PRE - AND POST HATCH GROWTH OF NIGERIAN INDIGENOUS GUINEA FOWL AS INFLUENCED BY EGG SIZE AND HATCH WEIGHT.

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Received 22 April 1993; Accepted 1 March 1994

ABSTRACT

TWO experiments were conducted to investigate the effects of egg size on the embryonic growth during incubation and of egg size and hatch weight on growth to 12 weeks of age in the Nigerian indigenous Guinea fowl. Weight loss in eggs incubated was about 5.42% while weight gain was 1.02g with the fastest increase in the last trimester of incubation. At hatching, the keets were 72.42% of the weight of the eggs. Egg weight was positively and significantly ($P < 0.05$) correlated with embryonic weight and is reliable for estimating embryonic weight. Body weight up to 12 weeks of age differed when eggs were classified into small, medium and large size. Egg weight was significantly ($P < 0.05$) and positively correlated to body weight up to 4 weeks of age and egg weight was found to be reliable for estimating body weight up to 4 weeks only. Hatch weight was also significantly ($P < 0.05$) and positively correlated with subsequent body weight to 8 weeks of age.

Key words: Egg size, Embryonic Growth, Hatch Weight, Body Weight, Guinea fowl.

INTRODUCTION

The Nigerian indigenous poultry has remained principally uninvestigated and untapped as a contributor of animal protein despite its potential and numerical strength. These birds constitute a substantial supplier of animal protein to the rural dwellers who keep them rather extensively. The local chicken and guinea fowl are the two major indigenous poultry birds in Nigeria and are found in the various ecological zones in the country. In order to improve the performance of these birds certain base line information or data are

needed. Presently, not much information is available on the genetic potential and possibility of improving the performance of the birds.

It has remained for long unresolved the influence egg size could have on subsequent growth of the birds. If it is possible to determine the positive influence an egg could have on the young hatched from it, then only such eggs need be set. In the domestic fowl, egg weight is reported to enhance the growth of the chick it produces (Wiley, 1950; Kosin *et al* 1952, Tullet and Burton, 1982) but the duration and significance of such effect has remained conflicting (Godwin 1961; Merrit and Gowe, 1965).

No such information is available on the indigenous poultry especially Guinea fowl in Nigeria. This work, apart from bridging such a gap, aims at providing information that could assist genetic improvement schemes in the local guinea fowl in Nigeria from determining the influence of egg size on the pre-and post incubation growth of chicks or keets.

MATERIALS AND METHODS

TWO experiments were conducted to investigate the effect of egg size on development of embryos during incubation and on subsequent growth after hatching.

Experiment 1.

Three hundred and fifty four guinea fowl eggs were used in this study. The guinea fowl eggs were purchased from villages within Kainji lake Basin, Niger State. The eggs were numbered, weighed individually and set in an incubator at 37.80°C and 60% relative humidity. The incubation period was divided into seven periods of 4 days each. At the end of each period i.e. 4,8,12,16,20 24 and 28, fifty eggs were randomly ~~picked~~ reweighed and carefully

broken into a petril dish.

The embryo was separated from the umbilical veins and allantoic fluids, dried with tissue paper and then weighed.

Data collected on weight gains of the embryos, loss in weights of the eggs set and the embryos as percentages of the weight of eggs set were statistically analysed using the completely Randomised Design on an IBM computer (AMSTRAD 1512k) using the SAS programme. Correlation and linear regression analyses ($Y = a + bx$) were also calculated between egg weight and weights of embryos during the incubation period.

Experiment 2.

Three hundred and eleven guinea fowl eggs obtained from same sources as in experiment 1 were used for this study. Eggs were weighed individually, separated into three groups namely small ($\leq 30g$), medium (30 - 40g) and large ($> 40g$) and incubated. The keets hatched were wing tagged and weighed. Thereafter body weights were taken weekly to twelve weeks of age. The birds were raised in battery cages allowing $0.07m^2$ per bird with feed and water supplied *ad libitum*. The diets fed between 0 and 6 weeks of age contained 19.8% crude protein 4.8% fat, 6.1% crude fibre, 6.3% ash, 1.2% Ca, and 0.62%P while that fed from 6 to 12 weeks of age contained 15.6% crude protein, 4.4% fat, 7.4% crude fibre 0.8% Ca and 0.62%P

The body weight gains of the three groups rather than absolute body weight (Kosin *et al.* 1952), were statistically analysed using the Randomised Design (Steel and Torrie, 1980). Also data collected on weight gains were subjected to regression and correlation analyses (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The mean weight of the eggs incubated was $38.09 \pm 2.02g$. During the incubation period, there were significantly ($P < 0.05$) higher weight losses with advancement in incubation period (Table 1). During the first four periods (16

days) however weight losses were similar.

The principal source of energy for embryos during incubation are carbohydrates during the first 4 days of incubation, protein during days 4 - 9 and fat during the latter part of incubation (Oluyemi and Roberts, 1979). Since the end products of these metabolites are gases, these and water vapour and probably not other metabolites are the major source of egg weight loss during incubation. Though the guinea fowl eggs have thicker (0.51mm vs. 0.36mm), denser, stronger and harder shell (Ayorinde, 1987) more losses occurred from it during incubation than in the domestic fowl (Rahn *et al.* 1981, Christensen and McCorkie, 1982). This was likely due to a rather faster rate of utilization of nutrients from the yolk and albumen resulting from the faster growth of the embryos with a consequent faster rate of gas production. The significance of greater weight loss is decreased hatchability (Reinhart and Moran, 1979, Rahn, *et al.* 1981; Christensen and McCorkie, 1982). Thus, apart from inherently low fertility in the guinea fowl (Ayorinde and Okaeme, 1984; Ayorinde and Ayeni, 1986; Ayorinde, 1989), the often reported low hatchability might, apart from infertility, be associated with greater amount of weight losses during incubation.

Embryonic weights.

The weights of the keets during development in the egg are shown in table 2. Growth was most rapid during the last eight days of the incubation. During this period, the increased growth accounted for 63.04% of the sizes of the embryos at hatching. The embryos as percentages of the weights of the eggs that were set are shown in table 2. The balance represented the shell and membranes as well as the yolk and albumen that are yet to be used up. With advancement in incubation, there was a more rapid decrease in the amount of yolk and a gradual decline in albumen content. This is principally because yolk is the main source of nutrient to developing embryos.

Egg weight was positively correlated with embryo weight throughout the incubation period (Table 2) although it was significant ($P < 0.05$)

for periods 1,2 and 7 only. The result indicated that the larger eggs produced heavier embryos throughout the incubation period but that egg size effect was largely confined to the first 8 or 9 days. A simple linear regression equation was fitted for estimating embryonic weight (Table 3). The level of significances as determined from R, the coefficient of determination, indicated that embryonic weight can be reliably estimated from egg weight at periods 1 and 7 only. Thus like Tullet and Burton (1982) noted, egg weight could be a major determinant of chick weight at hatch.

Table 4 shows that the weight difference between keets from large, medium and small eggs remained significant ($P < 0.05$) to twelve weeks of age. The disadvantage suffered by keets hatched from a small egg persisted throughout the experimental period while those hatched from medium sized eggs had significantly ($P < 0.05$) lower body weight up to 28 days of age.

Table 5 indicates the superiority of the keets hatched from large sized eggs over those from small and medium sized eggs. The superiority over the keets hatched from small eggs decreased from 36.3% at hatching to 5.2% at 12 weeks of age while those from medium sized eggs were inferior by 27.8% at day old and only 1.4% at 12 weeks of age. There thus appears to be compensatory growth with age as the effect of initial disadvantage was overcome.

The degree of relationship between egg weight and hatch weight with subsequent growth rates of the keets are shown in table 6. Though the relationship in both cases was positive, the degree of relationship between egg weight and body weight was obliterated by the 5th week. The relationship between day old weight and subsequent weight was significant ($P < 0.05$) up to the 8th weeks only. The linear regression equation (Table 7) between egg weight and post hatch body weights also indicated significance ($P < 0.05$) up to 4 weeks. Thereafter, the effect of egg size was small and hence egg size cannot be reliably used for estimating body weight. The role of the egg size as a factor in determining

the subsequent body weight of the young hatched from it has remained unresolved. All the same there is considerable evidence on hand to show that the initial close correlation between egg weight and chick weight is rapidly reduced during the postnatal growth of the chick to a point where correlations are too low to be significant (Kosin *et al.*, 1952). There is considerable variation, however, as to the actual time the association becomes too low and insignificant. The present work indicates that there is significant influence of egg weight on subsequent body weight gains. Similar results were reported by Gardiner (1973) and Skoglund *et al.* (1952). The significant differences in body weights of keets hatched from the three egg sizes agree with most earlier results though differences existed in the age at which no appreciable effect commenced. In broilers, Proudfoot and Hulan (1981) were of the opinion that the size of the hatching egg can influence the body weight of chicks up to slaughter age. Significant effect up to 9 weeks of age was also reported by Wiley (1950). Godfrey *et al.* (1953) were however of the opinion that the phenotypic correlation of egg size with body weight indicated that the influence of egg size on early growth phases decreases rapidly after 2 weeks of age and has no appreciable effect at broiler age. The observation of the latter authors agree with the results obtained in the present work especially for medium and large eggs while the difference in the performance of keets hatched from small eggs were significantly inferior up to broiler age (8 weeks).

The correlation and degree of predictability between hatching weight and subsequent weight gains obtained in this work suggest that keets with higher percentage hatching weight were heavier to 6 and 8 weeks of age. The faster growth of the keets with higher hatching weight indicated that the percentage hatching weight reflects the efficiency of food utilization of the keets and that keet weight at day old could be an important variable in subsequent performance. In pullets, McNaughton *et al.* (1979) noted that the initial body weight could

affect body weight at onset of egg production. This would affect egg size, feed requirements of the hens and hence the economy of egg production.

The results indicated that guinea fowl eggs weighing below 30g should not be used for hatching as it appears that even if the birds are intended for egg production, they may not attain sufficient pullet body weight at the onset of production for maximum egg production during the laying period. This is important since in commercial poultry production eggs are normally graded and those classified as small or jumbo are not set. In the local poultry, however, the eggs produced are mostly small. The results indicated that even with this, obviously small eggs (below 30 g) should not be hatched.

ACKNOWLEDGEMENTS

The funds for this research was provided by the University of Ilorin Senate Research Grant Committee.

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Table 1: PERCENTAGE LOSSES IN WEIGHT OF GUINEA FOWL EGGS DURING INCUBATION($\pm$ SE).

Period of incubation	Guinea fowl
1.	2.05 ^a $\pm$ 0.12
2.	2.61 ^a $\pm$ 0.34
3.	3.79 ^a $\pm$ 0.38
4.	5.10 ^{ab} $\pm$ 0.36
5.	7.75 ^b $\pm$ 0.49
6.	7.85 ^b $\pm$ 0.55
7.	8.82 ^b $\pm$ 0.39
	5.42

Figures followed by different letter superscripts (a, b) differed significantly ($P < 0.05$)

Table 2: WEIGHT OF GUINEA FOWL EMBRYOS, EMBRYOS AS % OF EGGS SET AND CORRELATION BETWEEN EGG WEIGHT AND EMBRYO WEIGHT ($\pm$ SE)

Incubation period	wt. of embryo (g)	Embryo as % egg wt.	Egg wt: Embryo wt. correlation
1.	0.02 $\pm$ 0.01	0.05 $\pm$ 0.01	0.89*
2.	0.62 $\pm$ 0.17	1.60 $\pm$ 0.09	0.47*
3.	2.00 $\pm$ 0.23	5.19 $\pm$ 0.21	0.39
4.	8.38 $\pm$ 0.28	22.67 $\pm$ 4.21	0.21
5.	10.53 $\pm$ 0.86	27.71 $\pm$ 5.5	0.35
6.	16.89 $\pm$ 2.43	45.32 $\pm$ 6.0	0.38
7.	28.49 $\pm$ 1.61	72.42 $\pm$ 10.2	0.65*

* = $P < 0.05$

Table 3: REGRESSION EQUATION FOR ESTIMATING EMBRYO WEIGHT (Y) FROM EGG WEIGHT (X) OF LOCAL GUINEA FOWL.

Period	Regression equation	R	Level of significance
1.	$Y = 0.111 + 0.0035x$	0.78	S
2.	$Y = 1.80 - 0.0305x$	0.15	NS
3.	$Y = 2.36 + 0.015x$	0.01	NS
4.	$Y = 5.93 + 0.0256x$	0.03	NS
5.	$Y = 3.85 + 0.176x$	0.15	NS
6.	$Y = 1.44 + 0.49x$	0.16	NS
7.	$Y = 8.76 + 0.49x$	0.44	S

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Table 4: EFFECT OF EGG SIZE ON BODY WEIGHT (G) OF LOCAL KEETS.

Age (wks)	Small eggs	Medium eggs	Large eggs
Day old wt.	22.6 ^a	25.6 ^b	35.5 ^c
1.	36.4 ^a	39.4 ^b	52.9 ^c
2.	55.6 ^a	64.6 ^b	79.7 ^c
3.	82.5 ^a	97.0 ^b	114.0 ^c
4.	105.6 ^a	118 ^b	142.0 ^c
5.	139.0 ^a	161.0 ^{ab}	182.9 ^b
6.	191.0 ^a	213.8 ^{ab}	239.4 ^b
7.	262.1 ^a	285.8 ^{ab}	312.4 ^b
8.	327.8 ^a	349.0 ^{ab}	378.5 ^b
9.	358.4 ^a	374.4 ^{ab}	399.1 ^b
10.	378.0 ^a	394.7 ^{ab}	418.6 ^b
11.	403.7 ^a	413.1 ^{ab}	429.9 ^b
12.	407.8 ^a	424.6 ^{ab}	430.6 ^b

Means within same row having different superscripts differ significantly ($P < 0.05$)

Table 5: BODY WEIGHT OF KEETS FROM SMALL AND MEDIUM SIZED EGGS AS PERCENTAGE OF KEETS FROM LARGE EGGS.

Age (wks)	Small	Medium
0	63.7	72.2
1.	68.9	74.5
2.	69.7	81.1
3.	72.2	84.9
4.	74.4	83.2
5.	76.4	88.5
6.	79.8	89.3
7.	83.9	91.5
8.	86.6	92.2
9.	89.8	93.8
10.	90.3	94.3
11.	93.9	96.1
12.	94.8	98.6

Table 6. THE DEGREE OF PREDICTABILITY (R) OF BODY WEIGHT FROM EGG AND HATCH WEIGHTS IN LOCAL GUINEA FOWL

Ages (wks)	From egg weight	From hatch weight
Day old	82.81*	
1.	53.76*	75.96*
2.	35.75*	35.75*
3.	34.81*	35.75*
4.	30.25*	38.21*
5.	20.25*	38.44*
6.	18.49	30.25*
7.	17.64	21.16*
8.	14.44	20.25*
9.	10.89	17.60
10.	10.89	17.62
11.	8.41	14.44
12.	7.84	12.96

*P < 0.05

Table 7: REGRESSION EQUATION FOR ESTIMATING BODY WEIGHT (Y) FROM EGG WEIGHT (X)

Age (wks)	Regression equation
Day old	Y = -1.11 + 1.22x*
1	Y = -1.46 + 1.46x*
2.	Y = -3.22 + 2.44x*
3.	Y = -0.60 + 3.64x*
4.	Y = 36.31 + 3.71x
5.	Y = 45.97 + 4.50xNS
6.	Y = 51.83 + 5.99xNS
7.	Y = 79.72 + 8.24x NS
8.	Y = 20.17 + 13.58xNS

*P < 0.05; N.S. = Not significant (P > 0.05)