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Assessment of external egg characteristics and production indices of the dual purpose French guinea fowl under semi-arid conditions in Nigeria.

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Abstract

A total of fifty one (51) dual purpose French guinea hens were managed intensively on deep litter under the semi-arid weather condition. Data were collected on external egg measurements and daily egg production during the first phase of production before the birds exhibited broodiness. Data were analyzed to measure egg production indices. The average egg length (5.16 ± 0.02 cm), egg width (4.01 ± 0.01), egg shape index (77.82 ± 0.18%) and egg weigh (53.63 ± 0.15 g.) were obtained. There was a significant (P<0.01) correlation between egg weight and egg length (0.879), egg weight and egg width (0.676), egg length and egg width (0.712) and between egg width and egg shape index (0.322). Negative correlations were observed between egg weight and egg shape index (-0.314), egg length and egg shape index (-0.434). The average daily egg, hen day production and hen house production were 26.71 ± 0.35 eggs, 51.39 ± 0.65% and 50.40 ± 2.24% respectively. The mean weekly egg number, hen day rate and hen house production reach their peaks at the third week of production, 46.57 ± 0.78 eggs and 87.87 ± 1.48% and 87.87 ± 1.48%, respectively. Mean weekly egg number and hen day rate begin to decline at week five, eight, nine, twelve, thirteen and fourteen but hen house production decreases from the peak immediately at week four of lay and continued steadily up to week fourteen.

Keywords: Dual-purpose, External-egg-characteristics, French guinea-fowl, Hen-day rate, Hen-house production, Semi-arid.

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Introduction

The challenge to overcome malnourishment especially for a developing country like Nigeria can only be won when the entire human populace has access to affordable balance diet. The challenge to meet up with the demand for daily animal protein intake (meat and egg) especially among most rural populace will require diversification of meat and egg production avenues. The French layer guinea fowls owing to their genetic credibility for egg production would be an appropriate choice. The importance of Guinea fowl in improving nutritional needs and standard of living among most rural household can never be over emphasized. Guinea fowl has promising potentials as world's alternative poultry enterprise [1]. Hence, information on egg characteristics and production performance of the French layer guinea fowls under the hot semi-arid climate will be useful for its introduction to or for alleviation of protein deficiency and poverty among the rural and the urban populace in Nigeria. Providing the information on the egg production of the dual purpose French guinea fowl will be useful to both large scale and smallholder farmers situated in other climatic belt where there could be a better environment to improve the egg production potential of the birds due favorable weather conditions.

The common source of egg for urban centers is the layer chickens whose production environment and managements needs are expensive as well as the needs for professional expertise [2]. Under rural conditions on free range, the layer guinea fowl has been reared on free range in Niger-Nigeria corridor under substandard environment and management [3]. While it is difficult to evaluate the egg characteristics and production potentials of the layer guinea fowl on free range, it is possible to evaluate these parameters under intensive management. The information obtained from the intensive management can be used to create advocacy for the introduction of the dual purpose French guinea fowl to diversify rural poultry production for job creation and poverty alleviation [4].

Guinea fowls are hardy, less susceptible to prevalent chicken diseases; feeding and management inputs are less expensive compared to the local chickens. The potential of guinea fowl for egg production is still alien among Nigerian poultry producers especially among the rural populace where their potential could be high and economical [5]. The objective of this study is to provide information on the egg qualities and production potentials of the dual purpose guinea fowl in an arid zone of Nigeria and advocates its capacity for introduction to diversify rural poultry production, in Nigeria

Materials and Methods

Location of the study

The experiment was conducted in some selected local government areas of Katsina state. Katsina is situated within North West Region of Nigeria, within the tropic region of the world between latitude 12º59' N/longitude 7º36' E and latitude 12.983º N and 7.600º E of the Greenwich Meridian (GMT) with altitude of 182.82 to 457 meters above sea level [6]. According to Koppen climate classification system, Katsina has a hot semi-arid climate (The Encyclopedia Britannica online, 2007). The annual rainfall is short and lies between 500–800 mm, the temperature fluctuates between 21°C and 35°C, the area experiences relative humidity variations of 20% to 40% in January and then rises to 80% in the rainy season [7].

Management of the experimental guinea hens, experimental design and procedure

The experimental guinea hens were purchased at day old from France and raise under intensive management up to the point of lay when the experiment commenced. Birds were fed commercial layer diet twice a day (Morning and evening) and water was provided ad libitum. The birds were raised in group housing on a deep litter on earthen floor house. Using the completely randomized design (CRD).

A Venire caliper with an accuracy of 0.1 mm was used to measure egg length. It was taken as the longitudinal distance between the narrow and the broad poles of the egg. The measurement for egg width was taken as the diameter of the widest segment of the egg circumference using a venire caliper. Egg number was counted as total number of eggs laid daily formed October, 2016 to first January, 2017.

The statistical analysis of data collected from the study was done using Statistical package for the social sciences (SPSS). Descriptive statistics and analysis of variance (ANOVA) of the parameters measured were carried out. The variation in weekly egg number, weekly hen day production (HDP) and hen housed production (HHP) were obtained using Duncan multiple range test (DMRT).

Egg shape index was determined by calculating the width and length of each egg using the formula as stated below

$$\text{Egg Shape index} = \frac{\text{Average width of egg}}{\text{Average length of egg}} \text{x100}$$

Egg mass was express as total number of egg multiplied by average weight.

$$\text{Egg mass}\left(\text{g}\right) = \text{Total egg number} \times \text{ Average egg weight}$$

Short term egg production was determined as a ratio of the number of eggs laid and the average number of birds and number of days multiplied by 100.

This will be expressed as hen-day rate of production (HDP) given by the expression:

$$\text{HDP}\left(\%\right) = \frac{\text{Total number of eggs laid}}{\text{Average number of bird alive x Numbers of hen days}} \text{x100}$$

Where: HDP=hen-day rate of production

$$\text{HHP}\left(\%\right) = \frac{\text{Average daily number of eggs produced}}{\text{Number of hen housed}} \text{x100}$$

Where: HHP=hen house production.

The formula used to calculate the phenotypic correlation (r_p) among external egg characteristics as reported by Quaas et al. [8] is follows:

$$r_p = \frac{\text{Cov}(X)_{ij}}{\sqrt{\text{Var}\left(X_{ii}\right).\text{Var}\left(X_{jj}\right)}}$$

Where:

$\text{Cov(x)}_{\text{Ij}}$=the genetic (a), and environmental (e) covariance's between the first and second trait, respectively.

Var. x_{ii}=the genetic (a), and environmental (e) variances of the first trait, respectively.

Var. x_{jj}=the genetic (a), and environmental (e) variances of the second trait, respectively.

Estimation of the coefficient of variation: This was carried out using the formula

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{Mean}} \text{x100}\,.$$

Results

Table 1 presents the results of the mean ± standard error of mean external qualities of the French layer guinea fowl. These comprises egg length, egg width, egg shape index and egg weigh 5.16 ± 0.02 cm 4.01 ± 0.01 cm, 77.82 ± 0.18% and 53.63 ± 0.15 g, respectively

Correlation of external egg characteristics

Table 2 showed the significant (P<0.01) correlation between external egg qualities and egg weight. There were positive associations between egg weight and egg length (0.879), egg weight and egg width (0.676), egg length and egg width (0.712) and between egg width and egg shape index (0.322). Whereas negative correlation were noticed between egg weight and egg shape index (-0.314), egg length and egg shape index (-0.434).

Table 3 presents the overall mean values of the production indices that were assessed. The daily egg produced average at 26.71 ± 0.35 eggs, whereas the hen day rate and the hen house production were 51.39 ± 0.65 and 50.40 ± 2.24%, respectively.

Weekly egg production performance of intensively managed dual-purpose French guinea fowl under intensive management

Table 4 presents the result of mean weekly egg number and hen day production over 98 days (14 weeks) laying period. The weekly egg number and the hen day production were observed throughout the production stages. They were lowest in week one, week thirteen and week fourteen. The weekly egg number and the weekly hen day production continue to increase from

Table 1. *External egg characteristics of the dual purpose French guinea fowl strain.*

Egg traits	Mean ± SE
N	176
Egg length (cm)	5.16 ± 0.02
Egg width (cm)	4.01 ± 0.01
Egg shape index (%)	77.82 ± 0.18
Egg weight (g)	53.63 ± 0.15
Egg mass (g)	9438.88
N: Number of observations; SEM: Standard error of the mean.	

Table 2. *Phenotypic Correlations of external egg characteristics of the dual purpose French guinea fowl.*

	Egg weight	Egg length	Egg width	Egg shape index
Egg weight	1			
Egg length	0.879**	1		
Egg width	0.676**	0.712**	1	
Egg shape index	-0.314**	-0.434**	0.322**	1
**Correlation is significant at the 0.01 level.				

Table 3. *Daily egg production performance of the dual purpose French guinea fowl over 98 days laying period.*

Parameters	Mean ± SEM.	Minimum	Maximum	Coef.Var.
Average daily egg number	26.71 ± 0.35	3.00	50.00	44.08
Hen day production (%)	51.39 ± 0.65	5.88	94.34	43.29
Hen house production (%)	50.40 ± 2.24	5.66	94.34	44.08
Coef Var: Coefficient of variation; SEM: Standard error of the mean				

Table 4. *Least Square means egg number, hen day rate and hen house production by stage (week) of production of the dual purpose French guinea hens.*

Stage of egg production	Mean± SEM		
Week	Egg number*	Hen day rate*	Hen house Prod. *
1	11.29 ± 1.15	21.29 ± 2.17	21.29 ± 2.17
2	29.43 ± 3.87^{c}	55.53 ± 7.29	55.53 ± 7.29
3	46.57 ± 0.78^{a}	87.87 ± 1.48 ^{a}	87.87 ± 1.48 ^{a}
4	40.43 ± 1.00^{a,b}	77.30 ± 1.69^{a,b}	76.28 ± 1.88 ^{b}
5	38.00 ± 0.72^{b}	73.08 ± 1.39^{b}	71.70 ± 1.36 ^{b,c}
6	35.00 ± 0.62^{bc}	67.31 ± 1.19^{b,c}	66.04 ± 1.16 ^{c}
7	34.43 ± 0.30^{bc}	66.21 ± 0.51^{bc}	64.96 ± 0.56^{c}
8	29.57± 0.48^{c}	56.87 ± 0.92^{c}	55.80 ± 1.48
9	25.29 ± 0.94	49.29 ± 1.70	47.71 ± 1.78
10	23.14 ±0.67	45.39 ± 1.31	43.67 ± 1.26
11	23.43 ± 0.90	45.94 ± 1.76	44.21 ± 1.69
12	17.86 ± 0.94	35.01 ± 1.84	33.69 ± 1.77
13	12.29 ± 0.61	24.09 ± 1.19	23.18 ± 1.14
14	7.29 ± 0.92	14.29 ± 1.80	13.75 ± 1.73

^{a,b,c}Means with different letter(s) superscripts within a given trait differ significantly.
*=p<0.05 alpha level of significance.

the onset of production, reach maximum in week three (46.57 ± 0.78) eggs and (87.87 ± 1.48%) respectively, birds retained their maximum weekly egg number and the hen day production up to week four (40.43 ± 1.00) eggs and (77.30 ± 1.69%) but decline thereafter at week five (38.00 ± 0.72) eggs and (73.08 ± 1.39%) the birds persist at these levels of production productions up to week seven (34.43 ± 0.30) eggs and (66.21 ± 0.51%). Productions (mean weekly egg number and the mean weekly hen day production continue) continued to decline at week eight (29.57± 0.48) eggs and (56.87 ± 0.92%), respectively. The average weekly egg number and weekly hen day production at weeks nine, ten and eleven were found to be similar to those in week eight; but decreased in week twelve.

The minimum and maximum percent hen house productions were recorded at week fourteen (14) and week three (3). The hen house production and hen day production were the same. However, the percent egg produced in relation to the number of hen housed was lowered due to mortality at week four. The hen house production decreases from the maximum value (87.87 ± 1.48%) at week three (3). The percent hen house production were statistically similar in weeks four (4) and five (5). There was a further decline of mean hen housed production beyond week seven (7) with a further decline at week nine (9) and remains steady up to week eleven (11) followed by a significant decline at weeks twelve (12), thirteen (13) and fourteen (14).

Discussion

Egg external characteristics

Egg length: The average egg length (5.16 ± 0.02 cm) of eggs obtained in this study is higher than the egg length of the white and the pearl guinea fowls by Wilkanowska and Kokoszynski [9]. Eggs length in this study was also higher in average length than the egg length of the royal purple guinea fowls and the pearl in Nigeria [3], pearl and lavender [10,11] and those of indigenous guinea fowl [12].

Egg width: The average egg width (4.01 ± 0.01 cm) of birds in the present study may imply an appropriate acceptable width of egg, which was higher than the average egg width of the pearl guinea fowl [9]. Egg widths obtained in this study was also higher than those of the royal purple and the pearl guinea fowls in Nigeria [3], royal purple, pearl and white guinea fowls [10]. Furthermore, the egg width obtained in this study is higher than the reported average egg width of guinea fowls in Nigeria [11,12]. Furthermore, the width of eggs from this study is higher than egg width of the white guinea fowl variety [9]. The higher egg width of the intensively managed guinea hens in this study may partly be due to genotype by environmental interaction which enhanced higher expression of the trait.

Egg shape index: The average egg shape indexes 77.82 ± 0.18% was higher than those of the pearl, lavender, royal purple and white guinea fowl varieties [10]. Furthermore, the egg shape index of birds in this study was higher than the average egg shape index of the indigenous guinea fowl [12], and those of guinea fowls [11]. The higher egg shape index obtained in this study may be due to the higher egg length and the environmental effect.

Egg weight: The average egg weight (53.63 ± 0.15 g) was higher than average egg weight reported for guinea fowls in Turkey [13], in Poland [14] and the guinea fowls in India [15]. The eggs in this study also weigh higher than egg weight of the grey guinea fowl [16], white and pearl grey varieties [9] and those of the indigenous pearl and black guinea fowls reported by Obike et al. [3]. The reason for this disparity could be due to the effect of environmental and genetic variations that affect egg weights.

Correlations among external egg characteristics: There were positive associations between egg weight and egg length (0.879), egg weight and egg width (0.676), egg length and egg width (0.712) and between egg width and egg shape index (0.322). On the other hand, negative correlations were noticed between egg weight and egg shape index (-0.314), egg length and egg shape index (-0.434). Thus egg length and egg width can be used as selection criteria to improve egg weight.

Daily egg production, hen day production and hen house production: The average egg produced per hen in this study was higher than (32.7) per hen per laying season was reported for guinea fowl in Turkey during a short term egg production [13]. The average egg per hen obtained in this study is also higher than 22.71 ± 0.30 and 12.84 ± 0.29 eggs for the pearl and the royal purple guinea fowls in Nigeria [3]. The reason

for the higher average egg per hen in this study could be due to genetic improvement for egg and meat production (dual purpose guinea fowls). On the other hand, the average egg production per hen in this study was lower than the range value 170-200 eggs per hen over 36 to 40 weeks laying period [17]. The average egg produced per birds in this study is also lower than the range 90- 120 eggs per annum [18]. The lower egg number obtained for the dual purpose guinea hens could be as a result of the short term egg production duration. Average egg produced per bird in this study was lower than the average (190 eggs per birds) for the French guinea fowls, and 175- 200 eggs per 35-weeks of lay [19]. These disparities could possibly be due to environmental effect and variations in the length of the production period. Thus the longer the laying period in birds the higher the average eggs produced per bird per laying season (which is a measure of persistency in egg lay per birds). The lower average egg produced per birds in this study could be as a result of the short term egg production duration of 14 weeks and partly due to challenges in the environmental factors of the semi-arid conditions that may suppresses egg production capacity of the French guinea fowls thus suggesting that production could possibly improve when birds are introduce to a more favorable environmental conditions.

Daily egg production egg number: The average daily egg number, percent hen day and hen house production (26.71 ± 0.35) eggs, (51.39 ± 0.65%) and (50.40 ± 2.24%) during a period of fourteen (14) weeks laying period were higher than the percent hen day and hen house production by Oke et al. [20]. The higher mean percent hen day production in this study may be due to genetically superior breed developed for high egg production. Similarly the average hen house production in this study implies less mortality or casualty during egg production as compared to counterpart indigenous guinea fowl strains.

Conclusion and Recommendations

Conclusion

The egg length, egg width and egg weight are important parameters that affect egg hatchability and hatch weight. It could be inferred that average external egg qualities obtained in this study may be useful in judging the hatchability of the dual purpose French guinea fowls' eggs under the semi-arid condition. There were positive associations between egg weight and egg length, egg weight and egg width, egg length and egg width and between egg width and egg shape index. Thus, the positive associations between egg external traits may imply that factors the influence external egg qualities (maternal genetic make-up, external environment and maternal environments) influence these traits in the same direction. On the other hand, negative correlation coefficients were noticed between egg weight and egg shape index egg length and egg shape index [21-23].

There were significant variations in the weekly egg number, hen day production and hen house production. The average mean egg production, hen day production, hen house production and the average number of birds off lay imply that on the average about fifty percent of birds lay eggs each day throughout the production period.

Recommendations

Appropriate managerial practices as well as good feeding may be good techniques to maintain high production after peak egg production. This will eventually reduce the number of individual birds returning on pause (off lay).

The presence of abundant vegetation in the southern guinea savannah as opposed to the semi-arid zone is the may be an avenue for the birds to thrive under free range management in the southern guinea savannah. Hence the need for the farmers within the southern guinea savannah to incorporate the dual-purpose French guinea fowls in rural poultry production.

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