ASSOCIATION BETWEEN BODY WEIGHT AND SOME EGG PRODUCTION TRAITS IN A STRAIN OF COMMERCIAL LAYER

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ABSTRACT

Fifty 28 weeks old layers were reared in individual cages for 9 weeks to detect the effect body weight has on some egg production traits. Body weight was positively though non- significantly ($P > 0.05$) correlated with egg number, egg weight, egg length, egg breadth, shell weight, yolk weight and albumen weight and negatively with shell thickness ($r = -0.12$) and egg index ($r = -0.15$).

Estimates of optimum 28-week body weights, as determined from second-degree (quadratic) equations, indicated that for satisfactory performance a body weight range of 1728 to 1814g is required. Breeding and good management especially feeding are thought to be capable of maintaining this weight range.

Key Words: Body weight, egg traits, correlation, quadratic relationship, harco layer.

INTRODUCTION

Commercial breeders and producers have recognized the importance of body weight in egg-type chickens although its functional relationship to production traits is not well understood. The challenge presented to the breeder is thus to breed the most desirable size and have it also possess the desired production traits especially high egg production and big size.

Though the environmental non-genetic factors such as feeding, management, disease and climate, are known to affect the profitability of egg production, the greatest limitation is brought about by genetic differences. Even within the same breed, strain or variety, individual variations in performance often occur. It is thus important to detect early enough hens that are capable of high performance. This paper describes th interrelationships existing between boc weight and some egg production traits Harco layers with the aim of determinin models or indices for predicting perfc mance from mature body weight.

MATERIALS AND METHODS

Experimental birds. Fifty 28 weeks (Harco layers randomly selected from a flc of 385 birds at the Unilorin Teaching a Research Farms were used for this expe ment. Each bird was kept in individual ca measuring 45.7 x 40.6 x 35.6 cm. Feed a water were given *ad-libitum* throughout th weeks experimental period. The commer layer's mash fed contained 95.2% dry r ter, 4.0% ash, 17.5% crude protein, 5 fat, 10.5% crude fibre and 62.5% NFE.

Parameters measured

The birds were weighed at the beginning of the experiment and weekly thereafter. Eggs were collected daily and marked according to cage number. All eggs laid by each hen were weighed and the length and breadth measured. Egg index was determined as the ratio of egg breadth to egg length.

Weekly, one egg from each hen was randomly selected, the shell carefully broken and the contents emptied into a petri dish. The albumen and yolk were separated and weighed. From samples taken from the narrow, middle and broad portions of each egg, the average shell thickness was determined.

Statistical analyses

Variations in each of the parameters were tested for statistical difference using the completely randomised design (Steel and Torrie, 1980). Correlation coefficients (r) between the various parameters and body weight were also determined. The relationship between 28-week body weight and each parameter was described by quadratic equations of the polynomial type (Little and Hills, 1978). The various egg parameters were the dependent variables (Y) while 28 week body weight served as the independent variable (X). The second-degree or quadratic equation used was of the form

$$Y = a + bX + cX^2$$

The three equations used for estimating the coefficients (a, b. c) are

$$an + b\Sigma X + c\Sigma X^2 = \Sigma Y$$
$$a\Sigma X + b\Sigma X^2 + c\Sigma X^3 = \Sigma XY$$
$$a\Sigma X^2 + b\Sigma^{X2} + c\,\Sigma X^4 = \Sigma X^2Y$$

The value of X (28 week body weight) that will give the maximum value of each of the egg traits (Y) was determined from the equation

$$X\ max = \frac{b}{2c}$$ (Little and Hills, 1978).

RESULTS AND DISCUSSION

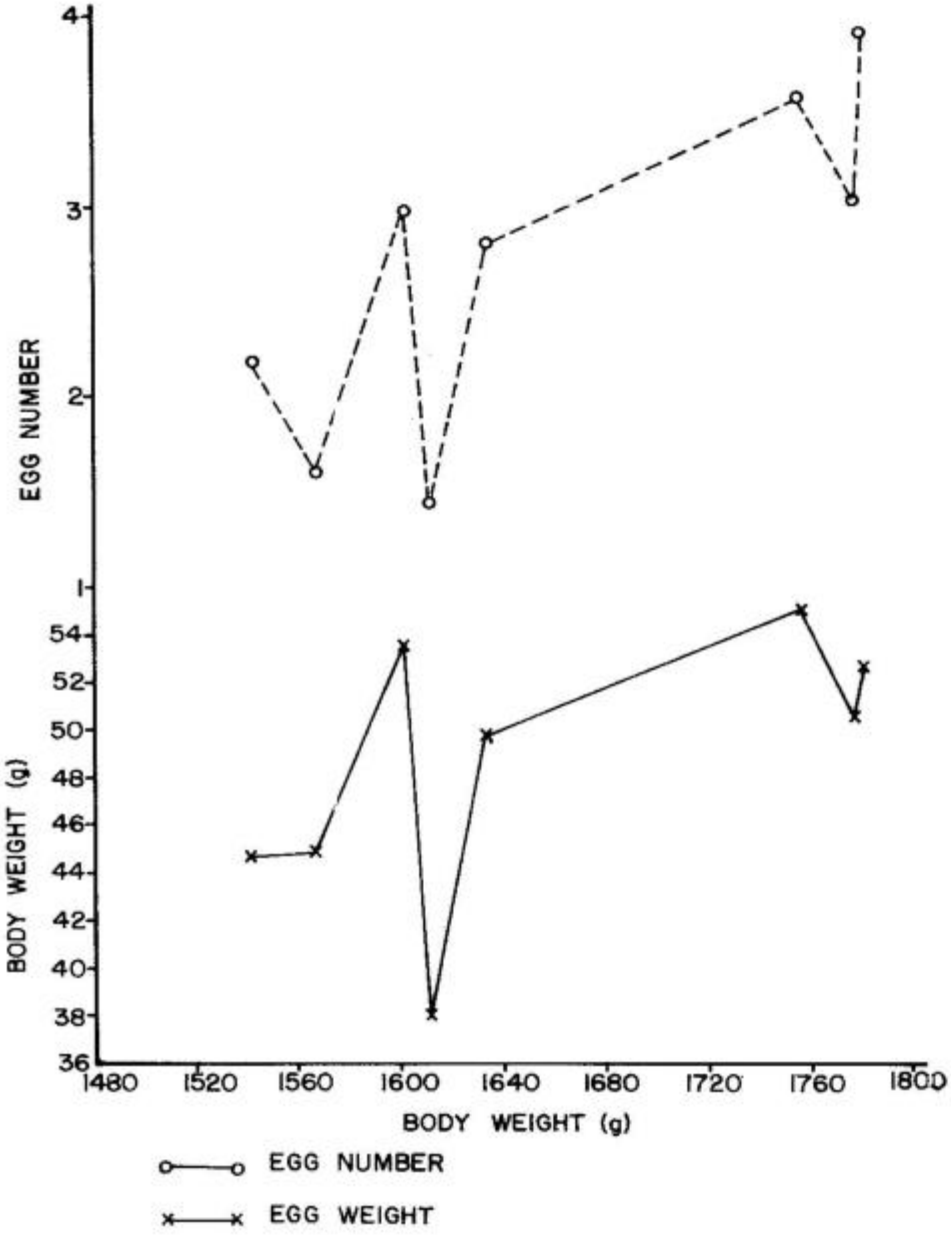
Variations in parameters measured

There was a decrease in body weight gain over the experimental period (Table 1) with an overall mean decrease of 118.5g. The decline in body weight probably resulted from an increase diversion of nutrients from body weight gains to egg formation after meeting maintenance requirement, once mature body weight has been attained (Du Plessis and Erasmus, 1972). The reduction in live weight thus probably resulted from an increased use of physiological reserves to counter egg production demands.

The number of eggs laid per hen per week varied from 3.14 to 4.86 with a hen day production of 52.0 to 72.9% (Table 1). Weekly egg weights averaged 58.126g with a range of 50.36 to 64.75g. Egg index also varied from 0.57 to 0.77. Shell thickness was constant (0.39mm) for the first two weeks of the experiment but rose to 0.41 in the 3rd and then declined.

Figure 1 indicates that a fall in egg number occurs between 1539 and 1562g body weight showing that over this body weight range 0.5 less egg was produced per bird per week. Egg number rose between 1562 and 1595g body weight and fell between 1595 and 1608g. A rise was also observed within the body weight range of 1608 and 1755g. Thus except for the sharp drop at 1600g (fig. 1) there seems to be a continuous increase in egg weight and egg numbers with body weight.

There were no appreciable differences in the shell thickness of eggs laid by hens in the body weight range of 1600-1800g (fig. 2). Lighter birds however laid eggs with thinner shells. The lowest egg index, breadth, length and shell weight were obtained at a body weight of 1608g after which they increased with body weight (fig. 2).



EGG NUMBER
BODY WEIGHT (g)
BODY WEIGHT (g)
EGG NUMBER
EGG WEIGHT

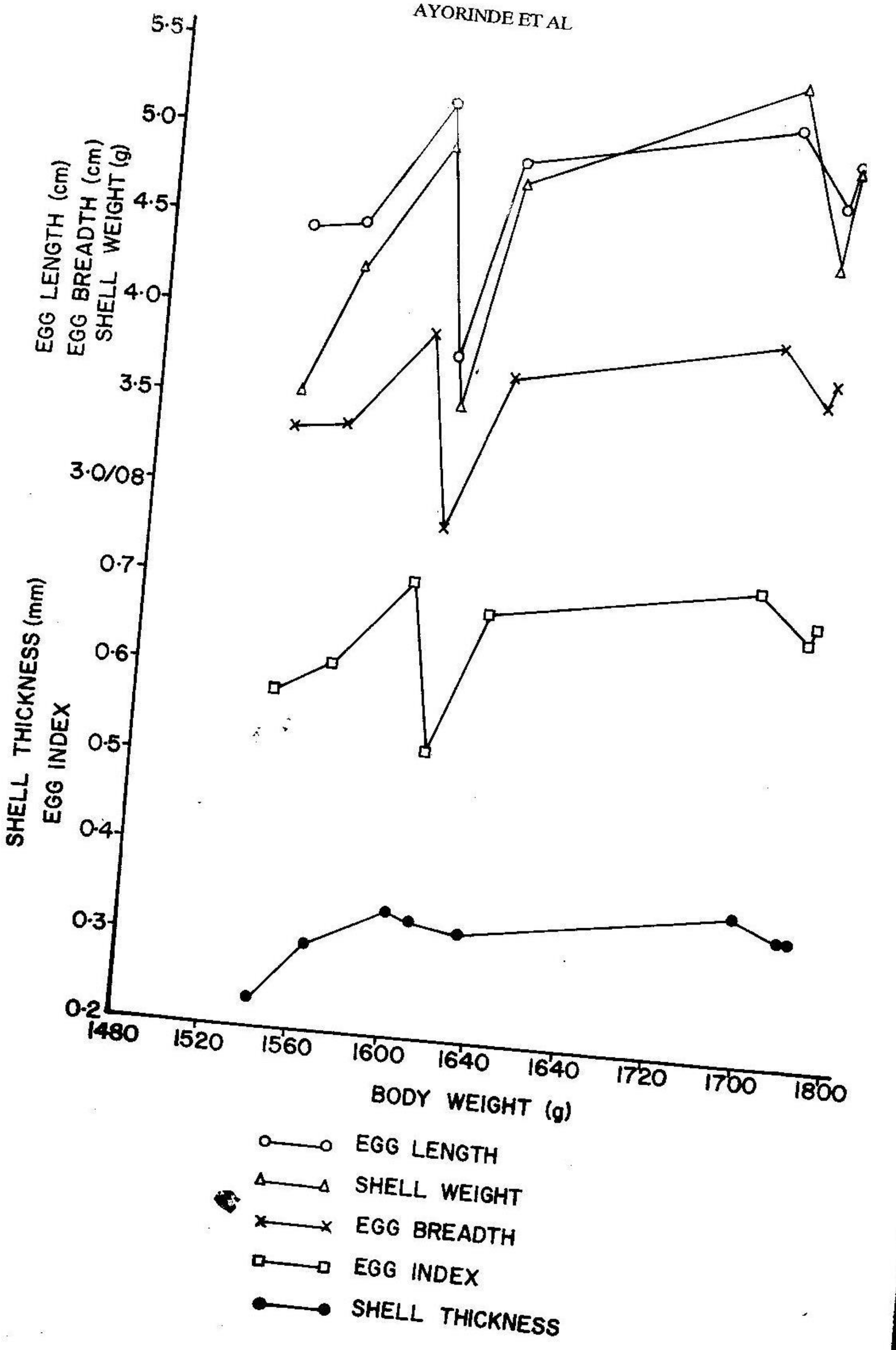

EGG LENGTH (cm)
EGG BREADTH (cm)
SHELL WEIGHT (g)
SHELL THICKNESS (mm)
EGG INDEX
5·5
5·0
4·5
4·0
3·5
3·0/08
0·7
0·6
0·5
0·4
0·3
0·2
1480
1520
1560
1600
1640
1640
1720
1700
1800
BODY WEIGHT (g)
EGG LENGTH
SHELL WEIGHT
EGG BREADTH
EGG INDEX
SHELL THICKNESS

Table 1
Means of weekly body wt(g) and egg production traits (±S.D.)

Trait	WEEK 1	2	3	4	5	6	7	8	9	Mean
Body wt(g)		1771.1	1773.6	1755.8	1627.4	1608.8	1595.1	1539.4	1652.6	
S.D.	189.5	187.9	199.2	184.1	151.0	179.9	189.4	178.3	166.3	189.5
Egg wt(g)	50.36	52.26	54.78	59.67	58.5	62.1	63.6	64.75	61.2	58.91
S.D.	15.54	11.56	4.65	13.28	13.4	8.62	9.10	19.4	11.26	10.12
Egg No.		3.96	4.86	3.28	3.22	3.92	3.14	4.18	3.92	
S.D.	1.49	1.56	1.28	1.31	1.05	1.04	1.07	0.91	1.21	1.52
Egg length (cm)	5.01	5.22	5.12	4.02	4.58	5.39	4.68	4.65	4.90	
S.D.	1.51	1.13	1.22	1.32	1.24	2.05	0.81	1.94	2.09	0.98
Egg breadth (cm)	3.89	4.01	4.24	3.94	3.06	3.50	4.13	3.58	3.54	3.76
S.D.	1.16	0.86	0.16	1.01	1.84	1.56	0.62	1.49	1.60	0.65
Egg Index	0.72	0.74	0.77	0.72	0.57	0.64	0.75	0.65	0.63	0.64
S.D.	0.21	0.16	0.35	0.19	0.34	0.29	0.12	0.27	0.13	0.14
Shell wt(g)	4.64	5.24	5.66	4.99	3.75	4.70	5.16	4.46	3.75	4.71
S.D.	1.54	1.25	0.70	1.47	2.31	1.74	0.96	1.95	1.78	0.11
Yolk wt (g)	13.48	13.68	14.27	13.6	9.87	11.89	14.29	12.41	12.21	12.86
S.D.	0.63	0.43	0.19	0.52	0.86	0.78	0.36	0.77	0.82	0.22
Albumen wt(g)	29.83	31.4	34.86	31.06	24.91	28.38	33.83	28.46	29.58	30.26
S.D.	1.36	1.09	0.51	1.21	2.16	1.88	0.88	1.76	1.96	0.52
Shell thickness (mm)	0.39	0.39	0.41	0.37	0.38	0.35	0.39	0.34	0.39	0.38
S.D.	0.14	0.01	0.01	0.11	0.08	0.14	0.01	0.14	0.13	0.06
Hen-day-production (%)	52.0	65.4	59.7	58.8	60.0	72.9	70.6	72.2	71.1	64.74

In agreement with the findings in this work, Funk (1949) and Briggs and Nordskog (1976) reported that egg weight increases with body weight. Ricklefs (1983) also observed that larger body size resulted in large egg length, width and mass – all factors affecting egg weight.

Body weight was positively correlated with yolk weight, egg weight, egg numbers, egg length, egg breadth, shell weight and albumen weight (Table 2) but negatively with egg index and thickness. The associations were however low and non-significant ($P > 0.05$). These observations are in agreement with the reports of Sochkan (1973), Ricklefs (1973), and Harms *et al* (1982). These authors reported correlated values varying between 0.026 and 0.84.

The positive correlation between body weight and egg number (Table 2) agrees with the assertions of Du Plessis and Erasmus (1972) and Singh and Nordskog (1982) that light birds were poor egg producers on the phenotypic scale. As noted by Starak (1965), Nozchev and Kunev (1973), Sochkan (1973) and Harms *et al* (1982) body weight and egg production can be negatively correlated. The negative association according to Nordskog (1960) could arise as a result of fat deposition in large bodied hens.

Though egg weight increased with body weight the rate of increase as indicated by the correlation coefficient (Table 2) is not directly proportion to the increase in body weight. Similarly positive but higher association (r = 0.6) was reported by Briggs and Nordskog (1967).

Values of the correlation between body weight and egg length and breadth (Table 2) indicate that larger mature (28 weeks) body size results in longer and broader eggs. This is similar to the positive correlation reported by Ricklefs (1983). The negative correlation between egg index and body weight (Table 2) is probably so because egg breadth responded more positively to change in body weight than did egg length. Egg index will thus decrease with an increase in body weight making the eggs more oblong in shape.

The negative correlation between body weight and shell thickness implies that egg shell becomes thinner with increased body weight. This according to David (1980) and Nordskog (1960) is because birds with small body sizes lay smaller sized eggs and that irrespective of egg size the amount of shell is the same. This implies that larger eggs have thinner shells. The positive correlations between mature body weight and the egg production (Table 2) agree with the reports of Fender *et al* (1984).

The relationship between body weight and the various egg traits was not strictly linear.

The non-linearity might have arisen from a direct functional association between these variables or from the confounding of two or more simpler relationships which though could be themselves linear. Du Plessis and

Table 2
Correlation and regression coefficients of body weight (X) on the different traits (Y)

Dependent variable(Y)	Correlation	Coeffients		
		a	b	c
Egg number	0.33	13705.556	-0.0150	-0.0043
Egg weight	0.77	782.045	-0.0726	-0.00021
Egg length	0.21	443.654	-0.1628	-0.000047
Egg breadth	0.22	120.803	-0.0499	-0.000013
Egg Index	-0.15	140.157	-0.0169	-0.0000049
Albumen weight	0.22	241.967	-0.0899	-0.000026
Yolk weight	0.16	517.96	-0.0562	-0.000016
Shell weight	0.21	576.791	-0.2177	-0.00006
Shell thickness	-0.12	1350.214	-0.5011	-0.000145

Erasmus (1972) observed that a significant quadratic relationship [illegible] between total egg production body weight at sexual maturity in the White Leghorn.

The coefficients in the quadratic equations between egg traits (Y) and 28 week body weight (X) are shown in Table 2. From these equations optimum body weight below or above which the various egg traits would decline are 1744.19g (egg number), 1789.39g (egg weight), 1731.91g (egg length), 1730.69g (egg breadth), 1732.03g (egg index), 1737.45g (albumen weight), 1734.57g (yolk weight), 1813.83g (shell weight) and 1727.93 (shell thickness).

The results indicate that efforts (breeding and management) towards limiting body weight in Harco Layers to the range of 1728 to 1814g will lead to satisfactory egg production, egg weight, egg shape and shell quality.

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