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COMPARATIVE EGG PRODUCTION ANALYSIS OF ISA BROWN LAYING STRAIN RAISED IN THREE POULTRY FARMS IN A TROPICAL ENVIRONMENT

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ABSTRACT

Data from egg production records involving a total of 1,208 intensively-managed Isa-brown laying strain obtained from three poultry Farms A, B and C located in Calabar Municipality were used for this study. Percent hen-day production was computed for a period ranging from point-of-lay, 24 weeks of age (Farms A and C) and 20 weeks of age (Farms B). The 40 weeks in-lay for the three farms, was further sub-divided into four discrete production (10-weekly) phases (weeks 1-10; 11-20; 21-30; 31-40) in each of the farms. Maximum hen-day production was obtained as follows: Farm A (70.40% in week 18); Farm B (85.50% in week 20) and Farm C (79.30% in week 25). The percentage hen/day production pattern were fitted into two regression models namely – the simple linear model and exponential function using the age-in-lay as the predictor variable and percentage Hen-day production as the dependent variable. Irrespective of the function used, the rate of increase in percentage egg production was highest within the first quarter (1-10 week) of production in each farm. As the production phase lengthened, the predicted rate of increase in production declined and the predictive ability of the simple linear model as judged by the R^2 value became comparatively lower when compared to exponential function. The egg production pattern revealed a period of rapidly increasing production, attainment of peak, and the phase of a gradual declining production. Based on these findings, partitioning the laying period into phases could be a step forward in explaining the concept of phase feeding in which layers are fed at different protein levels at different phases based on their level of production.

KEY WORDS: Analysis, egg production, exotic bird, climate

INTRODUCTION

Based on annual growth rate of 4.7 % for animal number and 7.3 % egg production, North and Bells (1990) reported an expected increase in the number of laying birds. In Africa, while the number of laying birds is expected to have increased from 241 million by 1980 to 531 million by the year 2000, egg production is expected to reach a target of 2.36 million tones in the year 2000 from the estimated 2.36 million tones in the year 2000 from the estimated 0.58 million tones in 1980 (North and Bells, 1990). The authors noted that these production targets are based primarily on the expected intensification of commercial egg production which involves, in the main imported breeds and strains of laying birds.

Nigeria, like many other developing countries has over the years depended on imported breeds and strains of poultry for the growth of her industry (Obioha, 1992). It suffices to note, however, that these birds generally fail to attain peak performance reported of them in their native environment even under excellent management conditions (Oluyemi and Roberts, 2000). When they do, peak period is comparatively shorter. Apart from the genotype of the birds, other factors which affect egg production include: nutrition, ambient temperature, photo-periodism, hormonal action and relative humidity (Ibe, 1992, Oluyemi and Roberts, 2000 and Akanni *et al*., 2008). Values of percent hen-day production in the tropical environment under varying and various nutritional conditions have been reported (Obioha, 1992). A typical egg production curve from the point of lay is usually characterized by a rapid increase in production, attainment of a peak, and a gradual decline in production (Shaib *et al*., 1992 and Oluyemi and Roberts, 2000). Information is scarce on the quantitative prediction of percent Hen-day production at the different production phases in a tropical wet climate. This information is necessary to ensure a more definite and precise formulation of layers rations for the different phases of egg production for the new breeds and strains introduced into the country. In addition, prediction and production equation so derived from studies involving different breeds and strains of imported birds under tropical conditions will enable livestock planners to project more realistic future egg production.

Since breed, strain and environment differences exist and affect egg production in a given environment, this study was conducted to compare and evaluate the egg production pattern of Isa Brown laying birds and to examine the predictive ability of Isa Brown layers using (two mathematical models) simple linear and exponential functions.

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MATERIALS AND METHODS

This study involved a total of 1,208 laying birds of Isa Brown commercial strain undertaken in three selected poultry farms in Calabar metropolis, located in the rainforest zone of Nigeria between Latitudes $4^{o}58^{1}$N and Longitudes $8^{o}17^{1}$E of the equator with an average annual rainfall and temperature range of 1260-1280mm and 25^{o}C-30^{o}C respectively during the period. The farms were; Farm A (Kinet Farm), Farm B (Fedison Farm) and Farm C (Efitric Farm). The total number of birds in these farms were: Farm A (117 birds); Farm B (306 birds) and Farm C (785 birds). The birds in all the farms were managed intensively on deep litter system and fed *ad libitum* on a standard commercial layer ration (Livestock layer mash) containing 16.00% crude protein and 2900 kcal/kg metabolizable energy. Fresh, cool water was provided always. Samples of the feed were analyzed for proximate composition, calcium and phosphorus according to AOAC methods (1990), and the following results were obtained: crude protein 16.10%, crude fibre 5.62%; metabolizable energy 2889.52 kcal/kg, calcium 3.48% and phosphorus 0.52%. Records on daily egg production kept in the Farm's were studied. Egg production records from point-of-lay (Farm A and C, 24 weeks of age and Farm B, 20 weeks of age) to 40 weeks in production were divided into four production phases: (weeks 1-10; 11-20, 21-30, 31-40) for easy analysis and comparing of production at different stages. The percentage hen-day production for each week was calculated from the total number of egg collected (weekly) expressed as percentage of the expected number of eggs.

STATISTICAL ANALYSIS

Regression and correlation analysis were carried out between the percent hen-day production (Y) and the length of time in lay (X) weeks.

The two mathematical functions used were;

Simple linear model, $Y = a + bx$ and Exponential Function, $Y = aX^{b}$

The constants 'a' and 'b' were estimated using the method of Least square (Steel and Torrie, 1980). Duncan's Multiple Range Test as outlined by Steel and Torrie (1980) were used where significant differences were obtained.

RESULTS

The prediction equations for percentage egg production for the four periods considered using simple linear model and exponential function are shown in Tables 1 and 2. With reference to Table 1, the weekly rate of increase in percentage Hen-day production in Farms A, B and C was highest in the first phase (weeks 1-10), 7.49%, 9.58% and 8.67%, decreasing to 1.35%, 0.27% and 1.44% in the last phase (31-40 weeks) in each farms respectively. While 83.72%, 79.85% and 98.37% of the changes in percentage hen-day production were attributable to changes in the age-in-lay in the first production phase in Farms A, B and C respectively. Egg production in the second phase in the three Farms showed a negative rate of 0.58%, 0.74% and 0.59% Hen-day production per week with 53.90%, 24.30% and 24.47% of the changes due to age of birds in lay. The production equation in phase three revealed a weekly decrease in egg production rate 0.29%, 0.19% and 1.05% in Farms A, B and C respectively. The prediction equation using the exponential function (Table 2) showed a comparatively higher values for the indices of prediction (R and R^{2}) in Farms A, B and C with 83.28%, 90.36% and 98.43% of the changes in egg production accounted for the changes in the birds age-in lay. The predictive ability fell to 48.44%, 21.17% and 30.25% in Farms A, B and C respectively in phase two with a non-significant ($P>0.05$) rate of changes in b-values. Highly significant changes ($P<0.001$) with decreases in the egg production coefficient was observed in the third production phase. However, the predictive ability of the exponential model was comparatively higher in Farms A and C in the fourth phase of production. This trend of egg production is in line with the observation that changes in egg production with time which like growth is a physiological process, can better be described by the exponential function than simple linear model.

The graphical presentation of the changes in percentage Hen-day production with age from point of lay in Farms A, B and C are shown in Fig. 1. The peak production of 70.40% was obtained in the 18^{th} week in Farm A. This was established with only some slight decline till the 40^{th} week in-lay recorded 47.38%. However, point-of-lay in Farm A was 24weeks. In Farm B, the birds came into lay at 20weeks of age and reached a peak production of 85.50% in the 20^{th} week in-lay. There was no sharp decline thus stable till the 35^{th} week in-lay where a gradual decline brought the value down to 67.63%. A consistent decline in Hen-day production occurred till 40^{th} week in-lay. In Farm C, birds came into lay at 24weeks of age and recorded peak production of 79.30% in the 25^{th} week in-lay, this was stabilized with some slight decline which brought down the value to 43.95% on the 39^{th} week.

TABLE 1: PREDICTION EQUATIONS FOR PERCENT HEN-DAY PRODUCTION (Y) FOR ISA BROWN LAYERS USING THE SIMPLE LINEAR MODEL (Y = a + bx)

EGG PRODUCTION PHASE (WEEKS)	FARM 'A' EQUATION	r	r^2	FARM 'B' EQUATION	r	r^2	FARM 'C' EQUATION	r	r^2
1 – 10 (1^{st})	Y = 3.50 + 7.49X	0.9150***	0.8372	Y = 1.04 + 9.580X	0.8936***	0.7985	Y = 12.10 + 8.667X	0.9918***	0.937
11 – 20 (2^{nd})	Y = 75.9 – 0.582X	– 0.7342*	0.5390	Y = 90.65 – 0.748X	– 0.4929	0.2430	Y = 82.36 – 0.596X	– 0.5429	0.2447
21 – 30 (3^{rd})	Y = 69.20 – 0.290X	– 0.7884**	0.6216	Y = 71.52 + 0.19X	0.1569	0.0246	Y = 98.69 – 1.056X	– 0.6178	0.3817
31 – 40 (4^{th})	Y = 99.41 + 1.352X	– 0.8539**	0.7291	Y = 79.00 + 0.266X	– 0.2450	0.0600	Y = 10.69 + 1.440X	– 0.9380***	0.8798

*** 'r' significant at P<0.001
** 'r' significant at P<0.01
* 'r' significant at P<0.05
Absence of asterisk indicate non significance at P>0.05

TABLE 2: PREDICTION EQUATIONS FOR PERCENT HEN-DAY PRODUCTION (Y) FOR ISA BROWN LAYERS USING THE EXPONENTIAL FUNCTIONS ($Y = aX^{b}$)

EGG PRODUCTION PHASE (WEEKS)	FARM 'A' EQUATION	r	r^2	FARM 'B' QUATION	r	r^2	FARM 'C' EQUATION	r	r^2
1 – 10 (1^{st})	$Y = 1.28\ X^{1.99}$	0.9126***	0.8328	$Y = 2.17\ X^{1.81}$	0.9036***	0.9036	$Y = 1.83\ X^{1.67}$	0.9921***	0.9843
11 – 20 (2^{nd})	$Y = 71.64\ X^{-0.02}$	– 0.6960*	0.4844	$Y = 114.14\ X^{-0.14}$	– 0.2117	0.2117	$Y = 101.73\ X^{-0.12}$	– 0.5500	0.3025
21 – 30 (3^{rd})	$Y = 90.39\ X^{-0.12}$	– 0.7824**	0.6122	$Y = 1.26\ X^{1.23}$	0.1613	0.1613	$Y = 233.02\ X^{-0.37}$	– 0.6098	0.3719
31 – 40 (4^{th})	$Y = 1398.78\ X^{-0.93}$	– 0.8556**	0.7321	$Y = 115.10\ X^{-0.14}$	0.0634	0.0634	$Y = 1261.40\ X^{-0.86}$	– 0.9427**	0.8887

*** 'r' significant at P<0.001
** 'r' significant at P<0.01
* 'r' significant at P<0.05
Absence of asterisk indicate non significance at P>0.05

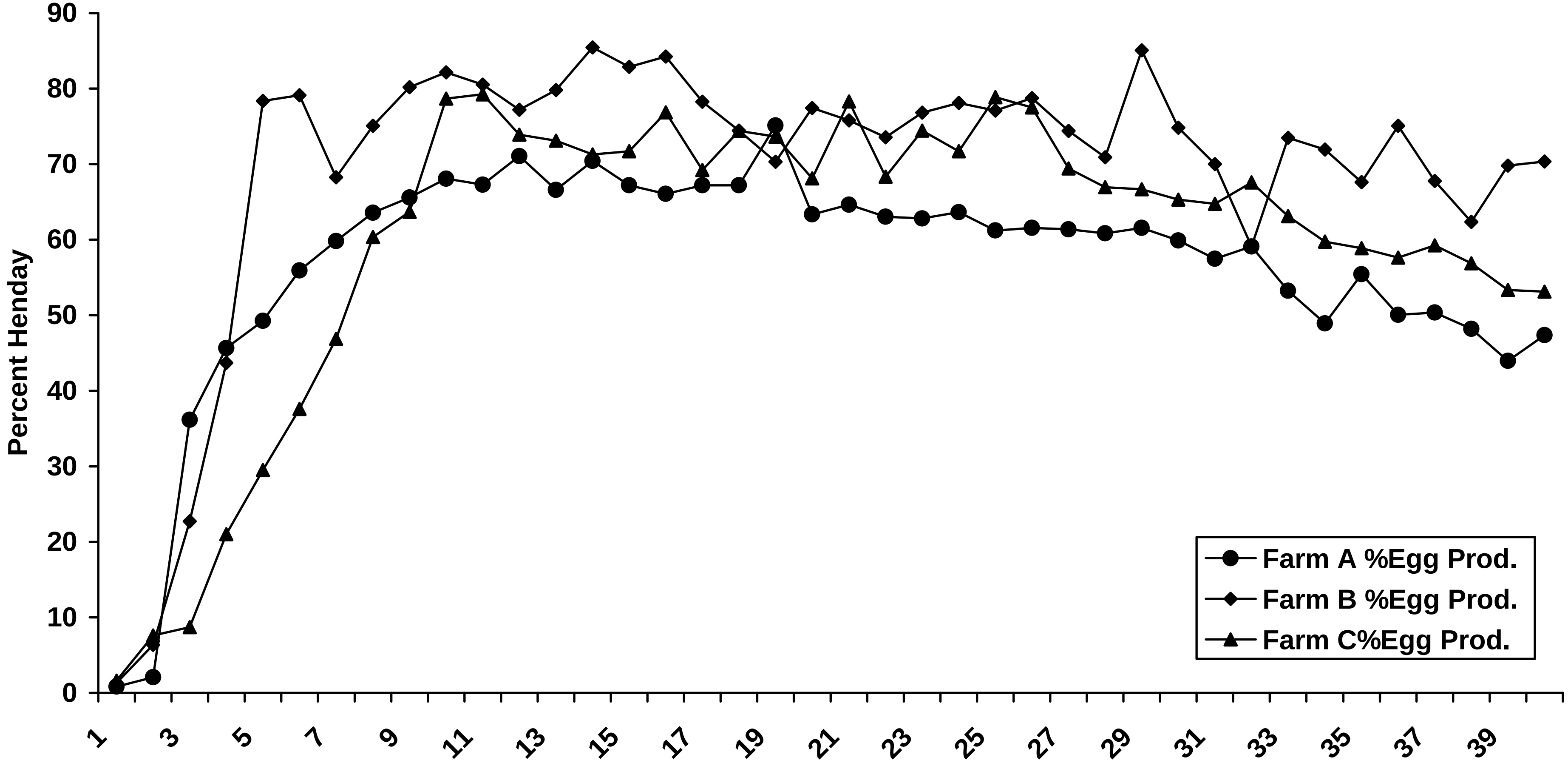

Fig. 1: Egg Production Pattern for Birds in Three Poultry Farms

DISCUSSION

The observation that the rate of increase in percentage Hen-day production declined with age of birds in-lay is in agreement with the report of Essien (1989). This also confirms the findings of Oluyemi and Roberts (2000), that in a flock the laying period ends at different ages for individual birds and that as the birds get older in age, the number of ovulations decrease and more ova are lost by not being covered in the oviduct. The egg production pattern observed in this study could be attributed to the age, management, and tropical environment where these birds were managed. Generally, the Hen-day production patterns obtained in this study were similar to that of Oluyemi and Roberts (2000), who illustrated the major phases of egg production to include the period of rapidly increasing production, attainment of peak and the phase of a gradual declining production. Similar egg production model was reported by Essien (1989) for Shaver laying strain and Wilson and Ogasawara (1998), for Leghorn birds.

Comparing the predictive abilities of Isa-Brown for the three Farms using R^2 value as the indicator, revealed that as age in-lay of birds increased, the predictive abilities of simple linear model decreases when compared with exponential function. Analysis of the percent Hen-day production in the first phase (1-10 weeks) indicated significance ($P<0.05$) differences between the Farms. Beyond the first phase, percent Hen-day production was negatively correlated with age in-lay. The exponential model gave a better predictive ability of the relationship between egg production rate with advancing age.

Findings from this study show that there is need to evolve a quantitative prediction of the percentage Hen-day for the various phases of egg production. This is necessary for a precise formulation of layer rations at various production phases. In addition, prediction and production equation so derived from studies involving different breeds and strains of imported birds under tropical conditions will enable livestock planners to project more realistic future egg production, demand and supply thereby curbing the error of under estimating or overestimating the production of and demand for egg relative to human population.

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