# EFFECT OF HEN'S EGGS COMPOSITION ON THE HATCHABILITY AND ON THE HATCHING WEIGHT AND BODY COMPOSITION OF CHICKS IN TWO MEAT-TYPE GENOTYPES

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Summary

Electrical conductivity of hens' eggs in two meat-type genotypes was measured *in vivo* by means of the TOBEC method. Eggs with extreme high, extreme low and average values (E-value) were chosen for incubation. It was observed that eggs with high E-value/egg weight ratio fall out in a significantly higher ratio during the incubation period than eggs with low E-value/egg weight ratio. The E-value/egg weight ratio resulted in a medium accuracy in the prediction of hatching weight in both genotypes. Separating the effects of egg weight and egg composition, it was observed that the increase of E-value at the same egg weight, and the increase of egg weight at the same E-value resulted in an increase in the hatching weight. All traits of main body components of the chicks hatched from eggs with low E-value/egg weight ratio showed higher values than those of the chicks hatched from eggs with high E-value/egg weight ratio.

## I. INTRODUCTION

In former experiments it has already been studied whether the size or the composition of the egg has a greater effect on the viability of the offspring. However, in these examinations correlations were mainly determined between different species, therefore the available information about intra-specific correlations is scarce.

In some poultry species it was pointed out that the egg and yolk weight increases with increasing the layer's production age (Applegate *et al*., 1998; Hartmann *et al*., 2000; Silversides and Scott, 2001). It was also established that the embryonic development is slower in the eggs of younger hens than in the eggs of older ones (Applegate, 2002). The reason for this could be the lower proportion of yolk in the eggs of the younger hens.

The clarification of the effect of egg composition on the hatchability and hatched bird's development was mainly hindered by the lack of a reliable technique/equipment, capable of determining the egg composition *in vivo*. Using the so-called TOBEC (Total Body Electrical Conductivity) method for this purpose, Williams *et al*. (1997) have found a positive correlation between the measured values and egg's water and albumen's dry matter content in fowls, ducks, guineafowls and quails. Between the measured values and yolk's dry matter content significant correlation was pointed out only in the case of fowls and quails.

Based on these literature data the aim of this study was the separation of hen's eggs based on their composition by means of the TOBEC method and the comparison of eggs' hatchability and the weight and body composition of chicks at hatching.

## II. MATERIAL AND METHODS

The experiment was carried out with altogether 4.000 hen's eggs originated from a 40 weeks old ROSS-308 (n=2.000) and COBB-500 (n=2.000) hybrid parent stock from the same Hungarian company (Gallus Ltd.). All of the eggs were collected on the same day and stored at room temperature for 24 hours. Eggs were weighted thereafter and positioned centrally within the detection chamber of the TOBEC analyzer in standing position.

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The TOBEC measurements were carried out with an EM-SCAN SA-2 type Small Animal Body Composition Analyser (EM-SCAN Inc., Springfield, Illinois, USA), which allows a rapid, non-invasive measurement of the total conductivity index (E-value) of the eggs. Electrical conductivity of each egg was determined once and the measured value was used for further evaluation.

After the TOBEC measurements linear regression was performed using the measured E-values as dependent and the weight of the eggs as independent variable in the model. With the help of this method, the average E-value was predicted to all egg weights and then the difference between the measured and predicted E-value was calculated in the case of each egg. Based on the calculated differences, eggs with extreme high, extreme low and average electrical conductivity values (10-10%) were chosen for further analyses.

From each of the three experimental groups 15-15 eggs were broken and their albumen/yolk ratio was determined. The dry matter, crude protein and crude fat content of these eggs was chemically analysed by the instructions of the Hungarian Standards.

The remaining eggs (185 in each group in both genotypes) were incubated thereafter in the hatchery of the Kaposvár University. Eggs were candled three times (on day 8, 15 and 19) during the incubation procedure. At each candling the number of outfalling eggs and the reason of the outfall was recorded. After placing eggs from the incubator into the hatching machine, pedigree-hatching was used, which allowed the exact identification of chicks at hatching. The weight of the chicks was recorded at hatching.

Twelve chicks per groups from the hatched animals were chosen for body composition analysis. The dry matter, protein and fat content of their body was analysed chemically using the regulations of the Hungarian Standards.

For the evaluation of the effect of separation on the eggs' and chicks' composition the One-Way ANOVA model was used. The significance of between group differences was tested by the LSD post hoc test. The significance of differences in the embryonic mortality was analyzed by Chi²-test. For predicting the hatching weight based on the E-value/egg weight ratio linear regression was used. All of the statistical analyses were performed by the SPSS statistical software package (SPSS for Windows, 1999).

## III. RESULTS AND DISCUSSION

In Table 1 it is well visible that eggs with different electrical conductivity values differ significantly from each other also in their chemical composition.

Table 1. Composition of eggs with different electrical conductivity in the ROSS-308 and COBB-500 genotype

| | Eggs with low electrical conductivity | Eggs with average electrical conductivity | Eggs with high electrical conductivity |
|---|---|---|---|
| **ROSS-308** | | | |
| **Albumen/yolk ratio** | $1.84^{a}$±0.15 | $1.84^{a}$±0.15 | $2.00^{b}$±0.19 |
| **Dry matter (g/kg)** | $25.8^{a}$±0.5 | $25.4^{ab}$±0.7 | $25.0^{b}$±1.1 |
| **Crude protein (g/kg)** | 13.1±0.3 | 12.8±0.5 | 12.7±0.6 |
| **Crude fat (g/kg)** | $10.7^{a}$±0.4 | $10.6^{ab}$±0.7 | $10.2^{b}$±0.9 |
| **COBB-500** | | | |
| **Albumen/yolk ratio** | $1.81^{a}$±0.14 | $1.84^{a}$±0.21 | $2.07^{b}$±0.23 |
| **Dry matter (g/kg)** | $25.6^{a}$±0.6 | $25.1^{a}$±0.7 | $24.1^{b}$±1.3 |
| **Crude protein (g/kg)** | $12.9^{a}$±0.4 | $12.5^{b}$±0.3 | $12.3^{b}$±0.6 |
| **Crude fat (g/kg)** | $10.6^{a}$±0.6 | $10.5^{a}$±0.7 | $9.8^{b}$±0.9 |

$^{a,b}$ Different letters in the same row indicate significant differences ($P<0.05$)

During the incubation period it was observed that embryonic mortality was significantly higher in eggs with high electrical conductivity than in eggs with low electrical conductivity (Figure 1 and 2).

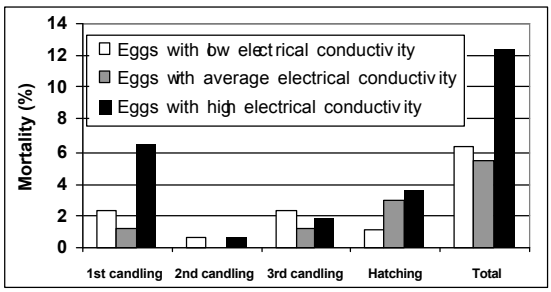


Figure 1.
Embryonic mortality in eggs with low, average and high electrical conductivity in the ROSS-308 genotype

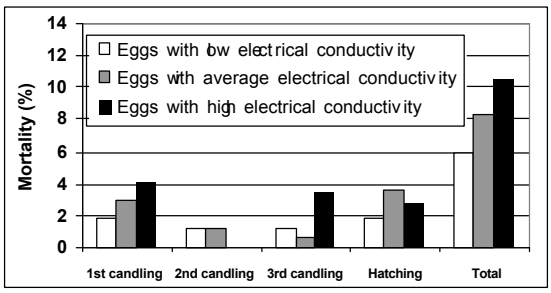


Figure 2.
Embryonic mortality in eggs with low, average and high electrical conductivity in the COBB-500 genotype

This result is in correspondence with the findings of Nestor and Noble (1995) and Hartmann *et al*. (2002), who have found a positive correlation between eggs' yolk ratio and hatchability of fertile eggs in turkeys and in a White Leghorn population.

Examining the effect of egg composition on the chicks' hatching weight, it was established that the use of the E-value/egg weight ratio as independent variable in the prediction equation resulted in a medium accuracy of prediction in both genotypes ($R^2$=0.406 in the ROSS-308 and $R^2$=0.418 in the COBB-500 genotype).

It was also pointed out that the egg weight has a greater effect on the chicks' hatching weight ($R^2$=0.780 in the ROSS-308 and $R^2$=0.783 in the COBB-500 genotype).

The common use of egg weight and E-value/egg weight ratio in the regression model did not improve the accuracy of hatching weight's prediction ($R^2$=0.800 in the ROSS-308 and $R^2$=0.783 in the COBB-500 genotype).

The examination of the separate effects of egg weight and egg composition on the hatching weight showed that the increase of E-value at the same egg weight, and the increase of egg weight at the same E-value resulted in an increase in the hatching weight in both genotypes (Figure 3 and 4).

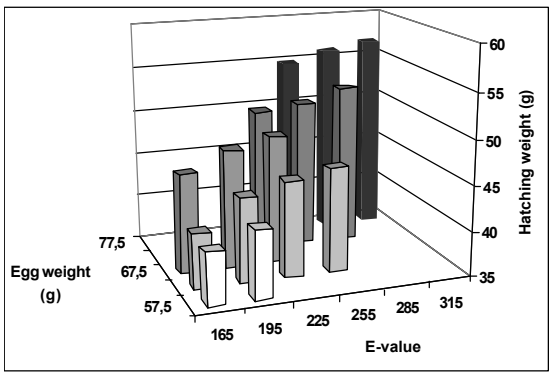


Figure 3.
Effect of egg weight and eggs' electrical conductivity on the hatching weight in the ROSS-308 genotype

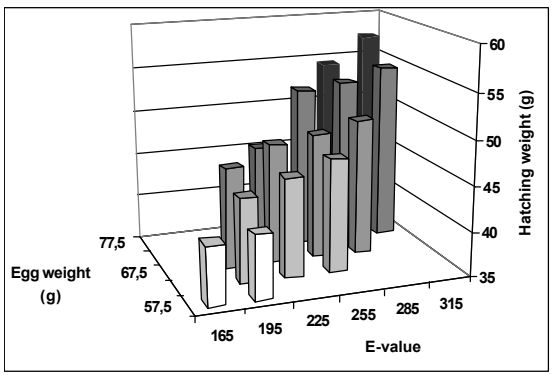


Figure 4.
Effect of egg weight and eggs' electrical conductivity on the hatching weight in the COBB-500 genotype

Examining the body composition of hatched chicks, it was established that all of the main body components showed higher values in the chicks hatched from eggs with low electrical conductivity than in chicks hatched from eggs with high electrical conductivity (Table 2).

Table 2. Body composition at hatching in ROSS-308 and COBB-500 chicks hatched from eggs with different electrical conductivity

| | Eggs with low electrical conductivity | Eggs with average electrical conductivity | Eggs with high electrical conductivity |
|---|---|---|---|
| **ROSS-308** | | | |
| **Dry matter (g/kg)** | $25.6^{a}$±1.2 | $25.6^{a}$±0.8 | $24.7^{b}$±1.2 |
| **Crude protein (g/kg)** | $16.7^{a}$±0.4 | $16.1^{b}$±0.4 | $15.8^{c}$±0.5 |
| **Crude fat (g/kg)** | 6.52±1.04 | 6.57±0.68 | 6.23±1.05 |
| **COBB-500** | | | |
| **Dry matter (g/kg)** | $25.5^{a}$±0.8 | $25.1^{ab}$±1.3 | $24.5^{b}$±1.2 |
| **Crude protein (g/kg)** | $16.3^{a}$±0.4 | $15.9^{b}$±0.2 | $15.5^{c}$±0.5 |
| **Crude fat (g/kg)** | 6.59±0.64 | 6.48±1.17 | 6.29±0.74 |

$^{a,b}$ Different letters in the same row indicate significant differences ($P<0.05$)

## IV. CONCLUSIONS

Based on the results of this experiment, it was concluded that TOBEC seems to be a useful method for separating eggs with different composition. It was also concluded that the egg composition has a significant effect on the embryonic mortality during incubation, and also on the weight and body composition of the chicks at hatching.

## V. ACKNOWLEDGEMENT

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