^{c}	65.67±0.70	86.80±1.11
Pearl x Late Rainy	400.00±0.00	325.00±2.88	38.67±1.16	280.33±2.37^{a}	81.25±0.70	86.31±1.11
White x Late Rainy	400.00±0.00	311.67±2.88	51.67±1.16	247.67±2.37^{b}	77.92±0.70	79.47±1.11
Lavender x Late Rainy	400.00±0.00	277.00±2.88	22.33±1.16	236.33±2.37^{c}	69.25±0.70	85.33±1.11
Pearl x Early Dry	400.00±0.00	326.33±2.88	38.67±1.16	282.67±2.37^{a}	81.58±0.70	86.63±1.11
White x Early Dry	400.00±0.00	306.00±2.88	52.33±1.16	254.00±2.37^{b}	76.50±0.70	83.02±1.11
Lavender x Early Dry	400.00±0.00	270.33±2.88	25.00±1.16	234.67±2.37^{c}	67.58±0.70	86.81±1.11
LOS	NS	NS	NS	***	NS	NS

NOES = Number Eggs of Set, NOFE = Number of Fertile Eggs, NODIS = Number of Dead in Shell, NOEH = Number of egg hatched, NS = non-significant and *** = p<0.001.

(crossing between the two strains) guinea fowls showed significant difference on number of fertile eggs. The authors observed higher values in Pearl and black strains than the cross bred type (53.43, 53.14 vs 33.57). On the contrary, Yakubu *et al*. (2019) observed the absence of significant variation on fertility of Pearl strain and Belgium breed of guinea fowl. The work of Obike *et al.* (2011) among black and Pearl strains of guinea fowls showed no significant variation on fertility. The fact that hatchability of guinea fowl varied according to strain confirms the report by Singh *et al*. (2011) who observed significantly higher number of eggs hatched in Pearl than white. Ayorinde and Okaeme (1984) observed significant variation on hatchability of different genotypes of guinea fowl (Pearl, ash, black, white and Golden Sovereign) and recorded higher percentage eggs hatched in Pearl than other strains. Similar observation was made by Sanfo (2009) who detected significant effect of strain on hatchability of guinea fowl and recorded higher number of egg pipped and hatched in Pearl than Lavender and white types, this was confirmed by Naazie *et al*. (2007) in similar genotype. The authors attributed the superiority of Peal over other strains to its reproductive adaptability in tropical environment of Africa which might be the reason why they dominated this region. In addition, Almarshade (2011) recorded a significantly higher number of eggs hatched in Pearl than ash, black and Lavender strains and attributed this result to medium sized eggs produced by Pearl thereby better hatchability in this strain. The variation observed on guinea fowl fertility as a result of seasonal differences corroborates the works of many investigators (Ayorinde *et al*., 1989; Nwagu, 1997) who found that the overall reproductive performance of this important poultry species (guinea fowl) managed under intensive system is significantly higher in wet season than dry period. Dharmani *et al*. (2018) compared the fertility of local strain of guinea fowls in different season and recorded significantly higher percentage fertile eggs during the periods of monsoon and post-monsoon than winter and summer. The non-significant effect of season on hatchability observed in this study contradicts the work of Naandam and Issah (2012) among local stocks of guinea fowl managed intensively. Alsobayel and Albadry (2002) recorded higher hatchability in late rainy than early rainy and dry seasons among Pearl, lavender, black and white strains of guinea fowl and attributed this to varied egg weight obtained across these seasons. The investigators noticed that during early rainy and dry seasons, smaller eggs were mostly laid which is believed to contributes to lower hatchability observed in these periods. Similar observation was made by Premavalli *et al*. (2009) who noticed a considerable effect of season on hatchability of guinea fowl and recorded a significantly higher number of eggs hatched in south west monsoon (56.60) than summer (50.80), north west monsoon (47.60) and winter (34.10) periods. The interaction effect of strain and season observed on fertility showed that Pearl had significantly higher values in all seasons (early rainy, late rainy and early dry seasons) than other strains. This is in line with the work of Premavalli (2013) who pointed out that the reproductive performance of guinea fowl strains varied according to seasonal variation. Similarly, the work of Ayorinde and Okaeme (1984) among the local strains (ash, pear, white and black) and exotic Golden Sovereign breed of guinea fowls depicted significantly higher fertility of Pearl strain over other genotype during wet period.

Conclusions

In conclusion, the study revealed that strain had effect on incubation parameters (number of fertile eggs, number of dead in shell, number of egg hatched, fertility and hatchability) of guinea fowl and the results obtained for

Pearl was significantly higher than the other genotypes. Except for hatchability where the influence of season was absent, the incubation parameters (number of fertile eggs, number of dead in shell, number of egg hatched and fertility) obtained for late rainy and early dry periods were significantly higher than that of early rainy. The interaction effect of strain and season showed that Pearl guinea fowl had significantly higher values of number of eggs hatched in all seasons than the other genotypes.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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