

## EFFECT OF YOLK RATIO IN HEN'S EGGS ON THE HATCHING WEIGHT AND ON THE HEART AND LIVER RATIO IN CHICKS AT HATCHING

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### ABSTRACT – Effect of yolk ratio in hen's eggs on the hatching weight and on the heart and liver ratio in chicks at hatching

The aim of this study was to examine, whether the yolk ratio of hen's eggs has an effect on the hatching weight and on the heart and liver ratio in chicks at hatching. Altogether 3.500 hen's eggs – originated from a 24 weeks old TETRA-H parent stock – were involved in the examination. The yolk ratio of these eggs was determined by means of computer tomography *in vivo* 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 extreme high, eggs with average and eggs with extreme low yolk content (10-10% in each group). All of these eggs (n=350 per group) were incubated thereafter. After hatching 30 chicks per group (15 males and 15 females) were randomly chosen and their liveweight was measured thereafter. After measuring the liveweight chicks were killed and dissected. The weight of the heart and liver was measured and their ratio to the hatching weight was calculated. Based on the results it was established that the hatching weight of the chicks decreased with increasing the yolk ratio in the eggs in both sexes. In spite of the hatching weight the ratio of the heart to the hatching weight was increasing with increasing the yolk ratio in the breeding eggs in the case of the cocks. In the case of the pullets the opposite tendency was observed. The change in the ratio of liver to the hatching weight showed similar tendency in the case of cocks as it was observed in the case of the heart. In the case of the pullets no clear tendency was observed in this trait. Based on the results it was concluded that – according to some former results – the higher albumen content in the eggs results in higher hatching weight and the higher yolk content in the eggs in better body composition in the chicks.

**Keywords:** egg yolk content, computer tomography, chicken, hatching weight, body composition

## INTRODUCTION

In poultry breeding, it is an old question, whether the size or the composition of the eggs has greater effect on the viability of the offspring. In former studies it was already observed that the mass of the eggs and also that of the egg yolk increases parallel with the age of layers (APPLEGATE et al., 1998; HARTMANN et al., 2000; SILVERSIDES and SCOTT, 2001; OLOYO, 2003). Experiments that followed up the development of embryos and the birds hatched have clearly demonstrated that in eggs laid by young layers the development of embryos is slower than in those laid by older ones (APPLEGATE, 2002). It was supposed that this is partially due to the higher egg yolk ratio of eggs from older birds, which enables a more substantial incorporation of nutrients into the organism of the developing embryo.

Over a long period of time, elucidation of the correlations between the composition of hatching eggs and the development of the birds hatched was hampered by the lack of instruments that would have been capable of determining the composition of eggs without opening them. An attempt for determining the chemical composition of intact eggs was made by WILLIAMS et al. (1997), using the so-called TOBEC (Total Body Electrical Conductivity) method in their study. In this experiment it was demonstrated that there are significant correlations between the so-called E-values measured by the TOBEC method (the electrical conductivity of the eggs) and the water content of the eggs as well as the dry matter content of the albumen in all the four species studied (chicken, duck, guinea fowl and quail).

Relying on the results of WILLIAMS et al. (1997), studies on the examination of correlations between egg composition, hatchability and hatched bird's development have recently been started at the Kaposvár University as well. This study demonstrated that, eggs of different composition – i.e., having dissimilar yolk/albumen ratios – have significantly deviating hatchability, and that the birds hatching from these eggs have significantly different body composition at the time of hatching and significantly different growth rate during rearing and finishing (MILISITS et al., 2008a, 2008b). In spite of the favourable results the biggest disadvantage of the TOBEC method is the only moderate correlation between the electrical conductivity and the composition of eggs and therefore it is not suitable for demonstrating minor changes in egg composition, and is reliable only for distinguishing eggs with extremely divergent composition (MILISITS et al., 2007). Therefore, in this study another technique, namely computer tomography (CT) was used for predicting the egg composition (yolk content) *in vivo* and for examining the effect of egg yolk ratio on the hatching weight and on the heart and liver ratio in chicks at hatching.

## **MATERIAL AND METHODS**

Altogether 3.500 hen's eggs – originated from a 24 weeks old TETRA-H parent stock – were involved in the examination. The yolk ratio of these eggs was determined *in vivo* by means of computer tomography using a SIEMENS Somatom Emotion 6 multislice CT scanner (*Figure 1*) 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 (*Figure 2*).



**Figure 1: The SIEMENS Somatom Emotion 6 multislice CT scanner**

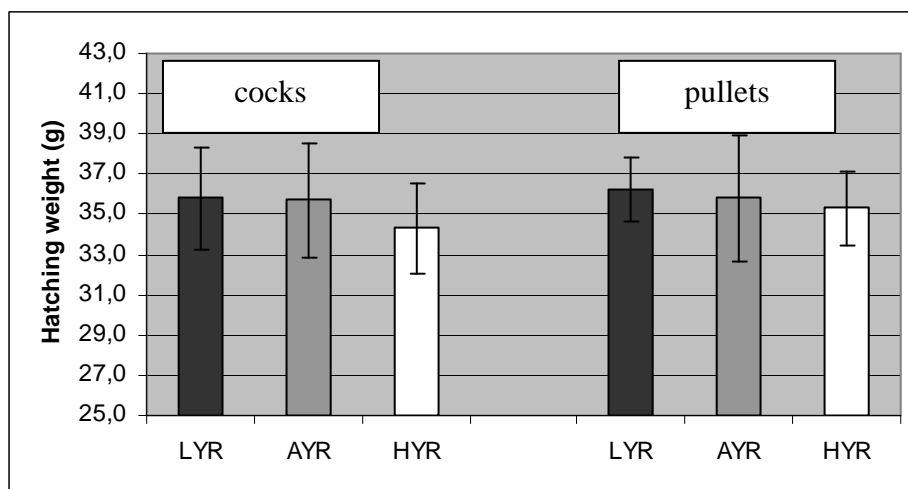
**Figure 2: Cross-sectional CT image of five simultaneously scanned hen's eggs**

The CT examinations were carried out by using the following technical parameters: tube voltage: 110 kV, X-ray radiation dose: 80mAs, mode: spiral, pitch: 1, field of view: 110 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 border of the shell and albumen and the border of the albumen and yolk was determined and the volume of the yolk was calculated thereafter.

Based on the measured values eggs were separated into three groups: eggs with extreme high ( $28.2 \pm 0.90$  %), eggs with average ( $24.6 \pm 0.15$  %) and eggs with extreme low ( $21.2 \pm 0.86$  %) yolk content (10-10 % in each group). All of these eggs ( $n=350$  per group) were incubated thereafter. After hatching 30 chicks per group (15 males and 15 females) were randomly chosen and their liveweight was measured thereafter. After measuring the liveweight chicks were killed by a lethal dose of pentobarbital, intraperitoneally and dissected thereafter. The weight of the heart and liver was measured and their ratio to the hatching weight was calculated. The differences in the hatching weight and in the heart and liver ratio between the experimental groups were evaluated statistically by using the One-Way ANOVA method. The statistical analysis was carried out by the SPSS statistical software package, version 10.0 (SPSS FOR WINDOWS, 1999).

## RESULTS

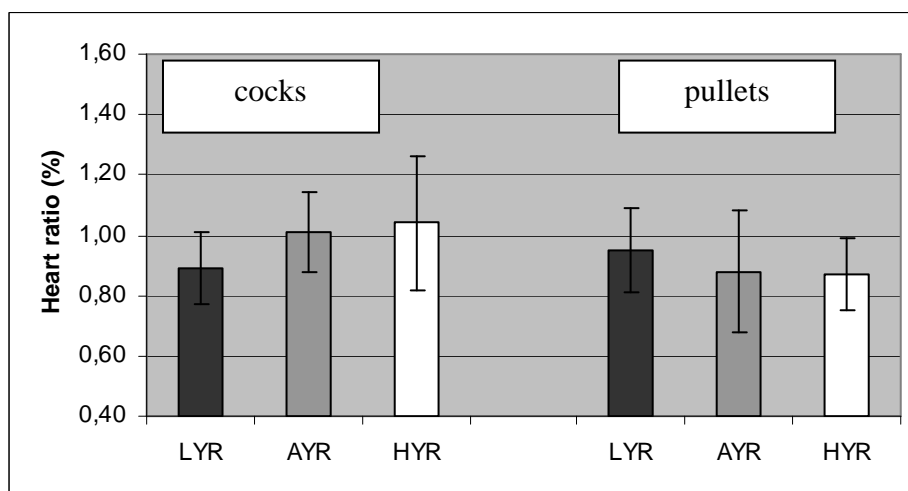
Examining the hatching weight of the chicks it was established that it was decreasing with increasing the yolk ratio in the breeding eggs in both sexes (*Figure 3*).



**Figure 3: Hatching weight of TETRA-H cocks and pullets hatched from eggs with low (LYR), average (AYR) and high (HYR) yolk ratio**

The hatching weight of the chicks hatched from eggs with high yolk ratio was lower by 4.2% in the case of cocks and by 2.5% in the case of pullets than that of the chicks hatched from eggs with low yolk ratio. The hatching weight of the chicks hatched from eggs with average yolk ratio was between the hatching weight of chicks hatched from eggs with high or low yolk ratio in both sexes. However, in spite of this clear tendencies the between group differences were statistically not proven neither in the case of cocks nor in the case of pullets ( $P>0.05$ )

In spite of the hatching weight the ratio of the heart to the hatching weight was increasing with increasing the yolk ratio in the breeding eggs in the case of cocks (*Figure 4*).

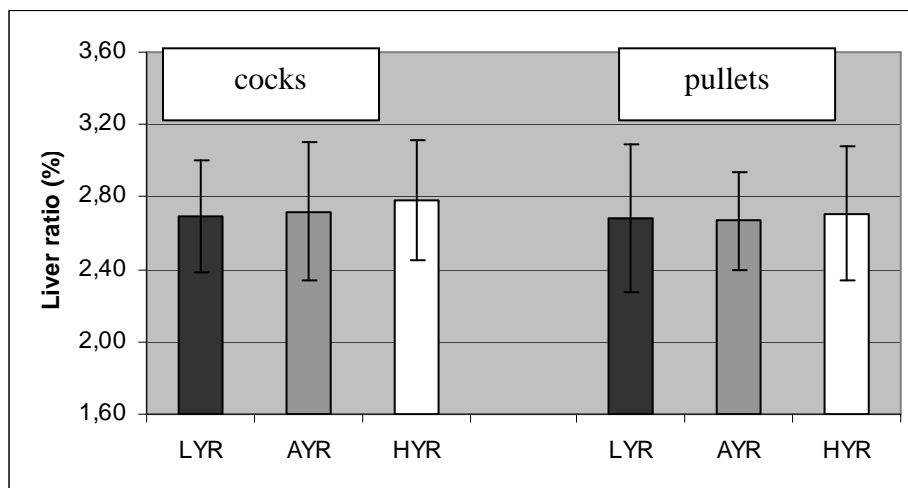


**Figure 4: Heart ratio to hatching weight in TETRA-H cocks and pullets hatched from eggs with low (LYR), average (AYR) and high (HYR) yolk ratio**

The ratio of the heart to the hatching weight in the cocks hatched from eggs with high yolk content was higher by 16.9% than that of the cocks hatched from eggs with low yolk content. The difference observed between these groups was statistically significant at  $P<0.05$  level.

In the case of the pullets the opposite tendency was observed. In these birds the ratio of the heart to the hatching weight was decreasing with increasing the yolk ratio in the breeding eggs. Between the two extreme groups 9.2% difference was observed, but it was not statistically proven ( $P < 0.05$ ) in this case.

The change in the ratio of liver to the hatching weight showed similar tendency in the case of cocks as it was observed in the case of the heart (Figure 5).



**Figure 5: Liver ratio to hatching weight in TETRA-H cocks and pullets hatched from eggs with low (LYR), average (AYR) and high (HYR) yolk ratio**

The ratio of liver to the hatching weight was higher by 3.3% in the cocks hatched from eggs with high yolk content than in those hatched from eggs with low yolk content. The between group differences were not statistically proven in this case ( $P > 0.05$ ).

In the case of the pullets no clear tendency was observed in this trait. The data obtained were very similar in all of the examined groups (2.67-2.71%).

## CONCLUSIONS

Based on the results it was concluded that the yolk ratio in hen's eggs has an influence on the hatching weight and on the heart and liver ratio of the hatched chicks. According to some former results it was established that the higher albumen content in the eggs resulted in higher hatching weight and the higher yolk content in the eggs in better body composition in the chicks. Because the hatching weight and the body composition could have an effect on the further development of the hatched chicks, the further examination of the effect of egg composition on the growth and development of the hatched chicks seems to be necessary.

## ACKNOWLEDGEMENT

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