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Effect of Egg Weight on Egg Traits and Hatching Performance of Turkey (*Meleagris gallopavo*) Eggs

Research Article

M. Anna Anandh[1*], P.N. Richard Jagatheesan[2], P. Senthil Kumar[2], G. Rajarajan[2] and A. Paramasivam[2]

[1] Veterinary College and Research Institute, Eastern Garden, Orathanadu, 614625, Thanjavur District, Tamil Nadu, India
[2] Tamil Nadu Veterinary and Animal Science University, Regional Research Centre, Pudukkottai, 622004, Tamil Nadu, India

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*Correspondence E-mail: drmaatnvasu@yahoo.com
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ABSTRACT

The study was conducted to determine the effects of turkey *(Meleagris gallopavo*) egg weight on certain egg traits and hatching performance. A total of 178 turkey eggs comprising of three different egg weight groups below 60 g (G I), 61 to 69 g (G II) and above 70 g (G III) were used for this study. Average egg weight (g), egg length (cm), egg breadth (cm) and egg volume (cm^3) values increased with increasing egg weight. There was a significant ($P<0.01$) difference in egg traits between egg weight groups except shape index. Percentage of infertile eggs and embryonic mortalities were decreased whereas percentage of dead in shell, total egg hatchability, fertile egg hatchability, fertility and poult hatched weight values were increased as weight of egg increased. Results of higher hatching performance was obtained for eggs that weighed above 71 g and were statistically significant ($P<0.01$) from eggs that weighed between 60-69 g and below 60 g. It is concluded that turkey eggs that weigh above 70 g would be suitable for setting to obtain better reproductive performance followed by medium sized turkey eggs (6-69 g) and small sized turkey eggs weighed below 60 g.

KEY WORDS egg traits, egg weight, fertility, hatchability, hatching, turkey.

INTRODUCTION

The turkey *(Meleagris gallopavo)* in a well known bird in western countries, but in the rest of the world especially in developing countries it is yet to be well-established on a commercial basis. The turkey industry has been slowly developing and more recently, production units have been established in many parts of the world. Hatchability is an important economic trait in domestic poultry (Hassan and Nordskog, 1971).

There are lots of factors affecting the hatching process and post hatching performance in poultry. One such factor is the weight of the hatching egg (Altan *et al*. (1995). Egg size has been widely studied because it can be highly variable.

The physical characteristics of the egg play an important role in the processes of embryo development and successful hatching.

The most influential egg parameters are weight, shell thickness and porosity, shape index (maximum breadth to length ratio) and the consistency of the contents (Narushin and Romanov, 2002). Hatchability, hatching time, embryonic mortalities, chick weight at hatch and chick's developmental performance at post hatch period are directly affected by hatching egg weight (Shanawany, 1987 and Altan *et al*. 1995).

It has been reported that the hatchability and fertility of heavier eggs is better than that of light weight eggs (Sachdev *et al*. 1985). Baspinar *et al.* (1997) reported that egg size, egg weight and shape index have an important influence on overall hatchability, chick size and one day old chick weight. Senapati *et al.* (1996) also reported positive correlation between egg weight and hatchability. It was reported that egg yield, egg fertility and hatchability were usually lower compared to that in other poultry species and successful turkey breeding primarily requires the determination of factors that affect hatchability. Since scanty published literature is available on egg weight and hatching performance of turkey, the present study was carried out to determine the effect of egg weight on certain egg traits and hatching performance of turkey eggs.

MATERIALS AND METHODS

Experimental design and management

The study was conducted at Turkey Research Unit of Tamil Nadu Veterinary and Animal Sciences University-Regional Research Centre, Pudukkottai, Tamil Nadu, India. Beltsville Small White and Board Breasted Bronze turkeys were raised in an intensive system of management and the birds maintained under standard management practices. Free mating was used in the flock and the ratio of males to females was 1:4. A commercial turkey layer mash (Table 1) was fed *ad libitum* to the birds and fresh water was made available to the birds throughout the day.

Table 1 Ingredients and nutrient contents of turkey layer mash

Ingredients	Inclusion level (%)
Maize	40.00
Cumbu	20.00
De oiled rice bran	19.00
Soya bean meal	08.00
Dry fish	08.50
Mineral mixture	01.50
Shell grit	03.00
Nutrient contents	
Crude protein (%)	15.15
Metabolizableenergy (kcal/kg)	27.50
Calcium (%)	04.04
Phosphorus (%)	00.89
Lysine (%)	00.81
Methionine (%)	00.31

Beltsville Small White turkeys all at 36 weeks of age were used in this study. A total of 178 eggs were collected randomly selected, weighed and divided in to three groups according to the weight viz., below 60 g (G I), 61 to 69 g (G II) and above 70 g (G III). The collected eggs were stored at room temperature for about 3-5 days and then kept for incubation.

Proper cleaning, disinfection and fumigation were conducted before setting of eggs.

The temperature of 99.5 ˚F in dry bulb and relative humidity of 87.0 ˚F in wet bulb were set to incubate the eggs for 25 days during which they were rotated hourly interval. Thereafter, these eggs were transferred to the hatcher where a temperature 98.5 ˚F in dry bulb and relative humidity of 90.0 ˚F in wet bulb were maintained. Hatching started on the day 27 and was completed by the end of the 28th day. All the unhatched eggs were opened to determine cause of hatching failures.

Egg characteristics measurements

The egg characteristics were assessed before incubation in each egg weight groups. Egg weight was determined using an electronic scale, while egg length and width were measured with a vernier caliper.

Egg shape index was calculated as a ratio of the egg width to the egg length as follows:

$$\text{Egg shape index} = (\text{Egg width}/\text{Egg length}) \times 100$$

The values of the egg length and egg width were used to determine egg volume as described by Malago and Baitilwake (2009).

Reproductive performance

At the end of hatching process, egg were classified as infertile, hatched, embryonic mortalities (early and late) and dead in shell. Hatched poults were collected, counted and weighed by using an electronic scale. Reproductive performances included total egg hatchability, fertile egg hatchability and fertility and were calculated using the below formulae.

$$\text{Total egg hatchability} = (\text{Poults hatched}/\text{Total eggs set}) \times 100$$

$$\text{Fertile egg hatchability} = (\text{Poults hatched}/\text{Fertile eggs set}) \times 100$$

$$\text{Fertility} = ((\text{Total eggs set} - \text{Infertile eggs})/(\text{Total eggs set})) \times 100$$

Statistical analysis

The data generated from each experimental group were analyzed statistically by following standard procedures (Snedecor and Cochran, 1989) for comparing the means and to determine the effect of egg weight groups.

RESULTS AND DISCUSSION

Egg characteristics

Effect of egg weight on average egg weight (g), egg length (cm), egg breadth (cm) shape index and egg volume (cm^3) are presented in Table 2.

The mean average egg weight in the G I, G II and G III were 55.61±0.14, 65.28±0.17 and 72.55±0.11, respectively. The average egg weight between different weight group differ significantly (P<0.01). This result is in accordance with the findings of Ozcelik *et al*. (2009) who reported the mean weight of turkey eggs ranged 67.4 to 70.3 g.

The mean egg width in the G I, G II and G III were found 4.30±0.01, 4.65±0.03 and 4.83±0.01, respectively. The egg breadth was higher in G III followed by G II and G I. Egg width of all three turkey egg weight groups differed significantly (P<0.01).

The mean egg length in the G I, G II and G III were found 5.65±0.01, 6.20±0.02 and 6.44±0.01, respectively. Eggs from G III were significantly longer than those of G II and G I. The egg breadth and length values were also gradually increased as the weight of egg increased in all turkey weight groups.

This finding is in accordance with Malago and Baitilwake (2009) who reported that increased egg weight increased the egg length and egg width in Rhode Island Red, local and cross bred chicken eggs.

The mean shape index in the G I, G II and G III were found 76.10±0.21, 75.00±0.31 and 75±0.13, respectively. Shape index of all three turkey egg weight groups did not differ significantly.

The mean egg volume in the G I, G II and G III were found 52.97±0.32, 67.97±1.47 and 76.17±0.69, respectively. The values increased significantly as the weight of egg increased in all turkey weight groups.

Calculations to estimate egg volume by relating egg length and breadth adopted by other researchers have shown positive correlation between egg weight and egg volume (Malago and Baitilwake, 2009; Narushin and Romanov, 2002). This study also reports a positive correlation between egg weight and volume.

Reproductive performance

Effect of egg weight on percentage of infertile eggs, embryonic mortalities, dead in shell, total egg hatchability, fertile egg hatchability, fertility and poults hatched weight are presented in Table 3.

The mean percentage of infertile eggs in the G I, G II and G III were 59.61±0.92, 14.03±0.20 and 19.53±0.02, respectively. The highest percentage of infertile eggs were found in G I followed by G II and G III.

The percentage of infertile eggs decreased significantly as the weight of egg increased in all weight groups. Mroz *et al*. (2010) reported that the percentage of infertile eggs was low in turkeys, but may reach 10% at the beginning and towards the end of the laying season. In contrast, in this study, a higher percentage of infertile eggs were obtained. The mean percentage of embryonic mortalities in the G I, G II and G III were found 17.30±0.95, 14.03±0.29 and 8.69±0.23, respectively.

The percentage of embryonic mortalities decreased significantly as the weight of egg increased. These results are in agreement with the findings of Sachdev *et al.* (1985) and Altan *et al.* (1995).

Table 2 Effect of egg weight on egg traits of turkeys (Mean±SE)

Egg traits	Egg weight groups		
	Below 60 g (n=52)	61-69 g (n=57)	Above 70 g (n=69)
Average egg weight (g)*	55.61±0.14^{a}	65.28±0.17^{b}	72.55±0.1^{c}
Egg width (cm)*	4.30±0.01^{a}	4.65±0.03^{b}	4.83±0.01^{c}
Egg length (cm)*	5.65±0.01^{a}	6.20±0.02^{b}	6.44±0.01^{b}
Shape index^{NS}	76.10±0.21	75.00±0.31	75.00±0.13
Egg volume (cm^{3})*	52.97±0.32^{a}	67.97±1.47^{b}	76.17±0.69^{c}

* P<0.01; NS: non significant.
The means within the same row with at least one common letter, do not have significant difference (P>0.01).

Table 3 Effect of egg weight on egg traits of turkeys (Mean±SE)

Hatching characteristics	Egg weight groups		
	Below 60 g (n=52)	61-69 g (n=57)	Above 70 g (n=69)
Infertile eggs (%)*	59.61±0.92^{a}	14.03±0.20^{b}	11.59±0.02^{c}
Embryonic mortalities (%)*	17.30±0.95^{a}	14.03±0.29^{b}	8.69±0.23^{b}
Dead in shell (%)*	5.76±0.53^{a}	5.26±0.90^{a}	11.59±0.43^{b}
Total hatchability (%)*	17.30±0.34^{a}	66.66±0.44^{b}	68.11±0.71^{c}
Fertile egg hatchability (%)**	42.85±0.75^{a}	77.55±0.14^{b}	77.04±0.68^{b}
Fertility (%)*	40.39±0.92^{a}	85.97±0.33^{b}	88.41±0.30^{b}
Poults hatched weight (g)*	40.33±0.40^{a}	44.47±0.25^{b}	47.51±0.13^{c}

* P<0.01; ** P<0.05.
The means within the same row with at least one common letter, do not have significant difference (P>0.01) and (P>0.05).

They found that embryonic mortality rate was decreased as the egg weight increases. This might be due to heavy eggs having more sufficient nutrients to support embryos compared to lighter eggs.

The mean percentage of dead in shell in the G I, G II and G III were found 5.76±0.57, 5.26±0.90 and 11.59±0.43, respectively. The highest percentage of dead in shell were found in G III and was significantly different from G II and G I.

The percentage of dead in shell increased as the weight of egg increased in all turkey weight groups. An explanation for increased dead in shell due to increasing egg size was that larger eggs would be expected to have greater difficulty initially achieving adequate embryonic temperature and then losing embryonic metabolic heat during later stage of incubation.

The higher heat production and increased difficulty of heat dissipation in large eggs has been found to result in higher embryo temperatures in large eggs (Altan *et al.* (1995). The mean -percentage of total egg hatchability in the G I, G II and G III were found 17.30±0.34, 66.66±0.44 and 68.11±0.71, respectively.

The highest total egg hatchability percentage was found G III followed by G II and G I. The mean -percentage of fertile egg hatchability in the G I, G II and G III were found 42.85±0.75, 77.55±0.14 and 77.04±0.68, respectively. The higher fertile egg hatchability percentage was found G III followed by G II and G I.

The fertile egg hatchability between groups II and III did not differ significantly, but both groups found statistically significant (P>0.05) from group I. The mean percentage of fertility in the G I, G II and G III were 40.39±0.92, 85.97±0.33 and 88.41±0.30, respectively and the values were significantly (P<0.05) different.

The total hatchability, fertile egg hatchability and fertility percentage were increased as the weight of egg increased in all weight groups. Optimum hatching results can be obtained from heavy eggs weight. Sachdev *et al.* (1985) reported that hatchability of fertile eggs and fertility rate were found higher in heavy hen eggs than in light weight eggs. Similarly, Altan *et al.* (1995) reported that fertility rate, hatchability of all eggs set or fertile eggs were higher in heavy weight eggs compared to light eggs. It has been reported that hatchability of turkey eggs is maximized with eggs weighing between 70 -85.5 g (Karacanta *et al.* 1977). The effect of egg size on hatchability was explained by Deeming (1997) who stated that the effect of egg size on hatchability was due to a reduction in the surface area to volume ratio with increasing egg size making the gas heat exchange more difficult.

The present findings were in conformity with above findings. The mean percentage of turkey poults hatched weight in the G I, G II and G III were found 40.33±0.40, 44.47±0.25 and 47.51±0.13, respectively. Turkey poults hatched weight of all three turkey egg weight groups differ significantly (P>0.01).

Poults hatched weight increased in parallel to increase in hatching egg weight. The positive correlation found between egg weight and the hatching weight indicated the advantage of initial bigger size egg at the time of setting. This result is similar to the finding of Altan *et al.* (1995). The rate of poults hatched weight to the hatching egg weight was 63.5 % in turkeys (Shanawany, 1987).

CONCLUSION

From these results it can be concluded that, turkey egg weight had a very significant effect on certain egg characteristics and hatching performance. Turkey eggs that weighed above 70 g would be suitable for setting to obtain better reproductive performance followed by medium sized turkey eggs (61-69 g) and small sized turkey eggs weighed below 60 g.

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