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Effects of egg weight and storage time on hatchweight of Fulani ecotype chicken eggs under artificial incubation

[1]Muhammed, S.M., [1]Yakubu, A., [2]Dogara, M. U.,[2]Abdullahi, H.R. and Ubangari, M.A.

[1]Department of Animal Science, Faculty of Agriculture, Nasarawa State University Keffi, Nasarawa State, Nigeria.
[2]Department of Animal Science, Faculty of Agriculture, Federal University of Lafia, Nasarawa State, Nigeria.

***Corresponding Author**: u.muhammad48@gmail.com* ***Phone Number**: +2347065021802*

***Target Audience**: Poultry breeders, Farmers and Physiologists*

Abstract

The study was conducted to evaluate the effects of egg weight and storage time on the hatch weight of Fulani ecotype chicken eggs under artificial incubation. A total of 50 eggs [Small (<30.84 g) (26 eggs) and Medium (>30.84 g) (24 eggs)] were used for the study. Data generated were subjected to analysis of variance and the relationships among the parameters observed were estimated using Pearson's correlation and regression analyses. The medium eggs (>30.84 g) had the highest (P<0.05) mean value of 34.65 g for hatch weight while the small category (<30.84 g) recorded the lowest of 27.00 g. Storage period had no significant (P>0.05) effect on hatch weight. The result indicated that there was no significant (P>0.05) interaction effect on hatch weight of the Fulani chicken. Egg weight was significantly (P<0.01) and positively correlated with hatch weight (0.997). The correlation between egg weight and storage period (P<0.05) was, however, negative (-0.353). The correlation between hatch weight and storage period (P<0.05) was also negative (-0.342). The best fit was observed in the Linear model with R^2 = 0.994, adjusted R^2 = 0.994 and root mean square value of 0.365, which was lesser than the 0.367 obtained in the Quadratic model. The current study revealed that eggs of medium size produced chicks with higher hatch weight compared to eggs of small size while storage period did not affect the hatch weight of Fulani chickens.

Keywords: Fulani ecotype chicken, egg weight, artificial incubation

Description of Problem

There has been rapid increase in the number of farmers keeping chicken parent and grandparent stock leading to increase in the population of meat type chicken in Nigeria (1,2,3). Unfortunately, in Nigeria, poor fertility and hatchability rates among other factors constitute the major threat to performance of the industry (2). The fertility and hatchability characteristics of egg type chickens in Nigeria are two main traits of assessing the potentials of hens (3). According to (4), the gene make-up of an individual chicken is fixed at fertilization and hence fertility and hatchability are generally considered as traits of two parents.

Fertility is an important parameter in chicken and reflects the total actual reproductive capacity of females and males expressed by their ability when mated together to produce offspring. An egg is said to be infertile when it fails to show any evidence of developing embryo (5). Hatchability is a trait of economic importance in the chicken industry because it has a strong effect on chick output (6). It is influenced by a number of factors such as egg weight, turning of eggs, storage, humidity, shell strength, egg size and genetic factors within the chickens kept. The ability of the embryo to successfully escape from the shell is called hatchability (7). Good

hatchability of eggs is to some extent heritable, but is determined by a complicated genetic constitution and the environment.

Egg quality is important for consumer appeal, and the economic success of a producer depends on the total number of eggs sold. Egg quality comprises several aspects (8) related to egg weight, egg length, egg breath, shell weight, shell thickness and specific gravity (external quality) and to the albumen weight, haugh unit and yolk colour (internal quality). Egg quality has a genetic basis and the parameters of egg quality vary between strains of hens (9). However, the eggshell may be affected by interactions of age and breed (10).

The relationship between external traits, yolk and albumen had contributed to the egg weight increases with hen's age, reaching an apex by the end of laying cycle (11). Thus egg external qualities are one of the important phenotypic traits which influence egg quality and reproductive fitness of the chicken parent (12). It is real that beneficial egg quality traits are of immense importance to poultry breeding industries (13). In addition, embryonic development of hen's egg is dependent on traits like egg weight, yolk and albumen weights, genetic line and age of hen (14)including the storage period of the eggs.However, there is dearth of information on the relationship between egg weight, egg storage time and the weight of newly hatched chicks.This study, therefore, was designed to evaluate the influence of egg weight and storage period on the hatch weight of the Fulani ecotype chicken under artificial incubation in Nasarawa State, north central Nigeria

Materials and Methods

Location of the study

The study was carried out at the Teaching and Research Farm of Faculty of Agriculture Shabu-Lafia Campus, Nasarawa State University, Keffi, located on Latitude 08^0 33.85N and Longitude 08^0 33E and elevation of 162m above the sea level.

Experimental Layout and Design

The experiment was a Completely Randomized Design (CRD) with a total of fifty eggs. The eggs were further categorized into two: Small (<30.84 g) (26 eggs) and Medium (>30.84 g) (24 eggs). The egg storage periods were 1, 3, 5, 7, and 11 days,respectively.

Determination of Weights of Hatched Chicks

Fifty (50) eggs were set in the setter according to their groups (small and medium) and storage periods (1, 3, 5, 7, and 11 days). The eggs spent a total number of 21 days in the incubator, after which the chicks were brought out. Counting was done based on the ranges set in the incubator.

Thereafter, the initial weight of each chick was determined using a digital sensitive scale (Wiggen Hauser, WH 200-4, Germany).

Statistical Analysis

The hatch weight data were subjected to the univariate general linear model (GLM) procedure to test the effects of egg weight and storage period using IBM-SPSS (15). Where significant differences were found, the Least Significant Differences (LSD) method was used to separate the means. Phenotypic correlations were established among the egg weight, storage period and hatch weight. Also, hatch weight was predicted from egg weight using linear and quadratic models.

Results

Effects of egg category and storage period on hatch weight (g), storage period interaction on hatch weight (g), phenotypic

correlations among egg weight, storage period and hatch weight (g) and estimation of hatch weight from egg weight of Fulani chicken are presented in tables 1,2,3 and 4 respectively. The medium eggs (>30.84 g) had the highest (P<0.05) mean value of 34.65 g for hatch weight while the small category (<30.84 g) recorded the lowest of 27.00 g. Storage period had no significant (P>0.05) effect on hatch weight of Fulani chicken. Non-significant (P>0.05) interaction effect on hatch weight was observed.

The result of the phenotypic correlations among egg weight, storage period and hatch weight (g) of Fulani chicken is shown in Table 3**.** Egg weight was significantly (P<0.01) and positively correlated with hatch weight (0.997). The correlation between egg weight and storage period (P<0.05) was, however, negative (-0.353). The correlation between hatch weight and storage period (P<0.05) was also negative (-0.342). The result of the prediction of hatch weight from egg weight of Fulani chicken is show in Table 4 and Figure 1. The best fit was observed in the Linear model with R^2 = 0.994, adjusted R^2 = 0.994 and root mean square value of 0.365, which was lesser than the 0.367 obtained in the Quadratic model.

Table 1 Effect of egg category and storage period on hatch weight (g) of Fulani chicken

Group	Number	Mean	Standard error	Minimum	Maximum
Egg category					
Small (<30.84 g)	26	27.00[b]	0.54	22.10	30.60
Medium (>30.84 g)	24	34.65[a]	0.63	30.90	40.20
Storage period (days)					
1	11	32.71[a]	0.84	28.20	40.20
3	10	31.09[a]	0.86	25.70	34.70
5	9	30.44[a]	0.88	23.70	39.30
7	9	29.98[a]	0.88	23.30	34.60
9	6	30.94[a]	1.37	22.10	35.60
11	5	29.78[a]	1.14	27.00	35.00

Means along column with different superscripts are significantly different (P<0.05)

Table 2. Effect of egg category and storage period interaction on hatch weight (g) of Fulani chicken

Egg category	Storage period (days)	Mean	Standard error
Small (<30.84 g)	1	29.20[a]	1.44
	3	28.24[a]	0.94
	5	25.23[a]	1.44
	7	25.82[a]	1.02
	9	26.28[a]	1.12
	11	27.20[a]	1.76
Medium (>30.84 g)	1	36.21[a]	0.88
	3	33.93[a]	1.44
	5	35.65[a]	1.02
	7	34.13[a]	1.44
	9	35.60[a]	2.49
	11	32.37[a]	1.44

Means along column with similar superscript are not significantly different (P>0.05)

Table 3. Phenotypic correlations among egg weight, storage period and hatch weight (g) of Fulani chicken

Traits	Egg weight	Storage period	Hatch weight
Egg weight		-0.353*	0.997**
Storage period			-0.342*

*,** Significant at P<0.05 and P<0.01, respectively

Table 4. Estimation of hatch weight from egg weight of Fulani chicken

Model	Equation	R^2	Adjusted R^2	RMSE	P-value
Linear	Y = –11.065X + 0.978X	0.994	0.994	0.365	<0.001
Quadratic	Y = –8.654 + 0.864X + 0.001X^2	0.994	0.994	0.367	<0.001

Y = hatch weight; X = egg weight; R^2= coefficient of determination; RMSE = root mean square error

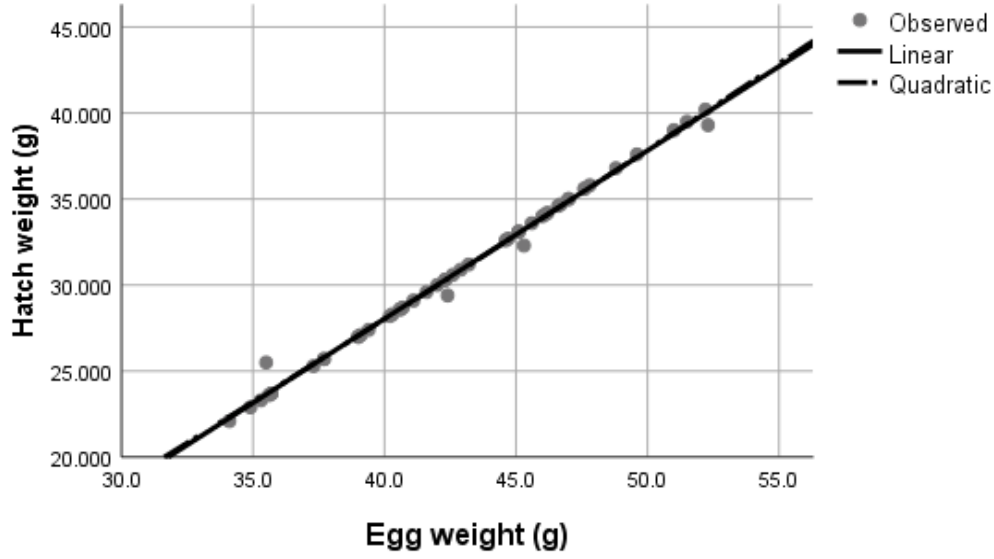

Figure 1. A graph showing the prediction of hatch weight from egg weight

Discussion

The potential of the chicken depends, in part, on the egg, an important parameter for embryogenesis as well as for day-old chick quality and growth. Pre-incubation period of hatching eggs is very important as it affects the hatching egg quality. In the current study, a medium size egg gave a higher hatch weight compared to a small size egg. This is an indication that the bigger the size of the egg, the more the propensity to produce a chick with a higher weight. The mean hatch weight of 34.65 g of the current study is higher than the 28.43±2.38 g reported for Egyptian Balady chicken (16).

The storage period of eggs did not affect the hatch weight of the birds. The present finding is contrary to the submission of Basha (16) that the incubation of prolonged stored eggs affected negatively the hatching quality characters of Egyptian Balady eggs. Similarly, Ayeni*et al*. (2020) (17) reported that egg storage must not exceed 4 days for optimum weight of the hatched chicks.

There is an established relationship between egg weight and hatch weight of chickens. The present positive correlation indicates that as egg size increases, there is every tendency to produce a chick with corresponding higher weight. It has been suggested that developing embryos from heavier eggs tend to have more nutrients for growth compared to those of small eggs (18). The negative correlation between egg weight and storage period is an indication that as the former increases, the latter decreases. It has been postulated that eggs stored for a long period of time may lose weight due to moisture loss (19). However, Nowaczewski*et al*. (20) reported that a prolonged egg storage period (up to 21 days) should not significantly impact the biological value of eggs regardless of their weight. As the storage period increased, the hatch weight reduced as indicated by the negative correlation between the two characters in this study.The linear model was better for the prediction of hatch weight as it contains fewer parameters than the quadratic model.Such a model was also used by Sola-Ojo*et al*. (21) as well as Ramaphala and Mbajiorgu(22) to predict chick hatch-weight from egg weight. However, the limitation of the current study is sample size.

Conclusion and Applications

1. The study revealed that eggs of medium size produced chicks with higher hatch weight compared to eggs of small size. Storage period did not affect the hatch weight of Fulani chickens in the present study.
2. Although lower period of storage is recommended, positive outcomes may still be achieved with a long-storage period in certain circumstances.
3. Hatch weight can best be predicted from egg weight using the linear regression model.

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