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Original scientific paper

INFLUENCE OF WEIGHT OF MEAT-TYPE HYBRID HATCHING EGGS ON INCUBATION RESULTS

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Abstract: The aim of study was to examine the values of the incubation parameters (weight loss, fertilization, hatchability of placed and fertilized eggs, total, early, middle and late embryonic mortality) of eggs of different weights in brolier hybrid Cobb 500. In total, 600 eggs were divided into four equal groups (n = 150 each) according to their weight: 57.5-62.5 g (S); 62.6-67.5 g (M); 67.6-72.5 g (L) and 72.6-77.50 g (XL). Values of incubation parameters were determined and statistically processed by standard methods. The weight of eggs significantly influenced the loss of egg weight during incubation ($p<0.05$), with this loss being higher in smaller eggs (group S 11.10% and group M 11.40%) compared to larger eggs (group L 10.42% and group XL 10.31%). Hatchability of all eggs in groups S, M, L and XL was 76.0; 75.3; 78.7 and 66.0%, respectively, and for fertilized it was 82.0; 81.3; 82.5 and 71.7%, respectively, with no significant difference ($p>0.05$). The weight of eggs did not significantly affected the difference in embryo mortality values, although in the XL egg group a higher value of total, early and late mortality was found, compared to other groups. The results of this study indicate lower hatchability and higher mortality of embryos in eggs of extremely large weight, compared to other groups, which indicates that special attention should be given to the selection of hatching eggs in terms of their weight.

Key words: hatching eggs, egg weight, incubation parameters

INTRODUCTION

Egg weight is included in external quality indicators, together with the shape index, mass, thickness, strength, density, color and purity of the shell

(King'ori, 2012). These indicators are equally important in assessing the quality of consumable and hatching eggs. The success of the incubation of hatching eggs of meat-type hybrid, measured by the percentage of the hatchability and quality of the chickens, in addition to the length and conditions of storage (Fasenko, 2007), and incubation conditions (Molenaar et al., 2010), can be significantly determined by the quality of incubated eggs. (King'ori, 2011). Eggs that do not satisfy the criteria, mainly due to poor quality of the shell (eg, irregular shape, physical damage, drowsiness) and eggs of extremely small or large mass (Bell and Weaver, 2002), are removed from the hatching eggs before the incubation process.

The mass of eggs and the results of incubation are directly interrelated so that the hatchability of extremely small and extremely large eggs has a relatively lower value than of eggs of medium or average weight of the range of 55-65 g (Bell and Weaver, 2002). The mass of hatching eggs of meat-type hybrids has an increasing trend during the period of exploitation (Đermanović et al, 2010), which can be influenced by numerous factors of genetic and paragenetic nature (King'ori, 2012). Kumpula (2004) did not recognize the difference in fertilization and hatchability between three size groups of two commercial hybrids. However, the same author recognized a higher percentage of A class chickens in the group of small and medium eggs, and a significantly higher percentage of late embryonic mortality and B class chickens in the group of large eggs. Iqbal et al. (2016) found differences in the percentage of fertilization and hatchability of commercial hybrids among different egg sizes, maximum fertility and hatchability ($P \leq 0.05$) was noticed in small egg size group, followed by medium and large egg size groups. However, maximum embryonic mortality and higher percentage of infertile eggs was recorded in large size egg group, followed by medium and small egg size groups. Malik et al (2015) also described better fertility and hatchability of small eggs compared to medium and large eggs. The higher percentage of late embryonic mortality in the group of large eggs, in comparison to medium and small eggs, without distinction in other hatchability indicators, was described by Ulmer-Franco et al. (2010) and Gahri and Sarah. (2015), while Ramaphala and Mbajiorg (2013) didn't affirm the effect of egg size on hatching performance. A relatively higher percentage of mass loss in the incubation of small compared to medium or large eggs was established by Kumpula (2004), Ulmer-Franco et al. (2010) and Gahri et al. (2015), while this loss among the three weight groups of eggs in the research carried out by Duman and Şekeroğlu (2017) did not statistically differ. Effect of egg mass on incubation results in semi-intensive farming of autochthonous hens, according to Abudabos et al. (2017), was not consistent, while Singh et al. (2017) did not notice the effect of egg mass on the incubation results.

The aim of this study was to determine,

on the basis of technological indicators of incubation (loss of egg mass, percentage of fertilization, hatchability of placed and fertilized eggs, and percentage of total, early, middle and late embryonic mortality), the effect of different size eggs from parent stock on the final results of incubation.

MATERIAL AND METHOD OF WORK

The research was carried out on the commercial farm of Cob500 parent stock and the commercial incubator station on a sample of 600 hatching eggs. The eggs originated from the parent stock, aged 52 weeks, and were hatched, collected and delivered to the storehouse of the incubator station on the same day, and then stored for four days in the cardboard boxes until the incubation began. The collected eggs are classified into groups according to their mass, by individual measurement using a technical scale (0.01 g) immediately before incubation, after which they are marked and depending on the measured mass distributed in one of four groups: 57.5 - 62.5 g S), 62.6-67.5 g (M), 67.6-72.5 g (L) and 72.6-77.50 g (XL). Pre-heating and egg incubation conditions followed the standard work technology for the given hybrid in the commercial incubator station and were identical to all groups in the study.

Data obtained by measuring individual eggs before putting them in the setter and after transferring them to the hatcher was used to calculate the mass loss percentage (GM):

GM = ((Egg mass before placing in setter - egg mass on the 18th day of incubation) / egg mass before placing in setter) × 100.

Inspection of the hatcher residue determined: number of fertilized and unfertilized eggs; the number of hatched chickens, and the number of embryos that died in the first (early), second (middle) and third week incubation (late mortality),on the basis of this data the following parameters of incubation were calculated:

Fertilization of eggs (O,%)

O = (number of fertilized eggs / total number of eggs) × 100;

Hatchability of all eggs (Vu,%)

Vu = (number of hatched chickens / total number of eggs) × 100;

Hatchability of fertilized eggs (Vo,%)

Vo = (number of hatched chickens / number of fertilized eggs) × 100;

Total embryonic mortality (UM,%)

UM = (number of dead embryos / number of fertilized eggs) × 100;

Early embryonic mortality (RM,%)

RM = (number of dead embryos in up to 7 days of incubation /number of fertilized eggs) × 100);

Middle embryonic mortality (SM,%)

SM = (number of dead embryos in 8-14 days of incubation / number of fertilized eggs) × 100

Late embryonic mortality (KM,%)

KM = (number of dead embryos in 15-21 days of incubation / number of fertilized eggs) × 100.

Statistical data processing for loss of egg mass during incubation was carried out by analyzing variance at the level of significance p <0.05, while χ2 test at the significance level p <0.05 was used for hatchability and mortality values.

RESULTS OF RESEARCH AND DISCUSSION

Weight loss of hatching eggs during incubation is shown in Table 1.

Table 1. Weight loss of hatching eggs during incubation ("Mean ± SEM")

Group	Egg weight(g)	Egg weight on 18.day (g)	Weight loss (%)
S	61,27[d] (±0,19)	54,47[d] (±0,24)	11,10[a] (±0,24)
M	65,45[c] (±0,24)	57,99[c] (±0,30)	11,40[a] (±0,28)
L	69,83[b] (±0,22)	62,56[b] (±0,29)	10,42[b] (±0,25)
XL	74,19[a] (±0,25)	66,54[a] (±0,35)	10,31[b] (±0,34)

[abc] – values in the same column marked with different letters have statistically significant difference (p <0.05)

The highest loss of egg mass during incubation (11.40%) in this study was detected in group M, and the smallest (10.31%) in group XL. The values of loss of egg mass during incubation in groups S and M were significantly (p <0.05) higher than in groups L and XL. Iqbal et al (2016) found a significantly higher loss of weight during incubation in egg groups of average weight of 60.05 g (11.32%) and 65.03 g (11.12%) compared to the group of eggs with an average weight of 70.03 g (10, 62%). Rosa et al. (2002) classified eggs in relation to their weight (60.0, 65.1, 66.6, 69.0 and 73.2 g) and found minimal differences in percentage of mass loss during incubation (10.9, 10, 3; 10.2; 10.1 and 10.0%). A similar trend was described by Gahri et al. (2015), who classifed eggs in three groups by their weight (52.6-55.7, 57.2-60.2 and 61.7-64.7 g) and they found found a decrease in weight loss during incubation with the initial egg mass increase (12.56, 12.13 and 11.63%). However, Duman and Şekeroğlu (2017) did not find statistically significant difference in loss of weight (13.03; 13.24; 13.02%) among groups of eggs with different weight (55,0-60,0; 60,1-65,0; 65,1-70,0 g). The observed reduction in the percentage of mass loss during incubation with the increase in egg mass is probably due to a decrease in the ratio of the shell surface to the mass of egg contents (Ulmer-Franco et al., 2010; Iqbal et al., 2016). Optimum values for loss of egg mass during incubation are 6.5-14.0%, which is considered sufficient for the proper formation of the air chamber (Molenaar et al., 2010). Bell and Weaver (2002) state that the quality of the shell and the conditions of incubation can also affect loss of egg mass during incubation.

Indicators of fertilization and hatchability of eggs of different mass are shown in Table 2.

Table 2. Fertilization and hatchability of placed and fertile hatching eggs (%)

Group	Fertalization of eggs (%)	Hatchability of placed eggs (%)	Hatchability of fertilized eggs (%)
S	92,7	76,0	82,0
M	92,7	75,3	81,3
L	95,3	78,7	82,5
XL	92,0	66,0	71,7

The fertilization of the eggs, as a key factor of hatchability, is conditioned by the reproductive functions of the parents, in particular by the quality of sperm and full behavior of the cock, as well as by the process of egg formation and the functioning of hens' tubular glands (King'ori, 2011). This indicator varies depending on the age of the flock and the genotype (Kumpula, 2004; Abudabos, 2010; Iqbal et al., 2016), but also on paragenetic factors, such as nutrition and sex ratio. The influence of paragenetic factors, primarily nutrition on egg fertilization, is particularly important for the parent stock which is selected for fattening and well-used food, which is why they are prone to weight gain and it is necessary to feed them restrictively in order to preserve reproductive activity. With regard to the eggs hatchability of different masses Mbajiorgu and Ramaphala (2014) emphasize the importance of the specificity of each race or hybrid, but also the influence of individuals within the same race or hybrid. The fertilization of eggs in our study was the lowest in group XL (92.0%), slightly higher in groups S and M (92.7%), and the highest in group L (95.3%), but without statistically significant differences among groups ($\chi2$ 0.106; $p> 0.05$). Ulmer-Franco et al. (2010) did not find the difference in fertilization of three groups of eggs with an average mass of 58.3, 62.6 and 66.8 g (84.2, 85.1, 87.5%, respectively), but they noted its increase with an increase in average mass of eggs. Gahri et al. (2015) also did not find a statistically significant difference in fertilization of three groups of eggs of different masses (52.62-55.65; 57.15-60.15 and 61.65-64.65 g at 91.5; 93.0; 94.7%), but they confirmed the findings of other authors that with the increase in egg mass percentage of fertilization also increases. The absence of significant differences in the fertilization of eggs of different masses was also described by Abudabos et al. (2017) and Singh et al. (2017) in autochthonous breeds of free-range chicken,and Kumpala (2004) and Duman and Şekeroğlu (2017) described this absence in meat-type hybrids. On the other hand, Iqbal et al. (2016) found a statistically significant decrease in the percentage of fertilization, with an increase in the weight of eggs (96.7, 93.3, 90.3%, respectively). Hatchability of placed eggs in our study had the highest value in group L (78.7%), and the lowest in group XL (66.0%), and the differences among the groups in this study were not statistically significant ($\chi 2$ 1.856; p> 0 , 05). Hatchability of fertilized eggs was the highest in group L (82.5%), and the lowest in XL (71.7%), also without statistically significant differences ($\chi 2$ 1.377; p> 0.05). However, the percentage values of hatchanility in both cases were lower in the group of eggs of the highest mass (XL) compared to the groups S, M and L which had relatively similar values of these indicators. Kumpula (2004) states that the incubation of small, medium and large eggs did not show a statistically significant difference between the placed eggs (85.5; 82.3 and 82.2%) and the fertilized eggs (91.0; 89.9 and 87.9 %), but its values decreased with increasing egg mass. Ulmer-Franco et al. (2010) also received similar values in three groups for the hatchability of fertilized eggs (88.3, 89.9 and 84.3%) and relatively lower hatchability for large eggs, as confirmed by the results obtained by Ramaphala and Mbajiorgu (2013) (egg masses <49; 50-59 and 60-69 g for 92.4; 90.9; 90.9%, respectively). Gahri et al.(2015) state that they got similar valuees for hatchability of placed eggs (83.3%, 85.4%, 80.3%, respectively) and fertilized eggs of different masses (83.7; 86.4; 83.8%, respectively); where the best results were scored by a group of medium-sized eggs. Iqbal et al. (2016) found a significant difference between the eggs of an average weight of 60.05, 65.03 and 70.03 g, for placed eggs (89.7, 83.7, 78.3%) and for fertilized eggs (92, 7; 89.6; 86.7%). Analyzing the results of the incubation of four groups of average weight eggs (60.0, 65.1, 66.6, 69.0) and 73.2 g, Rosa et al. (2002) found statistically significant decreased hatchability in the group of eggs of the highest mass compared to all other groups (86.3, 86.6, 85.9, 85.5, 83.6%, respectively), which was also shown by the hatchability of fertilized eggs (92.5; 92.8; 92.0; 91.6; 89.5%, respectively) Duman and ekero lu (2017) discovered better hatchability of fertilized and placed eggs in the medium egg group (88.69 and 85.00%) and lower mass group (87.81 and 84.17%) compared to large eggs (80.76 and 78.05%) DeWitt and Schwalbach (2004)got the opposite results during the incubation of eggs of the New Hampshire and Rhode Island breed as they found better hatchability in a group of larger eggs.

The percentage of embryonic mortality, depending on the weight of hatching eggs, is given in Table 3.

Table 3. Embryonic mortality depiction, depending on the weight of eggs

Group	Embryonic mortality							
	Total		Early		Mid		Late	
	n	%	n	%	n	%	n	%
S	25	18,0	15	10,8	4	2,9	6	4,3
M	26	18,7	17	12,2	1	0,7	8	5,8
L	25	17,5	17	11,9	1	0,7	7	4,9
XL	39	28,3	25	18,1	3	2,2	11	8,0

The total embryonic mortality in our study ranged from 17.5% in group L to 28.3% in group XL.

The differences in the values of this parameter between the egg groups were not statistically significant ($\chi 2$ 5,317; p> 0,05). This finding is consistent with the data reported by Abudabos et al. (2017) for the incubation of eggs of autochthonous free-range chickens, and those by Duman and Şekeroğlu (2017) for the egg incubation of meat-type hybrid. On the contrary, Rosa et al. (2002) found a significantly higher total mortality in the group of large eggs of an average weight of 73.2 g (9.6%), compared to eggs of an average weight of 60.0 g (7.0%) and 65.1 g (6 , 7%), which is consistent with the results obtained by Iqbal et al. (2016) Kopecký (2015) found the highest total mortality in the group of eggs weighing 70-75 g (16.7%), and the lowest in the group weighing 55-60 g (9.7%). Early embryonal mortality in our study was most pronounced in group XL (18.1%), and lowest in group S (10.8%), with no statistically significant differences ($\chi 2$ 3,412, p> 0.05). The mid embryonic mortality was highest in the S group (2.9%) and the lowest in the M and L groups (0.7%), also without significant difference between the groups (2 3.081, p> 0.05). Late embryonal mortality ranged from 4.3% in group S to 8.0% in group XL, also without statistically significant difference (χ 1.870, p> 0.05) Kumpula (2004) and Malik and Sar. (2015) determined the absence of statistically significant differences between eggs of different masses for the mid and late mortality. Iqbal et al. (2016) found significantly higher early, mid and late mortality in the group of large eggs of an average weight of 70.03 g (3.3, 2.3 and 3.00%, respectively) in relation to the group of eggs of an average weight of 60.05 g (2.0; 1.3 and 1.67%, respectively). The largest mass group (XL) in our study had higher values of early and late mortality, although there was no statistically significant difference, which is in accordance with the results of several authors. Ulmer-Franco et al. (2010) did not find a difference in the values of early and middle embryonic mortality, while the value of late mortality was significantly higher in the group of large (7.0%) compared to the group of middle-sized (4.8%) and small eggs (2, 8%). Similarly to the mentioned authors, Kumpula (2004) found the difference only in the values of late embryo mortality, which was significantly higher in the group of large (6.1%) compared to small (1.8%) and medium eggs (4.3 %). Gahri and sar. (2015) registered the lowest early mortality in the group of medium eggs (2.96%) compared to 3.95% for smaller eggs and 4.68% in large eggs, while the late mortality was higher in the group of large (6.38%) compared to small (2.85%) and medium eggs (3.63%).

The increase in mortality with an increase in the mass of eggs, especially in older flock, may be associated with the inability of the embryo to achieve an appropriate temperature at the initial stage of incubation or loss of metabolic heat in the late incubation phase (Lourens et al., 2005).

CONCLUSION

The results of this study confirm the importance of breeding eggs for the ultimate incubation results, ie their interrelation, and therefore the need to classify hatching eggs before placung them in incubators. The loss of mass during incubation was proportionally smaller in eggs of higher mass, most likely due to the ratio of egg mass or volume to the shell surface. Also, embryonal mortality had a relatively higher value in the incubation of exceptionally large eggs, which suggests that average –sized eggs from the flock should be selected for incubation. The incubation results are influenced by other parameters such as hybrid, age, sex ratio, nutrition and similar, which shoud all be taken into account for the purpose of objectivation and correct interpretation of the research results.

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