EFFECT OF HATCHING EGG SIZE ON HATCHABILITY
AND CHICK HATCH-WEIGHT OF INDIGENOUS VENDA CHICKENS

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ABSTRACT

An experiment was conducted to determine the effect of hatching egg size on hatchability and hatch-weight of indigenous Venda chickens (Gallus gallus domesticus). Three different egg size groups classified into small: (<49 g) medium: (50-59 g) and large:(60-69 g) were used in the experiment. A complete randomized design was used for the experiment. Simultaneously a quadratic type equation was used to determine the egg size for optimum hatchability and hatch-weight. Large-sized eggs had higher (P<0.05) hatchability than medium and small-sized eggs. However, medium-sized eggs produced chicks with higher (P<0.05) hatch-weight than small and large-sized eggs. Results from quadratic analysis indicated that egg weight of 67 g supported optimum hatchability while optimum-hatch weight was achieved with an egg weight of 60 g. These values are higher than the average egg weight of 52.81 g recorded for the three different egg size groups used in the experiment. This may indicate that improvement in egg size would be needed in order to maximize the hatchability potentials and day-old chick weight in indigenous Venda chickens.

Key words : Egg weight, Indigenous Venda chickens, Hatchability, Hatch-weight, Optimization.

INTRODUCTION

The avian egg is a biological system intended to ensure the well-being of the embryo and its successful hatching into a fully developed chick (Narushin and Romanov, 2002). As such, hatching egg size has become increasingly important as poultry producers attempt to maximize hatchability. Hatchability is a function of number of chicks hatched, and is affected by numerous factors especially egg size and age of breeders, season of the year and nutrition, temperature and humidity throughout the incubation period, egg handling and storage (Wilson 1997). In addition, it has been observed that hatchability, chick weight and subsequent growth performance of chicks are closely related to the weight of the egg. In general, chicks born from excessively small or large eggs exhibit low growth rates (Uluocak et al., 1995). In broiler chickens, Wilson (1991) and Kalita (1994) reported a higher hatchability for intermediate sized eggs compared to too small or too large eggs. In another study with broiler chickens, Abiola (1999) reported that egg size typically affects hatching size in birds because the main effects of egg size lies in the mass of the residual yolk sac that the chick retains at hatching. In contrast, there is a paucity of information on the effect of egg size on hatchability and chick weight in indigenous chickens. Kitalyi (1998) suggested that the egg production level of indigenous hens is generally low with only 40-60 small sized eggs produced per bird per year under small holder management conditions. Therefore,

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improving the hatchability of these eggs will help to improve the productivity of these chickens. This study was therefore designed to determine the effect of hatching egg size on hatchability and chick hatch-weight of indigenous Venda chicken.

MATERIALS AND METHODS

A study was conducted at the Experimental farm, University of Limpopo, South Africa in 2009 with a total 270 hatchable eggs of different sizes produced by 75 Venda laying hens, aged 78 weeks in order 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 1000 and 1100 hours. 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 52.81g. Each egg size group had 90 eggs with 30 eggs per replicate. Thereafter, the eggs were fumigated with formalin on potassium permanganate in the ratio of 1:2 for 15 minutes and then were randomly set into a forced-draft single stage incubator at dry bulb temperature of 37.5 ºC and wet bulb temperature of 28.3 ºC with the broad ends pointing upwards. On the 18 day of incubation, all eggs were candled and those with evidence of living embryos were 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 hatching weight was measured by weighing the chicks in each replicate immediately after hatching.

Statistical analysis

Effect of egg weight on hatchability and hatch weight of Venda chickens were analyzed using the General Linear Model (GLM) procedures of the statistical analyses system (SAS 2008). The statistical model used was:

\[ Y_{ij} = \mu + T_i + \varepsilon_{ijk} \]

Where: \( Y_{ij} \) = the overall observation (hatchability and chick weight)
\( \mu \) = population means
\( T_i \) = Effect of different egg weights (small, medium and large)
\( \varepsilon_{ijk} \) = 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 responses in hatchability values or chick weight to egg weight were modeled using the following quadratic equation

\[ Y = a + b_1x + b_2x^2. \]

Where \( Y \) = Optimum hatchability value or chick weight, \( a \) = intercept, \( b \) = coefficients of the quadratic equations; \( x \) = egg weight and \(-b_1/2b_2 = x\) value for optimum response. The quadratic model was fitted to the experimental data by means of the NLIN procedure of SAS (SAS, 2008).

RESULTS AND DISCUSSION

Results of effects of hatching egg size on hatchability and chick hatch weight of indigenous Venda chickens are presented in Table 1. Results indicate that percentage hatchability ranged between 28.1 - 48.3 %. Percentage hatchability among the three egg size groups were much lower than the near 100 % reported for Nigerian local chickens (Atteh, 1990). A number of factors including egg age (Tarongoy et al., 1990), Storage condition (Brah and Sandhu, 1989), Age of flock (Rogue and Soares, 1994; Buhr, 1995), System of husbandry and rearing technology (Weis, 1991), Mating system (Gebhardt-Henrich and Marks, 1991), Incubation relative
humidity and egg turning angle (Permsak, 1996) have been shown to influence the hatchability of poultry eggs. As such, the low hatchability values recorded for the three egg size groups may however, not be a true reflection of the genetic potential of the indigenous Venda chicken breed, as most of the embryo died few days prior to hatching. Such a late embryonic mortality is not uncommon in poultry and

### Table 1: Effect of hatching egg size on hatchability and chick hatch-weight of indigenous Venda chickens.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatchability (%)</td>
<td>28.1a</td>
<td>45.5b</td>
<td>48.3c</td>
<td>0.02</td>
</tr>
<tr>
<td>Chick hatch weight (g/bird)</td>
<td>29.0a</td>
<td>32.0b</td>
<td>30.0c</td>
<td>0.01</td>
</tr>
</tbody>
</table>

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

### Table 2: Effect of hatching egg size on optimal hatchability (%) and chick hatch weight (g/bird) in Venda chickens.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Formula</th>
<th>Optimal egg weight</th>
<th>Y-Value</th>
<th>r²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hatchability</td>
<td>Y = -268.203 + 9.624x - 0.073x²</td>
<td>67</td>
<td>48</td>
<td>1.000</td>
</tr>
<tr>
<td>Chick hatch weight</td>
<td>Y = -24.165 + 1.820x - 0.015x²</td>
<td>60</td>
<td>31</td>
<td>0.998</td>
</tr>
</tbody>
</table>

r²: Regression coefficient Y-Value : Optimal Y-Value
Optimal egg weight: Egg weights for optimal hatchability and chick hatch weight, respectively.

![Graph](image_url)

**Fig. 1**: Effect of egg weight on hatchability of indigenous Venda chicken.
Thus, it is possible that egg quality and storage conditions might have caused these differences as similarly observed by Seker et al. (2004). Contrary to this finding, Wilson (1991) and Kalita (1994) reported higher percentage hatchability for intermediate sized eggs compared to too small or too large eggs in broiler chickens.

As revealed in the present study, medium-sized eggs produced chicks with higher (P<0.05) hatch-weight than small and large sized eggs. The physiological explanation for this effect is not clear and merits further investigation; however it is known that a positive correlation exists between egg size and chick weight in broiler chickens (Abiola et al., 2008; Shananwany, 1987) and pouls (Bray, 1965). This might reflect the differences between indigenous and broiler chickens in terms of their genetic and physiological abilities to achieve differences in chick hatch weights according to different egg sizes.

Table 2 and Figures 1 and 2 presents a series of quadratic regressions that predict optimum hatching egg size for hatchability and chick hatch weight of indigenous Venda chicken. Results indicate that hatchability was optimized at hatching egg weight of 67g ($r^2 = 1.000$) and chick hatch weight at 60 g ($r^2 = 0.998$), respectively. This may imply that the egg weight for optimum hatchability in indigenous Venda chickens is higher than that for optimum hatch-weight and may suggest that an alteration of tissues takes place, particularly muscle and fat deposits, which may differ in nutrient...
However, the values of 67 g and 60 g for optimum hatchability and chick-weight obtained in the present study are higher than the average egg weight of 52.81g obtained for all the three egg size groups used for the experiment. This may indicate that improvement in egg size would be needed in order to maximize the hatchability and chick-hatch weight in indigenous Venda chickens.

**CONCLUSION**

The range of egg sizes used in this study had a significant effect on hatchability and chick weight in indigenous Venda chickens. Large sized-eggs had a higher hatchability value of 48.3% than medium and small-sized eggs. However, medium-sized eggs produced chicks with higher hatch-weight than small and large sized eggs. It was concluded from the result of the present study that sorting of eggs by weight prior to incubation might be advantageous in obtaining higher hatchability and better day old chick weight in indigenous Venda chickens. This will help to produce uniform size Venda chickens to meet specific market demands with improved efficiency.

**REFERENCES**


