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APPLICABILITY OF THE TOBEC METHOD IN SELECTION OF HEN'S EGGS BASED ON THEIR COMPOSITION

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Original scientific paper

SUMMARY

Applicability of the TOBEC method (electrical conductivity) was tested for the in vivo determination of different egg components and for the separation of eggs with different composition. Altogether 300 hen's eggs – originated from a 36 weeks old ROSS-308 hybrid parent stock – were measured by TOBEC, and the extreme and average 5-5% – based on the measured values – were chosen for chemical analysis. It was established that the albumen/yolk ratio and the dry matter, crude protein and crude fat content of the eggs are in medium correlation with the E-value/egg weight ratio (r=0.47, -0.58, -0.59 and -0.35 respectively). The albumen/yolk ratio, the dry matter and the crude protein content of the eggs, selected for high and low E-value/egg weight ratio, differed significantly at P<0.05 level. The difference between the average crude fat content of the eggs in the two extreme groups was significant at P<0.10 level.

Key-words: TOBEC, electrical conductivity, hen, egg, composition, selection

INTRODUCTION

In former experiments it has already been studied whether the size or the composition of the egg had 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. Clarification of these correlations was mainly hindered by the lack of a reliable technique/equipment, capable of determining the egg composition *in vivo*. In the course of the present analysis the TOBEC method (based on measuring the electrical conductivity of intact eggs) was applied for *in vivo* egg composition determination, which could be a good starting point for further examinations to clarify the correlations between egg composition and hatched birds' development.
The use of this method gave close correlations (r=0.88-0.99) between the E-value (electrical conductivity of the whole body measured by this method) and lean mass of small birds and mammals (Cunningham et al., 1986; Castro et al., 1990; Staudinger et al., 1995), and only medium accuracy in the prediction of total body fat percentage (Fekete et al., 1995; Milisits et al., 1999; Milisits et al., 2000) in the previous experiments. Similar results were obtained by Williams et al. (1997) using this non-destructive method for determining egg composition in different species of birds.
Based on these literature data, the aim of this study was to clarify the correlations between electrical conductivity of hen's eggs and different main egg components.

MATERIAL AND METHODS

The experiment was carried out with 300 hen's eggs originated from a 36 week old ROSS-308 hybrid parent stock and collected on the same day. Before the TOBEC measurements eggs were stored at room temperature for 24 hours to eliminate the effect of eggs' temperature on the measured values.

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All eggs were weighed thereafter and positioned centrally within the detection chamber of the TOBEC analyzer in standing position.
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. Measurements were taken at 10 MHz frequency, because the electrical conductivity of fatty and non-fatty tissues is clearly different at this frequency. Electrical conductivity of each egg was determined once and the measured value was used for further evaluation. The E-value of some randomly selected eggs was measured twice for testing the accuracy of the method. The second measurements were taken at the end of the whole measurement procedure, after all of the eggs had been measured once. Differences between the results of the first and second measurements were within 2% in each case.
After the TOBEC measurements linear regression was made between the measured E-values and the weight of the eggs. The average E-value was predicted in all egg weights and the difference between the measured and predicted E-value was calculated in each case by this method. Based on these differences, eggs with extreme high and extreme low electrical conductivity values (5-5%) were chosen for further analysis. Eggs with average E-values (5%) were also involved into the experiment as a control group. The difference between the measured and predicted E-value of the eggs ranged from 6 to 13% and 7 to 19% in the extreme groups and it was 0% in the control group.
After finishing the TOBEC measurements, all eggs were broken and by weighing the albumen and yolk the albumen/yolk ratio was calculated. The dry matter, crude protein and crude fat content of the eggs were chemically analysed by the instructions of the Hungarian Standards.
The E-value/egg weight ratio was used to predict the composition of hen's eggs because of the high correlation between E-value and egg weight. Correlations and regressions between the E-value/egg weight ratio and different main egg components were calculated by the SPSS statistical software package (SPSS for Windows, 1999). The effect of separation on the egg composition was tested by the One-Way ANOVA model. The significance of between group differences was tested by the LSD post hoc test also using the SPSS statistical software package.

RESULTS AND DISCUSSION

As the first step of the evaluation, the correlation between E-value/egg weight ratio and albumen/yolk ratio was examined. It was found out that there is a medium (r=0.47), but highly significant (P=0.001) positive correlation between these two examined traits (Figure 1).
(Albumen/yolk ratio = 1.071 + 0.353 x E-value/egg weight ratio; R^2=0.218, P=0.001, SE=0.313)

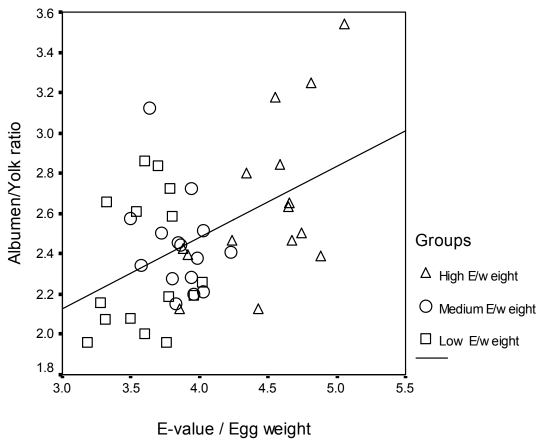

Figure 1. Correlation between E-value/egg weight ratio and albumen/yolk ratio in hen's eggs

Due to only medium correlation, it is clearly visible, that there is a relatively high variance in the albumen/yolk ratio in each experimental group.
Slightly stronger, but negative correlation (r=-0.58) was found out between the E-value/egg weight ratio and the dry matter content of the eggs (Figure 2). The correlation was also very highly significant (P<0.001) in this case.

(Dry matter (%) = 29.596 – 1.686 x E-value/egg weight ratio; R^2=0.336, P<0.001, SE=1.1108)

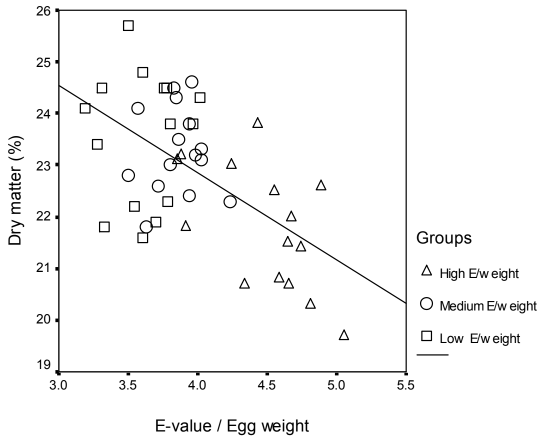

Figure 2. Correlation between E-value/egg weight ratio and dry matter content of hen's eggs

Very similar result was obtained when the correlation between the E-value and crude protein content was examined (r=-0.59, P<0.001, Figure 3).
(Crude protein (%) = 15.062 – 0.866 x E-value/egg weight ratio; R^2=0.348, P<0.001, SE=0.5557)

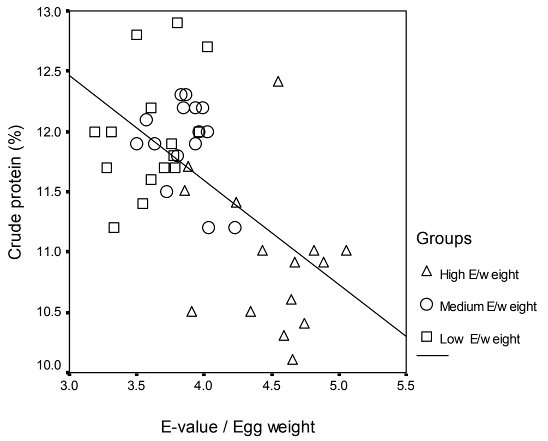

Figure 3. Correlation between E-value/egg weight ratio and crude protein content of hen's eggs

Only an r=-0.35 correlation was observed between the E-value/egg weight ratio and crude fat content being also significant at P<0.05 level (P=0.018, Figure 4).
(Crude fat (%) = 11.854 – 0.654 x E-value/egg weight ratio; R^2=0.122, P=0.018, SE=0.8200)

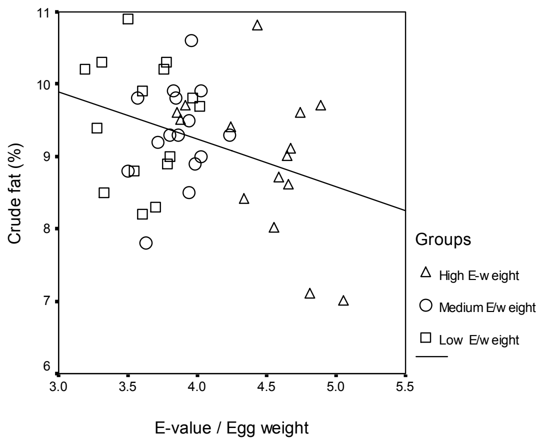

Figure 4. Correlation between E-value/egg weight ratio and crude fat content of hen's eggs

The correlation data obtained in this experiment between E-value/egg weight ratio and different egg components are slightly stronger, than correlations between E-value and egg components found out in an earlier experiment (Milisits et al., 2005). However, predictability of an egg or body composition of different species seems to be more accurate, when the egg weight or liveweight and the E-value, as independent variables, are used in a linear regression model (Milisits et al., 1999; Milisits et al., 2000; Hancz et al., 2003).

In a view of these medium correlations it was interesting to see that the albumen/yolk ratio and also the chemical composition of eggs separated for high and low electrical conductivity values differed significantly at $P<0.05$ level. The measured values of eggs with average electrical conductivity were between the values of the two extreme groups in all cases (Table 1).

Table 1. Some parameters of hen's eggs separated based on their electrical conductivity

Traits	Eggs with low electrical conductivity	Eggs with average electrical conductivity	Eggs with high electrical conductivity
Egg weight (g)	71.5±5.0	69.7±4.1	73.5±9.0
E-value/egg weight ratio	3.61^{a}±0.25	3.86^{b}±0.19	4.48^{c}±0.37
Albumen/yolk ratio	2.34^{a}±0.33	2.44^{ab}±0.24	2.65^{b}±0.41
Dry matter (%)	23.5^{a}±1.3	23.3^{a}±0.8	21.8^{b}±1.2
Crude protein (%)	12.0^{a}±0.5	11.9^{a}±0.36	10.9^{b}±0.6
Crude fat (%)	9.5^{a}±0.8	9.3^{ab}±0.7	8.9^{b}±1.0

^{abc} Different letters in the rows mean significant differences at $P<0.05$ level

The result of this separation is in accordance with our former experiment, where the body fat content of rabbits separated for high and low total body electrical conductivity, differed significantly at $P<0.05$ level (Milisits et al., 2006).

CONCLUSION

Based on the results of this experiment it was concluded, that TOBEC method seems to be a useful method for separating eggs with different compositions. This could be a good starting point to examine the effect of egg composition on egg's hatchability and hatched chick's development.

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