

Effect of egg size and day length on reproductive and growth performance, egg characteristics and blood profile of the Guinea fowl

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Abstract

This study was conducted to investigate the influence of egg size and day length on reproductive and growth performance, egg characteristics and blood profile of indigenous guinea fowls in Ghana. Two hundred and forty day old keets hatched from three different egg size groups: small (23-39g); medium (40-42g) and large (43-49g) were used in the experiment. The birds were subjected to artificial light between 6 to 36 weeks and the treatment groups were 12 hours of light: 12 hours of darkness, 14 hours of light: 10 hours of darkness, 16 hours of light: 8 hours of darkness and 18 hours of light: 6 hours of darkness with an average light intensity of 5.6 lux in a 3rd—4 factorial design. Data were analysis using General Linear Model (GLM) procedure of SAS. The best ($p<0.05$) hatchability was observed from medium size eggs with both small and large eggs showing poor results. Daily feed intake increased with an increase in the size of the eggs. Large size egg had the highest ($p<0.05$) yolk height, followed by both medium and small size eggs. Shell weight and shell thickness increased with increase in egg size. Age at sexual maturity reduced with increasing egg size. Similar trend was observed in egg size at first egg laid. Daily feed intake increased with increasing day length. Age at sexual maturity reduced with increasing day length. Similar trend was observed in egg size at first egg laid.

It was concluded that medium size eggs had higher hatchability. Daily feed intake increased with increasing egg size and day length. Age at sexual maturity decreased with increasing egg size and day length, whereas egg weight at first egg laying increased with increasing egg size and day length.

Keywords: *age at sexual maturity, dead in shell, fertility, hatchability, light and piped eggs*

Introduction

In many West African countries, Guinea fowl production is extremely low as compared to many European countries like Canada, France and Italy (Teye et al 2003). The major hindrances to Guinea fowl production in Ghana and Africa are seasonal changes, nutrition, poor reproductive performance and lack of proper management practices for efficient production (Moreki and Seabo 2012). Guinea fowls are known to be seasonal breeders and therefore, Guinea hens do not lay eggs in certain parts of the year. Variation in day length, nutrition and egg size affect the reproductive and growth performance of indigenous guinea fowls (Moreki and Seabo 2012). It is well known that the reproductive performance of Guinea fowl in Ghana and Africa is very poor due to insufficient lighting

regimen (Lien et al 2007). According to Lien et al (2007) the year-round production of Guinea fowl is not possible without proper lighting management; especially with regard to increase in day length. Typical poor egg production during minor rain season in Ghana is a consequence of insufficient lighting and reduced photoperiodic drive and this can be improved by egg selection (Moreki and Seabo 2012) and increase in day length (Lien et al 2007).

The ultimate goal of this experiment was to investigate the effect of egg size and day length on reproductive, growth and laying performance of indigenous Guinea fowl (*Numida meleagris*) in Ghana.

Materials and methods

The study was carried out at the Poultry Section of the Animal farm of the Department of Animal Science Education, University of Education, Winneba, Mampong-Ashanti campus, Ghana, from 2016 to 2017. Mampong-Ashanti lies in the transitional zone between the Guinea savanna zone of the north and the tropical rain forest of the south of Ghana along the Kumasi-Ejura road.

A total of 240 day old keets hatched from three different egg size groups: small (23-39g); medium (40-42g) and large (43-49g) were randomly selected and used for the experiment. The birds were brooded for 6 weeks and subjected to natural daylight and darkness before being transferred to a deep litter floored house. Each group was randomly assigned to a lighting programme of either 12 hours of light: 12 hours of darkness, 14 hours of light: 10 hours of darkness, 16 hours of light: 8 hours of darkness and 18 hours of light: 6 hours of darkness using bright energy saving bulbs of 50 watts and a rechargeable lamp containing 40 watts with an average light intensity of 5.60 lux.

Percentage fertility was calculated by expressing the total number of fertile eggs as a percentage of the total number of eggs set. Arithmetically.

Percentage hatchability was determined as the total number of eggs hatched as a percentage of total number of fertile eggs.

Number of dead in shell was determined by breaking the un-hatched eggs. Number of piped was determined by checking for those eggs that cracked but the keets did not emerge. Feed intake was calculated as the difference between the initial feed offered to birds and the feed left over. Growth rate was calculated as the difference between the final body weight of birds and the initial body weight divided by the number of days.

Body weight gain (g/bird) was calculated by subtracting the initial weight from their final weights. Feed conversion ratio (FCR) was computed as the feed intake divided by the total weight gain. Arithmetically

Age at sexual maturity was estimated to be the age at which five percent (5%) of the pullets laid their first egg. External and internal egg characteristics were considered at 24 weeks. Haugh unit was calculated using the following formula adopted from Haugh (1937). $HU = 100 \log (H - 1.7w^{0.37} + 7.6)$

Where, HU = Haugh Unit, H =Albumen height (mm) W= Egg weight (g)

Hen day egg production was therefore calculated as the percentage of the number of eggs laid to the number of hen days.

The data collected was analyzed using General Linear Model (GLM) procedure of Statistical Analysis System (SAS for Windows, version 7). The means were separated by using the probability of difference (PDIFF) procedure of SAS (SAS, 2008). Two-way interactions among fixed variables were not significant and therefore ignored.

Results and discussion

Table 1. Effect of egg size on reproductive performance and six months growth parameters

	Large	Medium	Small	SEM	<i>p</i>
Fertility, %	51.8	56.8	45.8	7.15	0.07
Hatchability, %	25.0 ^c	50.5 ^a	37.9 ^b	6.36	0.02
Dead in Shell, %	25.3	16.4	22.5	5.14	0.12
Piped eggs, %	18.4	11.4	17.4	2.31	0.18
<i>Growth parameters</i>					
Feed intake, g	67.33 ^a	67.60 ^a	36.85 ^b	0.41	0.02
Growth rate, g	37.91	65.18	35.26	0.68	0.06
Body weight, kg	1.21	1.17	1.14	0.02	0.06
FCR, g	0.06	0.01	0.88	0.02	0.32

^{abc} Means bearing different superscripts in the same row are different at $p<0.05$.
SEM= standard error of means p = probability of mean effects

Figure 1. Effect of egg size on fertility and hatchability

Table 2. Effect of egg size on laying performance, egg characteristics and biochemical parameters

	Large	Medium	Small	SEM
Age at sexual maturity, days	151 ^c	175 ^b	182 ^a	5.17
Hen- day egg production, %	67.6	66.3	66.4	2.13
Hen- house egg production, %	66.2	31.7 ^a	65.3	28.1 ^b
Egg size at first egg laying, g	24.9 ^c	1.56	2.41	0.19
Egg characteristics				
Haugh unit	83.9	89.9	86.6	0.31
Egg diameter, mm	3.85	3.89	3.85	0.02
Yolk height, mm	2.15 ^a	2.05 ^b	1.96 ^b	0.03
Yolk weight, g	16.8	16.9	15.9	0.33
Yolk colour	3.50	2.50	2.50	0.45
Albumen height, mm	2.34	2.39	2.30	0.08
Albumen weight, g	19.9	21.6	18.6	1.13

Shell weight, g	10.33 ^a	8.00 ^b	7.18 ^c	0.24
Shell thickness, mm	0.09 ^a	0.06 ^c	0.07 ^b	0.01
Biochemical parameters				
Total serum protein, g/dl	55.2 ^a	53.7 ^b	52.5 ^c	1.38
Albumin, g/dl	23.0	23.2	21.6	0.49
Globulin, g/dl	5.60	5.93	5.03	0.33
Cholesterol, g/dl	3.35	3.60	3.53	0.25

^{abc} Means bearing different superscripts in the same row are different at $p < 0.05$.
SEM= standard error of means p = probability of mean effects

Table 3. Effect of day length on six months growth parameters and laying performance

	12L : 12D	14L : 10D	16L : 8D	18L : 6D	S
Feed intake, g	65.3 ^d	65.2 ^c	66.9 ^b	69.4 ^a	0
Growth rate, g	36.3	36.6	37.5	37.6	0
Body weight, kg	1.11	1.12	1.11	1.16	2
FCR (g)	0.06	0.06	0.06	0.06	0

Laying performance

Age at sexual maturity (days)	179 ^a	174 ^b	155 ^c	150 ^d	4
Hen- day egg production (%)	64.6	64.9	66.4	66.9	1
Hen- house egg production (%)	62.5	63.4	65.9	65.5	1
Egg weight at first egg laying (g)	25.6 ^d	27.2 ^c	29.1 ^b	30.9 ^a	1

^{abc} Means bearing different superscripts in the same row are different at $p < 0.05$
SEM= standard error of means, p = probability of mean effects, FCR= Feed conversion ratio, 12L: 12D=12 hours of light: 12 hours of darkness, 14L: 10D=14 hours of light: 10 hours of darkness, 16L: 8D=16 hours of light: 8 hours of darkness, 18L: 6D=18 hours of light: 6 hours of darkness.

Figure 3. Effect of different lighting regime on feed intake and growth rate.

Effect of egg size on reproductive performance

The size of Guinea fowl eggs had influence on hatchability (Table 1). Medium size eggs had the highest hatchability followed by small and large eggs respectively. The differences observed among hatchability in this experiment could be attributed to the thickness of the shell and the size of the egg (Sklan et al 2003). This finding is in support of the observation made by Abiola et al (2008) who reported 96.67% hatchability for medium size eggs from chicken.

Effect of egg size on six months growth parameters

Daily feed intake increased with an increase in the size of the eggs that produced the birds. Large and medium size eggs recorded the highest feed intake followed by small size eggs. This corresponds with the results reported by Song et al (2000). The variation in feed intake observed in this experiment could be as a result of the size of the egg. This is because birds hatch from large size eggs have higher body weight at day old which influence feed intake and enhances rapid growth of domestic fowls (Abiola et al 2008).

Effect of egg size on laying performance

Age at sexual maturity reduced with increasing egg size. Similar trend was observed in egg size at first egg laid. This could be explained that large size eggs have higher protein levels which increase the total protein concentration in the blood of a newly hatch, enhance early maturity and increase egg weight as compared to both medium and small (Saina et al 2005). This observation agrees with the finding of Nahashon et al (2006).

Effect of egg size on egg characteristics

Large size egg had the highest yolk height, followed by medium and small size eggs. The differences observed can be explain that large size eggs have sufficient nutrients and large surface area which

increased the height of the yolk (Sklan et al 2003). Shell weight and shell thickness increased with increase in egg size. Large size eggs had the highest shell weight as compared to both medium and small size eggs. Large size eggs had the tallest shell height whilst medium and small eggs had similar thickness. The significant differences observed in shell weight and shell thickness can be explained that small size eggs have higher surface to volume ratio which might have resulted in the lowest shell weight and thickness (Nahashon et al 2006). This observation agrees with the finding of Song et al (2000).

Effect of egg size on biochemical parameters

There was reduction in total serum protein with reducing egg size. The significant difference observed in total serum protein could be attributed to the size of the egg as well as the yolk content. This is because egg protein increased with increasing in the yolk content (Cheng 2010). Smith (2001) observed that egg size determines the composition of protein in the egg.

Effect of day length on six months growth parameters

Daily feed intake increased with an increase in day length. The highest daily feed intake was recorded in 18L: 6D, followed by, 16L: 8D, 14L: 10D and 12L: 12D respectively. This trend could be due to the fact that increasing day length allowed maximum feeding time (Zheng et al 2013). Physiologically, increases in day length inhibit the secretion of the hormone leptin (leptin is often referred to as the satiety hormone) from the adipose cell and ensures that the birds will feed throughout the lightning period (Kong et al 2004).

Effect of day length on laying performance

Age at sexual maturity and egg size reduced with increasing light. The significant differences observed could be explained that increased in day length triggers the anterior pituitary to stimulate the releases of follicle stimulation hormones and luteinizing hormone which promote follicular growth, development and stimulate ovulation which might had influenced age at sexual maturity and egg size at first egg laying (Lien et al 2007).

Conclusions and recommendations

- Results from the present study show that medium size eggs had higher hatchability as compared to both large and small size eggs.
- Feed intake is directly linked with the size of the egg. Daily feed intake increased with increasing egg size. Age at sexual maturity decreased with increasing egg size, whereas egg weight at first egg laying increased with increasing egg size.
- Daily feed intake in Guinea fowls increased with increasing day length. Age at sexual maturity decreased with increasing day length, whereas egg weight at first egg laying increased with increasing day length.
- It is recommended to farmers that medium sized eggs are more suitable for setting in the incubator in order to obtain good hatchability.

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