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EFFECT OF THE YOLK CONTENT OF HATCHING EGGS ON THE WEIGHT AND COMPOSITION OF THE LIVER IN THE HATCHED CHICKS

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ABSTRACT

The aim of this study was to examine, whether the yolk ratio of hen's eggs has an effect on the weight and composition of the liver in chicks at hatching. Altogether 3500 hen's eggs – originated from a 24 weeks old TETRA-H parent stock – were involved in the examination. The yolk ratio of the eggs was determined *in vivo* by means of computer tomography using a SIEMENS Somatom Emotion 6 multislice CT scanner at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvár University. Based on the measured values eggs were separated into three groups: eggs with the lowest (n = 350), eggs with the highest (n = 350) and eggs with average (n = 350) yolk ratio. All of these eggs were incubated thereafter. After hatching 30 chicks per group (15 males and 15 females) were randomly chosen and after weighing their live weight they were euthanized. Their liver was removed from their body and its weight was recorded. The dry matter and fat content of the liver was determined thereafter. Based on the results it was established that because of the high variation of the examined traits mainly no significant differences were found between the experimental groups. It was concluded that the yolk ratio of the hatching eggs has no significant effect on the ratio of the liver to the liveweight and on the dry matter and fat content of the liver in hatched chicks.

Key words: poultry / chickens / egg yolk content / computer tomography / hatching weight / liver composition

1 INTRODUCTION

It is an old question in poultry breeding, how the composition of the eggs influences the hatching weight, the body composition and the viability of the offspring. After Williams *et al*. (1997) – using the so-called TOBEC (Total Body Electrical Conductivity) method – pointed out some significant correlations between the electrical conductivity of the eggs and some egg components, further examinations were started for the clarification of the effect of egg composition on the hatchability of the eggs and on the development of the hatched birds. In these experiments it was pointed out that the composition of the eggs has a significant effect not only on the embryonic mortality and on the weight and body composition of the chicks at hatching, but also on the slaughter weight of the hatched animals (Milisits *et al*., 2010). Similar results were obtained also by other authors, who have used the so-called *in ovo* feeding technique for modifying the egg composition and for testing the effect of these changes on the hatchability of the eggs and on the development of the hatched birds (Coles *et al*., 2001; Foye *et al*., 2006; Tangara *et al*., 2010).

The aim of the present study was to examine how the yolk ratio of the hatching eggs influences the ratio of the liver to the live weight and the dry matter and fat content of the liver in the hatched chicks.

2 MATERIAL AND METHODS

The experiment was carried out with altogether 3,500 hen's eggs, which were originated from a 24 weeks old TETRA-H parent stock and were collected on the same day.

The yolk ratio of the collected eggs was determined

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in vivo by means of computer tomography using a SIEMENS Somatom Emotion 6 multislice CT scanner at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvár University. Before the scanning procedure all of the eggs were weighed and positioned for the scanning in standing/upright position. During the CT measurements eggs were positioned in egg trays (30 eggs), thus five eggs were scanned simultaneously (Fig. 1).

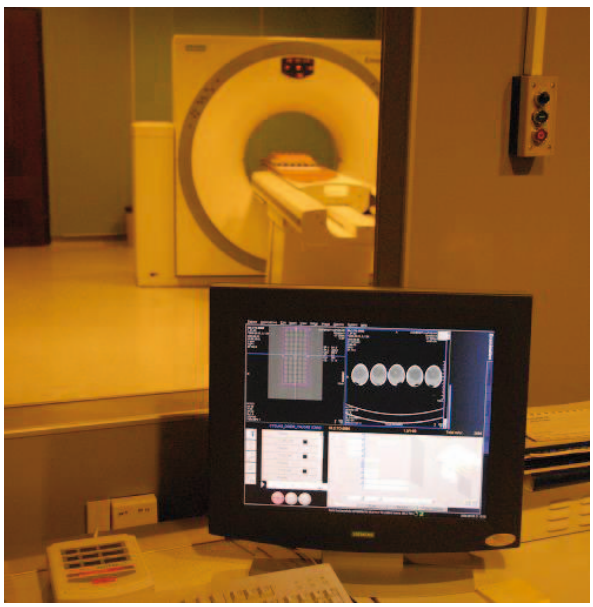

Figure 1: *CT scanning of the experimental eggs*

The CT examinations were carried out by using the following technical parameters: tube voltage: 110 kV, X-ray radiation dose: 80 mAs, mode: spiral, pitch: 1, field of view: 260 mm. From all of the eggs 3 mm thick overlapping slices were taken. The images obtained were analysed by a new self-developed egg-separation and segmentation software. With the help of this software, the image information of the individual eggs were separated and saved particularly from the archived scans. Afterwards, the border of the shell and albumen and the border of the albumen and yolk were determined and the volume of the yolk and its ratio to the volume of the whole egg was calculated in all of the examined eggs.

Based on the calculated yolk ratios eggs were separated into three groups:

- eggs with low yolk ratio (21.2 ± 0.86%);
- eggs with average yolk ratio (24.6 ± 0.15%); and
- eggs with high yolk ratio (28.2 ± 0.90%).

Each group contained 10–10% of the CT scanned eggs (n = 350 per group).

All of these eggs were incubated thereafter. After placing eggs from the incubator into the hatching machine, pedigree-hatching was used, which allowed the exact identification of which chick was hatched from which egg.

After the hatching procedure 30 chicks per group (15 males and 15 females) were randomly selected and their hatching weight was recorded. All of these birds were euthanised thereafter and their liver was removed from their body for the chemical analysis of their composition. The dry matter and fat content of the livers was determined in the laboratory of the Research Institute for Animal Breeding and Nutrition, in Herceghalom (Hungary) by the methods of the Association of Official Analytical Chemists (AOAC, 2000).

The effect of eggs' yolk content on the weight and composition of the liver was statiscally evaluated by the One-Way ANOVA method. The level of significance of the between group differences was tested by the LSD post hoc test. The statistical analysis was carried out by the SPSS statistical sofware package, version 10.0 (SPSS for Windows, 1999).

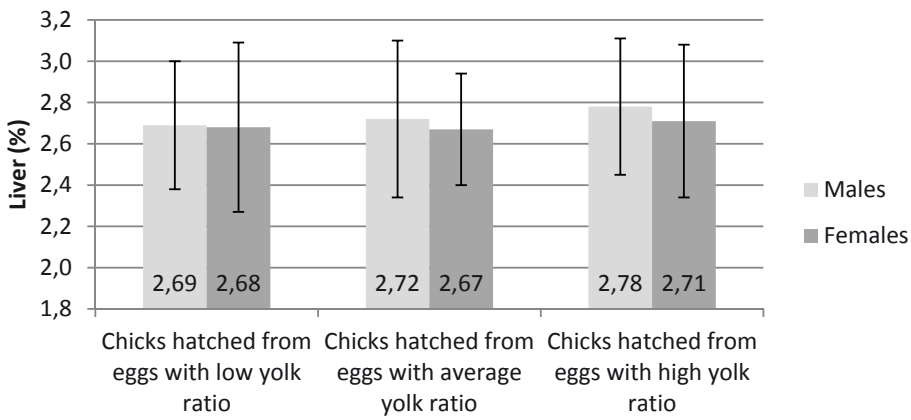

Figure 2: *Ratio of liver to the hatching weight in chicks hatched from eggs with low, average and high yolk ratio*

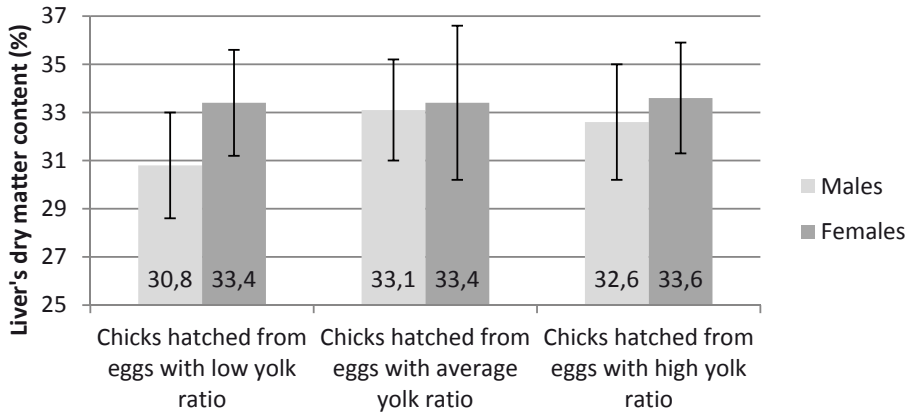

Figure 3: *Dry matter content of the liver in chicks hatched from eggs with low, average and high yolk ratio*

3 RESULTS AND DISCUSSION

In the ratio of liver to the hatching weight a slight increase was observed in the males with increasing the yolk ratio in the eggs (Fig. 2).

However, because of the high intra-group variation of this trait (CV = 11.5%, 14.0% and 11.9%, respectively) no significant differences were found between the experimental groups ($P > 0.05$).

Similar intra-group variation, but no clear tendency was observed in the case of the females, where the between-group differences were also not proven statistically ($P > 0.05$).

In the dry matter content of the liver significant difference was found between the males hatched from eggs with low and average yolk ratio, respectively ($P < 0.05$, Fig. 3).

In the case of the females no significant differences were found between the experimental groups in this trait ($P > 0.05$).

In the fat content of the liver similar tendency was observed in both sexes: the highest values were found in the chicks hatched from eggs with average yolk ratio, while the lowest values in the chicks hatched from eggs with low yolk ratio (Fig. 4).

Examining this trait it was also established that the liver of the females had higher fat content than the males in all of the experimental groups. However, significant differences were not found neither between the sexes nor between the experimental groups ($P > 0.05$).

When the fat content of the dry matter of the liver was examined the highest value was obtained also in those females, which were hatched from eggs with average yolk ratio (Fig. 5).

In the case of the males very similar values were found in all of the experimental groups. Significant differences between the experimental groups were not pointed out neither in the males nor in the females in this trait ($P > 0.05$).

The results of this experiment are in agreement with

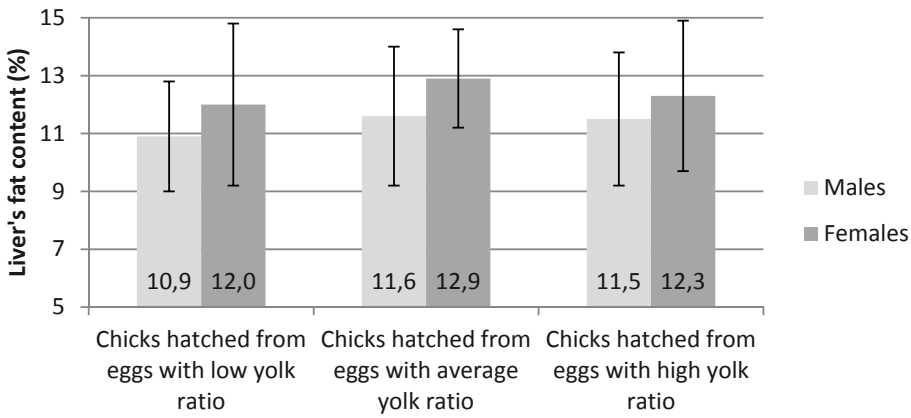

Figure 4: *Fat content of the liver in chicks hatched from eggs with low, average and high yolk ratio*

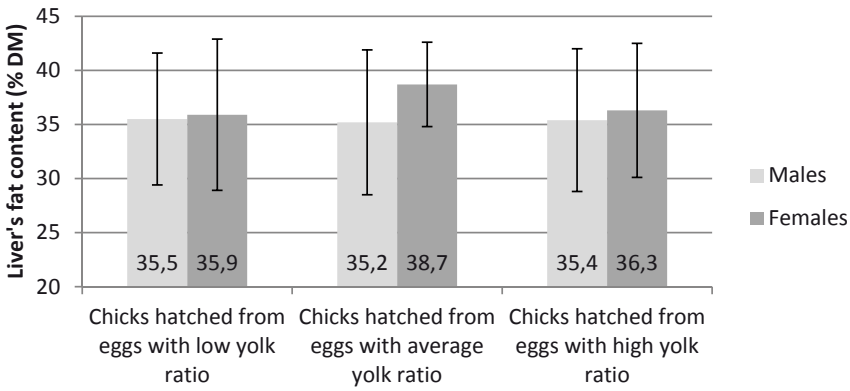

Figure 5: *Fat content in the dry matter of the liver in chicks hatched from eggs with low, average and high yolk ratio*

the findings of Zhai *et al*. (2011), who haven't found any significant differences in the liver weight and liver composition of the chicks hatched from eggs supplemented with different carbohydrates at the 18th day of incubation. However, it was an interesting observation in their experiment that almost all of the supplementary carbohydrates increased the concentration of glycogen and glucose and decreased the concentration of fat in the liver on the 19th day of incubation, but these differences were lost by the day of hatch.

Because it was already known from a previous work (Bartov, 1996) that the high energy to protein ratio in the diet increases significantly the fat content of the liver in chicks, it was supposed that the liver of chicks hatched from eggs with high yolk ratio will also contain more fat than that of the chicks hatched from eggs with low yolk ratio. However, based on the results of this experiment this hypothesis was not certified.

4 CONCLUSION

Based on the results of this experiment it seems that the yolk ratio of hatching eggs has no significant effect on the ratio of the liver to the live weight and on the fat content of the liver in hatched chicks.

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6 REFERENCES

AOAC. 2000.,Official Methods of Analysis, 17th ed. Gaithersburg, Maryland, USA, Association of Official Analytical Chemists

Bartov I. 1996. Interrelationship between the effects of dietary factors and feed withdrawal on the content and composition of liver fat in broiler chicks. Poultry Science, 75: 632–641

Coles B.A., Croom J., Daniel L.R., Christensen V.L., Eisen E.J. 2001. *In ovo* peptide YY administration improves body weight at hatch and day 3 in turkey poults. Journal of Applied Poultry Research, 10: 380–384

Foye O.T., Uni Z., Ferket P.R. 2006. Effect of in ovo feeding egg white protein, beta-hydroxy-beta-methylbutyrate, and carbohydrates on glycogen status and neonatal growth of turkeys. Poultry Science, 85: 1185–1192

Milisits G., Kovács E., Pőcze O., Ujvári J., Taraszenkó Zs., Jekkel G., Locsmándi L., Bázár Gy., Szabó A., Romvári R., Sütő Z. 2010. Effect of egg composition on hatchability and on growth and slaughter characteristics of meat-type chicks. British Poultry Science, 51: 289–295

SPSS for Windows. 1999. Version 10.0 SPSS Inc.

Tangara M., Chen W., Xu J., Huang F.R., Peng J. 2010. Effects of in ovo feeding of carbohydrates and arginine on hatchability, body weight, energy metabolism and perinatal growth in duck embryos and neonates. British Poultry Science, 51: 602–608

Williams T.D., Monaghan P., Mitchell P.I., Scott I., Houston D.G., Ramsey S., Ensor K. 1997. Evaluation of a non-destructive method for determining egg composition using total body electrical conductivity (TOBEC) measurements. Journal of Zoology, 243: 611–622

Zhai W., Bennett L.W., Gerard P.D., Pulikanti R., Peebles E.D. 2011. Effects of in ovo injection of carbohydrates on somatic characteristics and liver nutrient profiles of broiler embryos and hatchlings. Poultry Science, 90: 2681–2688