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Effect of Egg Weight on Hatchability and Chick Hatch-weight of COBB 500 Broiler Chickens

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ABSTRACT

This study was conducted to determine the effect of egg weight on hatchability and chick hatch-weight of COBB 500 broiler chickens. A total of 396 COBB 500 hatchable eggs classified according to three different egg weight groups as small: (<49 g) medium: (50-59 g) and large: (60-69 g) were used in the experiment. A complete randomized design of three treatments, three replicates with each replicate having 44 eggs was used for the experiment. Simultaneously a linear type equation was used to determine the relationship between egg size and responses in hatchability values and chick hatch-weight. Results indicated that large-sized eggs produced chicks with higher ($p<0.05$) hatch-weight than medium and small-sized eggs. However, no differences were detected with fertility rate percentage, hatchability percentage and percentage hatch of fertile. It is therefore concluded from the result of the present study that sorting of COBB 500 broiler chicken breeder eggs by weight prior to incubation might be advantageous in producing uniform size COBB 500 broiler chicken hatchlings to meet specific market demands with improved efficiency.

Key words: Broiler chickens, hatchability percentage, fertility rate percentage, egg sizes, South Africa

INTRODUCTION

The modern broiler chicken has been reported to be able to achieve the same body weight in less than a third of the time as compared to their random bred predecessors (Havenstein *et al.*, 2003). However, while the time spent on the farm may be decreasing, the embryo has been found to still require 21 day incubation period which translates into a greater percentage of the life of the broiler chicken being spent in the incubator. This places a greater emphasis on the egg under which this embryonic period of growth occurs. As a result, knowing the effect of egg weight on hatchability and chick hatch weight has become very important. At present, studies have nonetheless demonstrated conflicting evidence indicating that performance in broiler chickens in terms of hatchability and chick-hatch weight may be closely related to the weight of the eggs (Wilson, 1991; Uluocak *et al.*, 1995; Kalita, 1994; Abiola, 1999; Bell and Weaver, 2002; Rashid *et al.*, 2005; Kingori *et al.*, 2003). Due to this conflicting and inconsistence findings, interest in determining the effect of egg weight on hatchability and chick-hatch weight of COBB 500 broiler chickens has become very important. Beyond this, because as suggested by Kingori (2011) that chick weight, fertility and hatchability are interrelated heritable traits that vary among breeds, variety or individuals in a breed or variety it therefore becomes very important to understand the effect of egg weight on these traits in COBB 500 broiler chickens. This study was therefore designed to determine the effect of hatching egg weight on hatchability and chick hatch-weight of COBB 500 broiler chicken.

MATERIAL AND METHODS

Study area: A study was conducted at rainbow frames Rustenburg hatchery, North West; South Africa in 2012. The hatchery was located at about 18 km North West of Rustenburg. The ambient temperature around the study area was above 31°C during summer and around 24°C during winter season. Annual rainfall is between 456.8 and 489.3 mm.

Experimental procedure: A total amount of 396 hatchable eggs of different sizes produced by COBB 500 broiler hens, aged 55 weeks of age was used to determine the effect of egg size on hatchability and chick hatch-weight. All the hens used for egg collection were maintained under similar environmental and management conditions and feed and water was offered ad libitum. All the eggs used in this study were collected between 10: 00 and 11: 00 h. At commencement of the study, the eggs were numbered and weighed individually using sensitive weighing scale (Mettler-Toledo sensitive weighing balance) and later grouped into three egg size categories as follows: Small (<49 g), medium (50-59 g) and large (60-69 g) thus, ending up with three different incubating egg size groups with three replicates per group with an average egg weight of 54.60 g. Each egg size group had 132 eggs with 44 eggs per replicate. Thereafter, the eggs were fumigated with formalin on potassium permanganate in the ratio of 1: 2 for 15 min and then were randomly set into a forced-draft single stage incubator at dry bulb temperature of 37.5°C and wet bulb temperature of 28.3°C with the broad ends pointing upwards. On the 18 day of incubation, all eggs were candled and those with evidence of living embryos transferred from the turning trays to hatcher baskets. Number of eggs that hatched per replicate within each egg size group was recorded at 21.5 day of incubation.

Data collection: The hatchability percentage was determined in each replicate by dividing the number of hatched eggs per replicate by the total number of eggs set in each replicate and then multiplying by one hundred. The hatchling weight was measured by weighing the chicks in each replicate immediately after hatching:

$$\text{Fertility rate (\%)} = \frac{\text{No. of fertile eggs}}{\text{No. of egg incubated}} \times 100$$

$$\text{Formula for hatchability (\%)} = \frac{\text{No. of chicks hatched}}{\text{No. of fertile egg incubated}} \times 100$$

$$\text{Hatch of fertile (\%)} = \frac{\text{Hatchability}}{\text{Fertility rate}} \times 100$$

Statistical analysis: Effect of egg weight on hatchability and hatch weight of COBB 500 broiler chickens were analyzed by using the General Linear Model (GLM) procedures of the statistical analyses system (SAS, 2008). The statistical model will be:

$$Y_{ijk} = \mu+T_1+\Sigma_{ijk}$$

Where:

Y_{ijk} = Overall observation (hatchability, chick weight, fertility rate and hatch of fertile percentage)

μ = Population means

T_1 = Effect of different egg weights (small, medium and large)

Σ_{ijk} = Residual effect

Duncan test for multiple comparisons was used to test the significance of differences between treatment means at 5% significance level ($p<0.05$). The relationships between responses in hatchability values or chick hatch-weight to egg size were modeled using a linear regression equation (SAS, 2008) of the form:

$$Y = a+bx$$

Where:

Y = Hatchability value or chick hatch-weight

a = Intercept

b = Coefficients of the linear equation

x = Egg weight

The linear model was fitted to the experimental data by means of NLIN procedure of SAS (SAS, 2008). The linear model was used because it gave the best fit.

RESULTS

Results of the effects of egg weight on fertility rate percentage, hatchability and chick hatch weight of COBB 500 broiler chickens are presented in Table 1. Results indicate that egg weight have no significant effect ($p>0.05$) on fertility rate percentage and hatchability of COBB 500 broiler chickens. However, fertility rate percentage ranged between 92.40-90.90% while percentage hatchability ranged between 90.89-92.43%, respectively. Large-size eggs produced chicks with higher ($p<0.05$) chick hatch-weight than medium and small sized eggs but there were no significant differences ($p>0.05$) in percentage hatch of fertile eggs among the three egg size groups.

Table 1: Effect of egg-size on hatchability and chick-hatch weight of COBB 500 broiler chickens

	Hatching egg sizes			
Variables	Small	Medium	Large	SE
Fertility rate (%)	92.40	90.90	90.90	2.321
Hatchability (%)	92.43	90.89	90.92	2.325
Chick hatch weight (g $bird^{-1}$)	42.33^c	44.13^b	49.01^a	0.336
Hatch of fertile (%)	100.00	99.98	100.00	2.368

^{a,b,c}Means in the same column not sharing a common superscript are significantly different ($p<0.05$). SE: Standard error

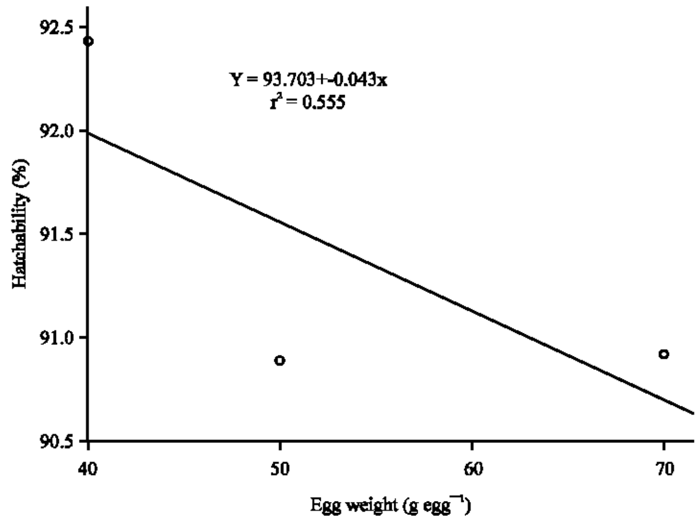

Fig. 1: Relationship between egg weight and responses in hatchability of COBB 500 broiler chickens

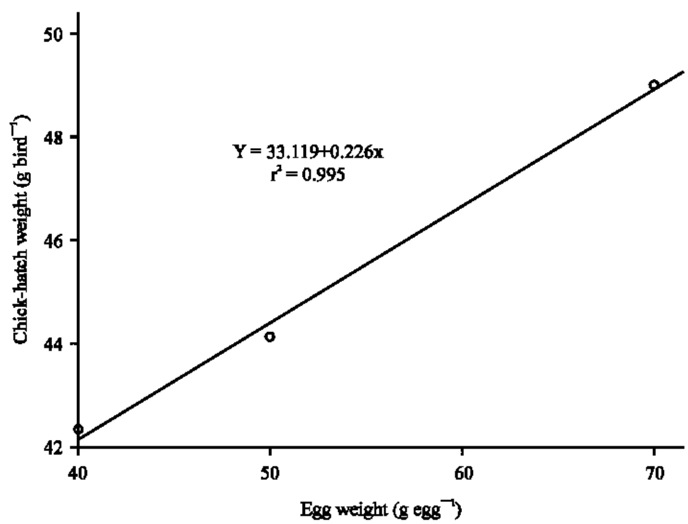

Fig. 2: Relationship between egg weight and responses in chick-hatch weight of COBB 500 broiler chickens

Figure 1 and 2 present a series of linear regression that predict the relationship between hatching egg weight and hatchability and chick hatch-weight of COBB 500 broiler chickens. Result indicate that hatchability was inversely correlated with egg size (R^2 = 0.555) and chick hatch-weight was moderately and positively correlated with egg weight (R^2 = 0.995), respectively.

DISCUSSION

The egg weights used in the present study ranged between <49-69 g with an average egg weight of 54.60 g. The average egg weight value of 54.60 g is slightly higher than the average egg weight of 52.81 g of Mbajiorgu (2011) and 52.2 g of Fourie and Grobbelaar (2003) reported for indigenous Venda chicken eggs but lower than the average egg of 60 g that supported optimum hatchability in indigenous Venda chickens as observed by Mbajiorgu (2011). These differences in average egg weight sizes were not unexpected and could be attributed to breed differences. However, as revealed in the present study, very high fertility rate ranging from 92.40-90.90% were observed in the present study. This rate is similar to those reported by Kamanli *et al.* (2010) and Islam *et al.* (2002). It was also observed in the present study that the egg fertility rate percentage was not affected by egg size of COBB 500 broiler chickens. The non-significant effect of egg weight on fertility rate percentage in COBB 500 broiler chickens is similar to the observations made by Petek *et al.* (2005) in quils, Sahin *et al.* (2009) in breeder hens and Kamanli *et al.* (2010) for ATAK-S Brown layers but contrary to the findings of Caglayan *et al.* (2009) in rock partridge.

On the other hand, the non-significant effect of egg weight on percentage hatchability might imply that effect of egg weight was similar on this parameter regardless of the different egg sizes used in the study. Contrary to the present findings, Mbajiorgu (2011) observed differences in hatchability values of indigenous Venda chicken eggs. Similarly, the very high hatchability percentage values ranging from 90.89-92.43% obtained in the present study are different from the 88.57% observed in Fayumi chickens, 80.77% observed in dual purpose Rhodes Island Red RIR and 60.00% observed in Desi chicken as reported by Farooq *et al.* (2001) on the basis of fertile eggs set. Perhaps, the improved percentage hatchability values associated with the COBB 500 broiler chickens could be attributed to their genetic make up for better propagation and reproductive abihty than the Fayumi, RIR and Desi chickens, respectively. Moreover, Desi chicken according to Farooq *et al.* (2001) is indigenous non-descript with no well documented characters for better hatchability.

Beyond this, because Farooq *et al.* (2001) suggested that hatchability is reduced with reduced fertility. Taking this further might also mean that hatchability will be improved with improved fertility. Thus, the very high hatchability percentage values ranging from 90.89-92.43% obtained in the present study mighty indicate that hatchability was limited by fertility of the eggs incubated and not by the hatcheries ability to effectively hatch eggs. This fact is supported by the similar percentage hatch of fertile eggs recorded for the three egg size groups. Such a high percentage fertility rate is not uncommon in poultry as similarly observed by Kamanli *et al.* (2010) and Islam *et al.* (2002) and hence may improve hatchability.

Results of the present study indicate that large-size eggs produced chicks with higher chick hatch-weight than medium and small sized eggs. This observation is not unexpected since it is known that a strong and positive correlation exists between egg size and chick hatch-weight in broiler chickens (Tullett and Burton, 1982; Abiola *et al.*, 2008; Shanawany, 1987) and in poults (Bray, 1965). Furthermore, it is also known that heavier eggs contain more nutrients than small or medium sized eggs (Williams, 1994) and hence as a result, chicks from heavier eggs tend to have more yolk attachment at hatching (Hassan *et al.*, 2005; Woanski *et al.*, 2006).

Thus, this yolk attachment is utilized by the chick after hatching and the potential performance of day-old chicks may depend on the quality and quantity of this yolk. Applying this to the present finding, may explain the differences in chick hatch weight among the different egg size groups. Similarly, Narkhede *et al.* (1981) also reported positive correlation ($r = 0.93$) of egg weight with hatching chick weight in crossbred chicken (Rhode Island Red×White Leg Horn).

On the other hand egg weight was found non-significantly but inversely correlated ($r = 0.555$) with hatchability. This Suggests that increased egg weight would result in decrease of hatchability. Farooq *et al.* (2001) and Narkhede *et al.* (1981) also found negative correlations between egg weight and hatchability in crossbreed chickens.

As shown in their studies, heavier eggs tended to result in lower hatchability. However, comparison of percentage hatchability values in the present study in relation to egg weight revealed non-significant differences. Thus, findings may not lead to a valid conclusion here because most of the eggs with larger weight of (60-69 g) were similarly fertile like others in the present study. It would be rather misleading to report present hatchability correlation result on the basis of egg weight. However, keeping in view findings of Kalita (1994) whose report suggested that too large eggs must be discarded while setting eggs in the incubator which is true because too large eggs may create problems in incubation process.

Egg weight was also found significantly and positively correlated (r = 0.995) with hatching chick weight suggesting that increased egg weight will result in increased hatching chick weight. The biochemical reason for this phenomenon as suggested by Williams (1994) is that heavier eggs contain more nutrients than small eggs and hence, developing embryos from heavier eggs tend to have more nutrients for their growth requirements. The present findings is similar to the findings of Narkhede *et al.* (1981) who also reported a positive correlation (r = 0.93) of egg weight with hatching chick weight in crossbred chicken (Rhode Island Red×White Leg Horn). Tona *et al.* (2002) also observed similar findings in broiler chickens. However, contrary to the present findings, Asuquo and Okon (1993) reported that egg size within the intermediate weight range of 45-56 g hatched heavier chicks than small or large eggs.

CONCLUSION AND RECOMMENDATION

The range of egg sizes used in this study had a non-significant effect on percentage fertility rate and hatchability of COBB 500 broiler chickens. However, large-sized eggs produced chicks with higher hatch-weight than medium and small-sized eggs. It is therefore concluded from the result of the present study that sorting of COBB 500 broiler chicken breeder eggs by weight prior to incubation might be advantageous in obtaining higher day-old chick weight in COBB 500 broiler chickens. This will help to produce uniform size COBB 500 broiler chicken hatchlings to meet specific market demands with improved efficiency. It is also recommended that future work may also address the effect of egg quality parameters on hatchability and chick-hatch of COBB 500 broiler chickens.

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