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Computer tomograph study of changes in the body composition of dual-purpose chicken genotypes between 4 and 12 weeks of age

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ABSTRACT

The aim of this study was to compare the changes in the body composition of Tetra-H chicks, reciprocal crossbred progenies and chicks from a new cock line, which is planned to use as a new parental line in the breeding program of the TETRA-H. Altogether 90 chicks (15 in both sexes in all genotypes) were involved into the experiment and were scanned biweekly by means of a SIEMENS Somatom Emotion 6 multislice CT scanner between 4 and 12 weeks of age. During the scanning procedure a total of 20 scans were made of each animal, using 8 mm slice thickness and different distances between the scans, depending on the length of the vertebrae. Using this method, scans with the same serial number represent the body composition at the same anatomical points, and so animals of different sizes could be compared. Based on the results it was established that the highest liveweight was reached by the animals of the new cock line at the end of the experiment. However, the lowest ratio of the muscle and the highest ratio of the fat was also observed in these animals, which means an unfavourable body composition at the slaughter compared to the other two genotypes. Therefore, it was concluded that the use of the new cock line as new parental line in the breeding program of the TETRA-H seems to be good for increasing the liveweight of the TETRA-H chicks, but it could be unfavourable for the body composition.
(Keywords: chicken, body composition, computer tomography)

INTRODUCTION

The three-line hybrid TETRA-H was developed in the beginning of the 1980's by the Bábolna Poultry Breeding Company. Thanks for its calm temperament and balanced production it was capable of replacing the traditional free-range poultry breeds. However, out of the dual-purpose characteristics, the egg-production of these birds is the dominant one (180–200 pieces under extensive circumstances) and therefore the increase of their body weight seems to be needed by keeping the good growing ability in the early weeks of the rearing. Concerning the meat-production ability of the new genotype the theoretical average body-weight would be between 2000 and 2400 g at 8–9 weeks of age as a target parameter. However, with increasing the final body weight, some unfavourable changes could be happen in the body composition of the animals and therefore the examination of changes in the body composition of the new cock line seems to be needed before using it in the breeding program. Therefore, the aim of this study was to compare the changes in the body composition of TETRA-H chicks, reciprocal crossbred progenies and chicks from a new cock line during the growing

period by means of computer tomography (CT), which was already effectively used in a lot of former experiments in the *in vivo* examination of changes in the body composition of different species (*Romvári et al.,* 1998; *Milisits et al.,* 1999; *Milisits et al.,* 2000; *Andrássy-Baka et al.,* 2003).

MATERIALS AND METHODS

The experiment was carried out with TETRA-H chicks, reciprocal crossbred progenies and chicks from a new cock line in the Test Station of the Kaposvár University, Faculty of Animal Science. Animals were reared on deep litter in pens (9.2 m² basic area), in a closed building, separated according to sex and genotype (cocks: 110 birds/pen, pullets: 129 birds/pen). Chicken were fed *ad libitum* with commercial diets during the whole experimental period (starter between days 0 and 10, growing between days 11 and 24 and finisher from the 25th day on (*Table 1*). Drinking water was also continuously available from self-drinkers.

Table 1

Composition of the diets used in the experiment

Component	Starter	Growing	Finisher
Dry matter (%)	91.4	91.3	90.0
Crude protein (%)	20.9	18.8	17.1
Crude fat (%)	5.7	6.5	6.8
Crude fibre (%)	2.4	2.7	3.0
Crude ash (%)	4.9	4.4	4.4
N-free extract (%)	57.5	58.9	58.7
Starch (%)	39.2	48.5	48.5
ME Poultry (MJ/kg dry matter)	13.64	15.54	15.27
Calcium (g/kg)	7.34	6.11	6.47
Phosphorous (g/kg)	5.70	5.80	5.40

Animals for the CT examinations – 15 according to sex in all of the three genotypes – were chosen randomly at 4 weeks of age. These birds were then assigned individually with wing tags and they were scanned by CT at every examination days thereafter. Before the CT measurements the liveweight of these birds was always recorded.

CT examinations were taken at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvár University bi-weekly, between 4 and 12 weeks of age. During the measuring 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 8 mm thick slices covering the whole body using a Siemens Somatom Emotion 6 multislice CT scanner. Using the images obtained the muscle and fat indices were calculated by determining the ratio of number of pixels with X-ray density values of muscle or fat with 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:

$$\text{Muscle index} = \Sigma(+20)\text{-}(+200) \,/\, \Sigma(-200)\text{-}(+200) \cdot 100 \quad (1)$$

$$\text{Fat index} = \Sigma(-200)\text{-}(-20) \,/\, \Sigma(-200)\text{-}(+200) \cdot 100 \quad (2)$$

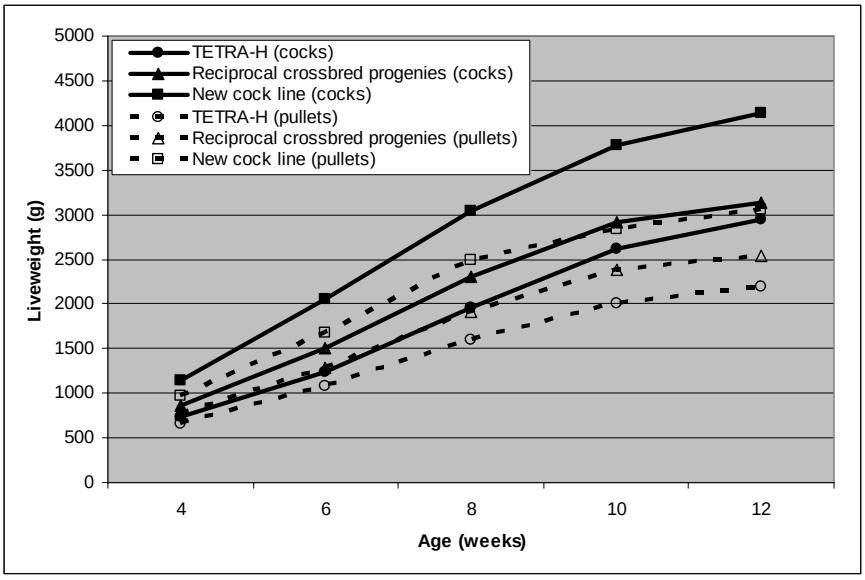
The differences in the liveweight and in the muscle and fat indices between the examined genotypes were evaluated statistically by the One-Way ANOVA method. The significance of the between group differences was tested by the LSD post hoc test. The statistical analysis was carried out by the SPSS statistical sofware package, version 10.0 (*SPSS for Windows,* 1999).

RESULTS AND DISCUSSIONS

Examining the changes in the liveweight of the chicks it was established that the liveweight of the three genotypes differs significantly ($P<0.05$) from each other in both sexes at all examined ages (*Figure 1*).

Figure 1

Changes in the liveweight of TETRA-H chicks, reciprocal crossbred progenies and chicks from the new cock line between 4 and 12 weeks of age



The highest liveweight was reached by the animals of the new cock line, while the lowest by the TETRA-H hybrids at the end of the experiment. The superiority of the new cock line was more than 1 kg in the case of cocks and almost 900 g in the case of pullets at 12 weeks of age.

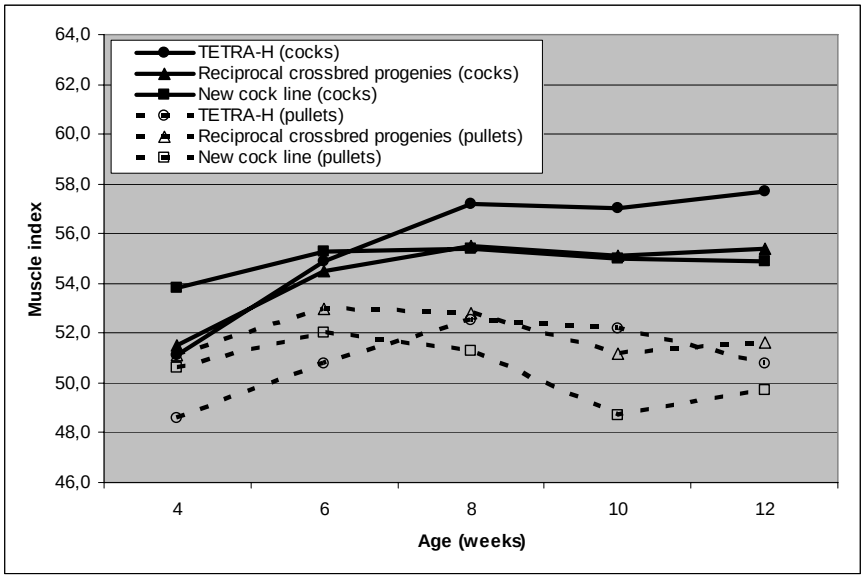
The liveweight was permanently increasing in all of the experimental groups till the 10^{th} week of age, except the pullets of the new cock line. In the last two weeks of the experiment a little break was observed in the increasing of the liveweight in both sexes in all of the three genotypes.

It was interesting to see that the liveweight of the pullets of the new cock line was higher at the end of the experiment, than that of the TETRA-H cocks (3064 g vs. 2950 g).

In the case of the muscle index an increase was observed in all of the three examined genotypes and in both sexes between 4 and 6 weeks of age (*Figure 2*).

Figure 2

Changes in the muscle index of TETRA-H chicks, reciprocal crossbred progenies and chicks from the new cock line between 4 and 12 weeks of age



However, from that time forth the muscle index remained at this level in the cocks of the new cock line till end of the experiment, while it was increasing till 8 weeks of age in the case of cocks of the other two genotypes. At 4 weeks of age the muscle index of the cocks from the new cock line was significantly ($P<0.05$) higher than that of the cocks of the other two genotypes, but at the end of experiment they reached the lowest value, which significantly ($P<0.05$) differed from that of the TETRA-H cocks. The highest ratio of the muscle in the body was observed in TETRA-H cocks at 12 weeks of age, which was higher by 4.2% and 5.1% than that of the other two genotypes.

In the case of the pullets the muscle index decreased from 6 weeks of age in the case of the reciprocal crossbred progenies and the new cock line genotypes, while it was increasing till 8 weeks of age in the TETRA-H genotype. At 12 weeks of age the worst result was produced by the birds of the new cock line also in this case, but the difference from the other two genotypes was not statistically significant ($P>0.05$) in this case.
The fat indices were decreasing between 4 and 6 weeks of age in both sexes and in all of the examined genotypes (*Figure 3*).

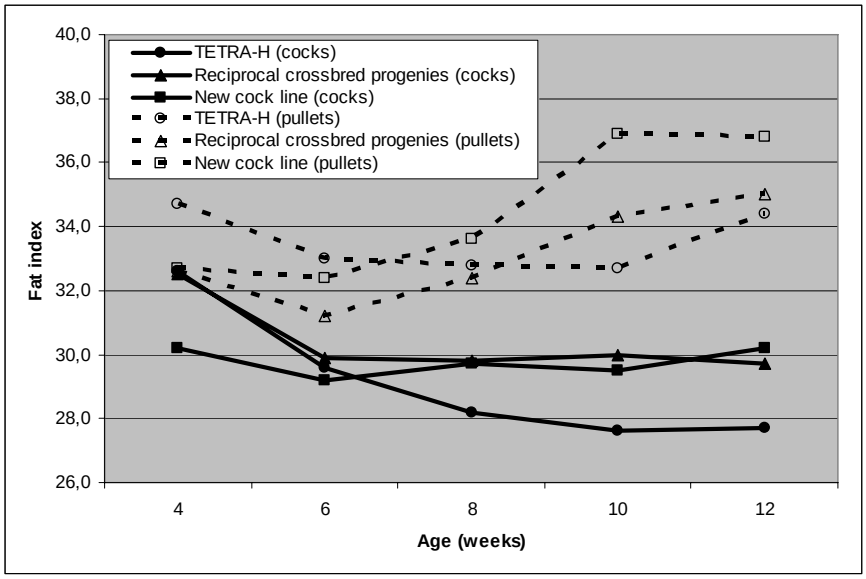
In the TETRA-H cocks the fat index was decreasing also from that time forth, while it remained at the same level in the other two genotypes. The lowest ratio of fat in the body was observed in the TETRA-H cocks at 12 weeks of age, which was lower by 6.7% and 8.3% than that of the other two genotypes. The difference between the TETRA-H cocks and cocks of the other two genotypes was also statistically significant at $P<0.05$ level.

In the case of the pullets the fat index was decreasing till 10 weeks of age in the TETRA-H genotype, while it was increasing thereafter in the last two weeks of the experiment. In spite of this, the ratio of fat to the liveweight was increasing from 6

weeks of age in the other two genotypes and it reached its maximum level at 10 weeks age in the new cock line and at 12 weeks of age in the reciprocal crossbred progenies. The lowest value was reached also in this sex by the TETRA-H birds, which was lower by 1.7% and 6.5% than that of the other two genotypes. However, the differences between the examined genotypes were not statistically proven (P>0.05) in this case.

Figure 3

Changes in the fat index of TETRA-H chicks, reciprocal crossbred progenies and chicks from the new cock line between 4 and 12 weeks of age



CONCLUSIONS

Based on the results it was concluded that the new cock line seems to be good for increasing the liveweight of the TETRA-H chicks. However, when using these birds as parental line in the new breeding program, than it should be taken into consideration, that the higher body fat content of these animals could cause some unfavourable changes in the body composition of the newly developed birds. Therefore, the examination of changes in the body composition of the new animals seems to be necessary before using these birds widely in the breeding program.

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