EFFECT OF GENOTYPE AND HENS' STARTING BODY FAT CONTENT ON THE CHANGES IN THE BODY FAT CONTENT OF THE HENS AND ON THE WEIGHT AND COMPOSITION OF THE EGGS PRODUCED IN THE FIRST EGG LAYING PERIOD

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ABSTRACT
The aim of this study was to examine the effect of genotype and hens' starting body fat content on the changes in the body fat content of the hens and on the weight and composition of the eggs produced in the first egg laying period. The experiment was carried out with altogether 30 hens (15 TETRA SL brown egg layers and 15 TETRA BLANCA white egg layers), which were chosen from altogether 45 TETRA SL and 45 TETRA BLANCA hens based on their CT (computer tomography) predicted body fat content at 20 weeks of age (hens with the highest (n=5), hens with the lowest (n=5) and hens with average (n=5) body fat content in both genotype). For the *in vivo* determination of changes in the body composition of these hens, computer tomography (CT) measurements were carried out at every fourth week between the 20th and 72nd week of age. During the CT measurements hens were fixed with belts in a special plexiglass container without using any anaesthetics. The measurements covered the whole body of the hens using overlapping 10 mm slice thickness on a Siemens Somatom Emotion 6 multislice CT scanner. After collecting, weighing and breaking the eggs produced by the experimental birds on the days of the CT measurements their yolk ratio was determined. Based on the results, it was established that the body fat content of the hens increased continuously in both of the genotypes in the first phase of the experimental period, while it did not change further in the second phase of the experiment. It was also observed at all examination days, that the body fat content of the white egg layers was higher than that of the brown egg layers. Hens with the highest starting body fat content had the highest body fat content in both genotypes during the whole egg laying period. The egg production of the hens was not influenced by the body fat content of the birds, but it was affected by the genotype. The TETRA SL hens produced significantly more eggs than the TETRA BLANCA hens. The hens with average body fat content produced lighter eggs than the hens with low or high body fat content.

Keywords: body fat content, egg weight, egg composition

INTRODUCTION

Because of the tremendous decrease on the international layer breeding market nowadays only three company groups are operating in this sector. The smallest among of them – and the only one coming out from Eastern Europe – is the Bábolna TETRA Ltd. Bábolna and the nearly twenty-five-year-old trade mark 'TETRA' guarantee the breeding quality on the international market, first and foremost because of the cultivated different poultry hybrids.

Parallel with the above mentioned market consolidation the egg production grew dynamically in the last decades. Today the world's egg production reaches 1193 billion pieces (FAO, 2010), out of which 88-90% is produced by layer hybrids for consumption.

In the breeding of egg layers the peak production nearly approached the biological limit of one egg a day, but there are some possibilities for the development in the early and late production, in the length of the persistence. The persistence of the egg production is defined nowadays as the decline in the egg production after the peak production, and it is measured by the slope of the decline (GROSSMANN et al., 2000). The breeders of laying hens concentrate on the maximum number of the saleable eggs per hen housed, on the lowest feed cost per egg or per kg egg mass, on the optimal internal and external egg

quality and on the low mortality and high adaptability to different environments (THIRUVENKADAN et al., 2010).
It is well known from former experiments that the success in the hen house is dependent upon the success in the pullet house. However, during the pullet's rearing period we are mainly focusing on managing pullet body weight and body weight uniformity, but we should also realize that the cumulative nutrition program can have a significant effect on pullet's body composition. We now know that pullet feeding programs can develop pullets of similar body weight, but with markedly different body compositions and subsequent reproductive patterns. Therefore, the optimal body conformation at photostimulation seems to be more important for reproductive success than just obtaining the recommended body weight targets (POWELL, 2004).
While 50% of the world's egg consumption is covered by Leghorn type hybrids (white eggshell layers), this hybrid has not been bred in Hungary since 1983 and has not been distributed since 1999 despite the fact that the white shelled eggs are more suitable from many aspects for the increased industrial egg processing than the brown ones.
Therefore, Bábolna TETRA Ltd. planned to breed and introduce a new Leghorn type layer hybrid (called TETRA Blanca), which would enlarge the range of types and could help to cover the world's industrial egg need and could give a further alternative to all of the egg market participants.
Based on the above mentioned things, this study had two main goals:

1. comparison of changes in the body and egg composition of the newly developed white egg layer (TETRA Blanca) and the well-known brown egg layer (TETRA SL) during the first egg laying period; and
2. comparison of the production and changes in the body and egg composition of hens in both genotypes starting the egg laying period with different amount of fat reserves in their body at the photostimulation.

MATERIAL AND METHODS

The experiment was carried out with altogether 30 hens (15 TETRA SL brown egg layers and 15 TETRA BLANCA white egg layers), which were chosen from altogether 45 TETRA SL and 45 TETRA BLANCA hens based on their CT (computer tomography) predicted body fat content at 20 weeks of age (hens with the highest (n=5), hens with the lowest (n=5) and hens with average (n=5) body fat content in both genotype). By TETRA SL the group of the hens with low body fat content was characterized with 20-23, the group of hens with average body fat content with 24-26, and the group of the hens with high body fat content with 27-32 fat index (see below). The same groups by TETRA Blanca were characterized with 25-27, 28-30 and 33-36 fat index. The differences in the fat content between the same groups of the two genotypes are originated from the difference in the body fat content of the examined genotypes (see the results).
The hens were kept in cages (1.800 cm² basic area), in a closed building at the Test Station of the Kaposvár University, Faculty of Animal Science, in Hungary. In order to the correct identification of which egg was produced by which hen, two hens (one TETRA SL and one TETRA BLANCA) were placed into one cage. The hens were fed *ad libitum* with the same commercial diet during the whole experimental period. Drinking water was also continuously available from self-drinkers.
The changes in the body and egg composition of the hens were monitored four-weekly between 20 and 72 weeks of age. The body composition of the birds was always determined *in vivo* by means of computer tomography (CT) at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvár University. During the CT scanning

procedures birds were fixed with belts in a special plexi-glass container, without using any anaesthetics. Three animals were scanned simultaneously.

The CT measurements consisted of overlapping slices covering the whole body using a Siemens Somatom Emotion 6 multislice CT scanner. Following scanning parameters were set in: tube voltage 130 kV, X-ray radiation dose 90 mAs, mode spiral, pitch 1, FoV 500 mm, slice thickness 10 mm, matrix 512x512. Using the images obtained so-called fat indices were calculated for the determination of the fat content in the hens' body *in vivo*. The calculation was performed according to Romvári (1996) by determining the ratio of number of pixels with X-ray density values of fat to the total number of pixels with density values of muscle, water and fat, i.e. the range between -200 to +200 on the Hounsfield-scale:

$$\text{Fat index} = \Sigma(-200)\text{-}(-20) / \Sigma(-200)\text{-}(+200) \times 100$$

After the CT measurements, all of the eggs, which were produced by these birds on the CT examination days were weighed and broken. After separating and weighing their yolk and albumen content the ratio of the yolk to the whole egg weight was calculated.

For the statistical evaluation of the between group differences in the liveweight and body and egg composition of the hens the One-Way ANOVA was used. The statistical analysis was carried out by the SAS statistical software package, version 9.3.1.

RESULTS

Examining changes in the body fat content of the laying hens it was established that it was increasing continuously in both of the examined genotypes in the first phase of the experimental period, while it did not change further in the second phase of the experiment (*Figure 1.*).

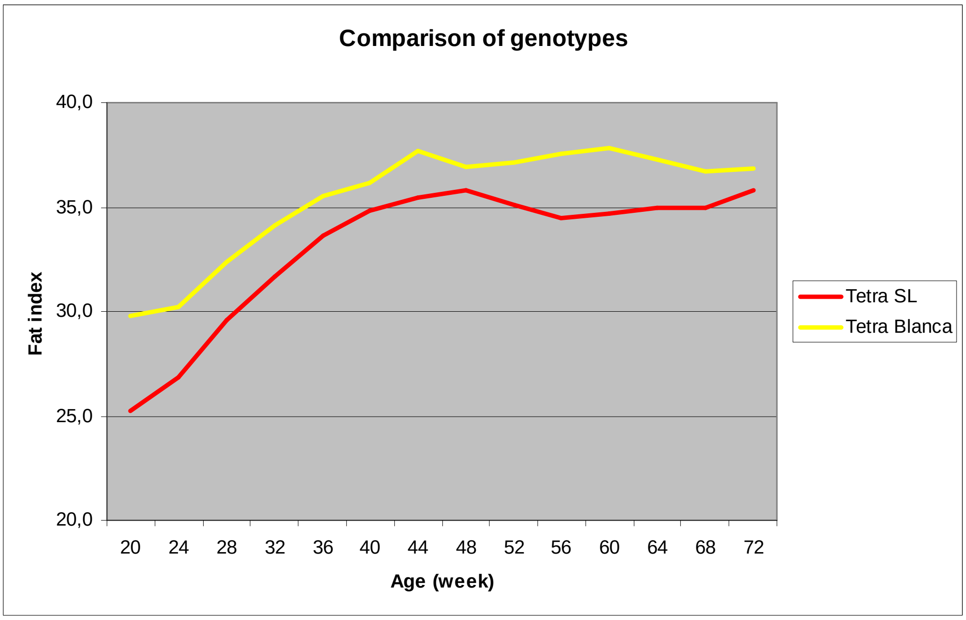

Figure 1: Changes in the fat index of TETRA SL and TETRA Blanca laying hens between 20 and 72 weeks of age

It was also pointed out that the body fat content of the white egg layers was higher than that of the brown egg layers at all examination days.

The body fat content of the hens, which were started the laying period with the highest body fat content, remained the highest in both genotypes during the whole egg laying period (Figure 2 and 3).

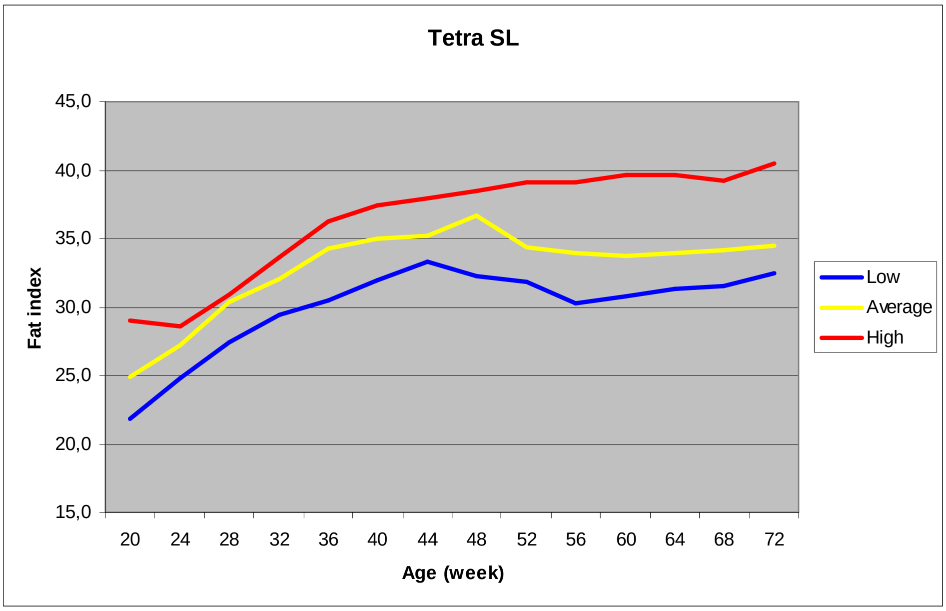

Figure 2: Changes in the fat index of TETRA SL laying hens between 20-72 weeks of age

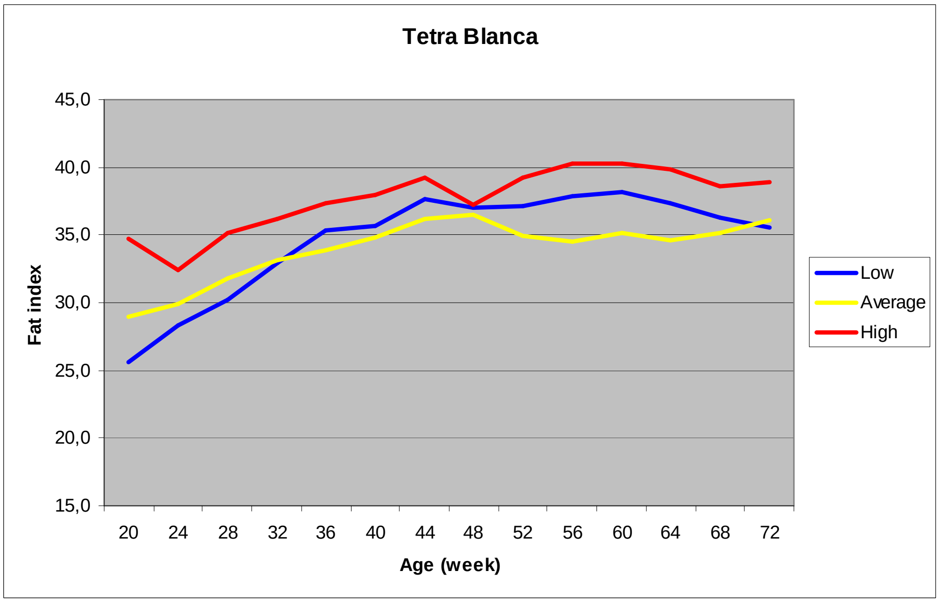

Figure 3: Changes in the fat index of TETRA Blanca laying hens between 20-72 weeks of age

The TETRA SL hens, which were started the laying period with average or low body fat content had the same (average or low) body fat content during the whole experimental period. In the case of the TETRA BLANCA hens the birds, which were started the laying period with low body fat content had higher fat content in their body from the 36th week of age on than those, which had the lowest body fat content at the photostimulation.

Similarly to the changes in the body fat content, the yolk ratio of the eggs produced increased also mainly in the first phase of the experiment and it remained almost at the same level thereafter (*Figure 4.)*.

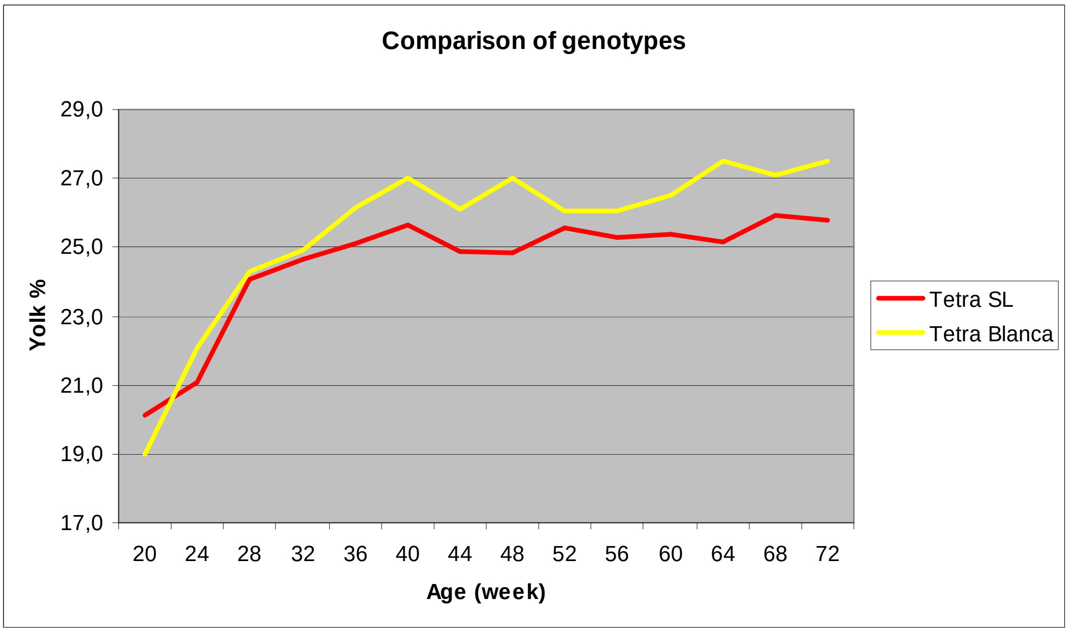

Figure 4: Changes in the yolk ratio of TETRA SL and TETRA Blanca laying hens between 20 and 72 weeks of age

The yolk ratio in the eggs of the TETRA SL and TETRA BLANCA hens was very similar till 32 weeks of age, but the TETRA BLANCA hens produced eggs with higher yolk ratio (+1-2%) thereafter.

In the case of the hens with different body fat content at 20 weeks of age no clear tendencies were observed in the changes of the average yolk ratio in the produced eggs with increasing the starting body fat content of the hens. (Eggs of TETRA SL hens with low body fat content had 24,8 %, with average body fat content 24,2 % and with high body fat content 25 %. Eggs of TETRA BLANCA hens had 24,8 %, 26,9 % and 25,9 % yolk ratio.)

The change in the number of produced eggs during the whole experimental period showed a descending tendency in the TETRA SL genotype with increasing the starting body fat content of the hens (number of produced egg was in the groups 337, 329 and 326). In the case of the TETRA BLANCA hens no clear tendency was observed, but the least number of eggs was produced by those hens also in this case, which had the highest body fat content at 20 weeks of age (hens with low and average body fat content produced 297 eggs, and with high body fat content 288 eggs).

When the egg production of the different genotypes was compared it was found that the TETRA SL hens produced more eggs in every month of the examined period than the TETRA Blanca hens. (*Figure* 5.)

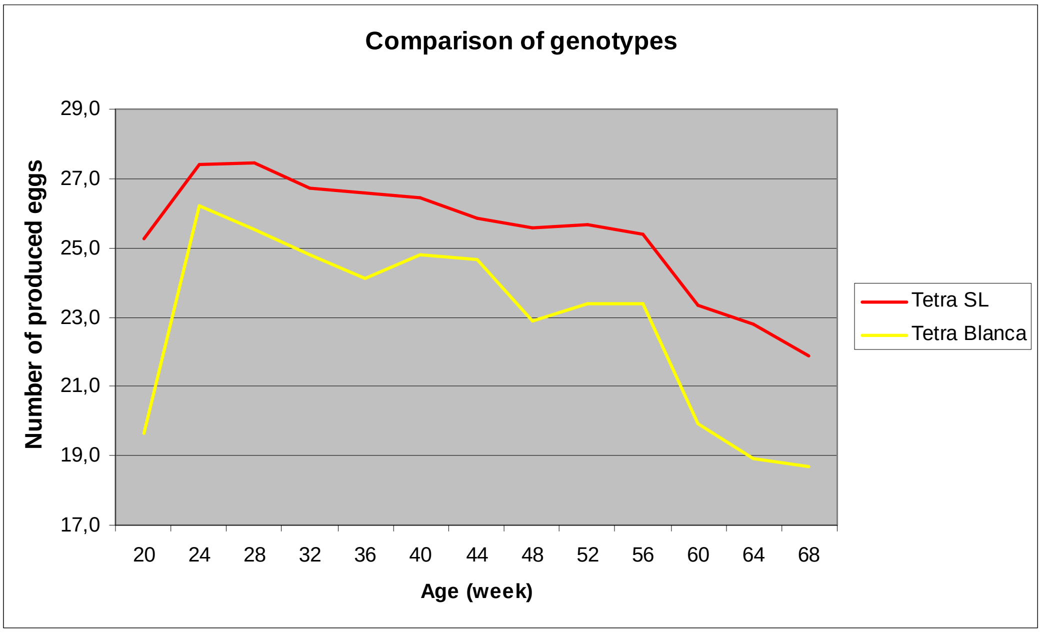

Figure 5: Changes in the number of produced eggs of TETRA SL and TETRA Blanca laying hens between 20 and 72 weeks of age

In the weight of the eggs no significant differences were found between the genotypes, but the hens with average starter body fat content produced lighter eggs than the other two groups in both genotypes.

CONCLUSIONS

The results of this experiment indicates that both of the genotype and the body fat content of the hens at the photostimulation has effect on the egg production and on the changes of body and egg composition during the first egg laying period. To clarify these effects further investigations seem to be needed involving more animals into the trials.

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