Effect of starting body fat content of Leghorn-type laying hens on the changes in their body fat content, egg production and egg composition during the first egg laying period

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EFFECT OF STARTING BODY FAT CONTENT OF LEGHORN-TYPE LAYING HENS ON THE CHANGES IN THEIR BODY FAT CONTENT, EGG PRODUCTION AND EGG COMPOSITION DURING THE FIRST EGG LAYING PERIOD

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Original scientific paper

SUMMARY

The experiment was carried out with 60 TETRA BLANCA laying hens chosen from 250 TETRA BLANCA pullets based on their body fat content, predicted at 16 weeks of age by means of computer tomography (CT). Pullets with the highest (n=20), lowest (n=20) and average (n=20) body fat content were chosen for the investigation. Changes in the body fat content of the experimental animals were followed by means of computer tomography in vivo, scanning the hens at every fourth week of the experiment, between 20 and 72 weeks of age. Eggs produced by these birds, were collected at 32, 52 and 72 weeks of age and, after breaking them, their yolk, albumen and egg shell ratio was determined and their dry matter, crude protein and crude fat content was chemically analyzed. Based on the results it was established that the body fat content of the hens started the egg production with high body fat content being higher than that of the hens started the egg production with average or low body fat content during the whole experimental period. The differences in the body fat content of the two extreme groups were statistically proven between 24 and 48 weeks of age (P<0.05). The total egg production of the hens with high starting body fat content was lower by 11 and 12 eggs per hen on the average than that of the hens with low and average starting body fat content, respectively. The composition of the produced eggs was mainly not affected significantly (P>0.05) by the starting body fat content of the hens.

Key-words: hen, body fat, egg production, egg composition, computer tomography

INTRODUCTION

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 focused on managing pullet body weight and body weight uniformity. However, we should also realize that the cumulative nutrition program can have a significant effect on pullet's body composition.

Nowadays the 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).

In the study of Gregory and Robins (1998) it was established that the body condition of laying hens could be very different at the end of the laying period. It was also pointed out in this experiment that the empty body weight increased with increasing body condition score and on the average the birds with a body condition score of 3 were over 50% heavier than the birds scoring 0. About 77% of the difference in empty body weight between the condition score 3 and 0 birds resulted from differences in muscle and fat weight. Differences in absolute fatness accounted for most of that difference,

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and this was evident when the results were expressed as proportions of fat in the empty body.

The determination of the optimal body fat content at the beginning of the laying period seems to be very important, because both the low and high body fat content could have a negative effect on the production of the laying hens (Robinson et al., 1991; Hocking et al., 2002). Therefore, the aim of this study was to examine the effect of starting body fat content of Leghorn-type laying hens on the changes in their body fat content, egg production and egg composition during the first egg laying period.

MATERIAL AND METHODS

The experiment was conducted with 60 TETRA BLANCA laying hens chosen from 250 TETRA BLANCA pullets based on their body fat content, predicted at 16 weeks of age by computer tomography (CT). Pullets with the highest, lowest and average body fat content were chosen for the investigation (n=20 in each group). The live weight of the pullets chosen was similar in all of the experimental groups (1091±33, 1103±54 and 1116±43 g in the group of pullets with low, average and high body fat content, respectively; $P>0.05$).

The experimental animals were kept in cages in a closed building and were fed commercial diet *ad libitum* during the whole experimental period (Table 1). Drinking water was also continuously available from self-drinkers.

Changes in the body fat content of the experimental animals were followed by computer tomography *in vivo*, scanning the hens at every fourth week of the experiment, between 20 and 72 weeks of age. 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. Due to the special arrangement of the hens, they were separable on the CT images, therefore their body fat content was determined individually.

Table 1. Composition of the diets used in the experiment

Component	Content
Dry matter (g/kg)	903.4
ME Poultry (MJ)	11.56
Crude protein (g/kg)	177.8
Crude fat (g/kg)	43.0
Crude fibre (g/kg)	43.1
Crude ash (g/kg)	47.6
Nitrogen-free extractives (g/kg)	591.9
Sodium (g/kg)	1.7
Lysine (g/kg)	8.7
Methionine (g/kg)	3.9
Methionine + cystine (g/kg)	7.0
Calcium (g/kg)	37.6
Phosphorous (g/kg)	7.0

The CT measurements consisted of overlapping 10 mm thick slices covering the whole body using a Siemens Somatom Emotion 6 multislice CT scanner at the Institute of Diagnostic Imaging and Radiation Oncology of the Kaposvár University. The following scanning parameters were set in: 130 kV – 80 mAs, spiral data collection (pitch 1), FoV 500 mm. From the images obtained so-called fat indices were calculated for the *in vivo* determination of the body fat content in the hens. The calculation was performed 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.

Eggs, produced by these experimental birds were collected at 32, 52 and 72 weeks of age and, after breaking them, their yolk, albumen and egg shell ratio was determined and their dry matter, crude protein and crude fat was chemically analyzed by the regulations of the following standards (dry matter: MSZ ISO 1442, crude protein: MSZ EN ISO 5983-1:2005 [Determination of nitrogen content and calculation of crude protein content by the Kjeldahl method], crude fat: 152/2009/EK. III/H [Lipid extraction with petroleum ether]).

For the statistical evaluation of the differences in the body fat content, egg production and egg composition between the experimental groups, the One-Way Analysis of Variance was used. For testing the significance of the between-group differences the LSD Post Hoc test was used. The statistical analyses were conducted by the SPSS statistical software package, version 10.0 (SPSS for Windows, 1999).

RESULTS AND DISCUSSION

Examining changes in the body fat content of the hens it was established that it was higher in the hens started the egg production with high body fat content than that of the hens started the egg production with average or low body fat content during the whole experimental period (Figure 1).

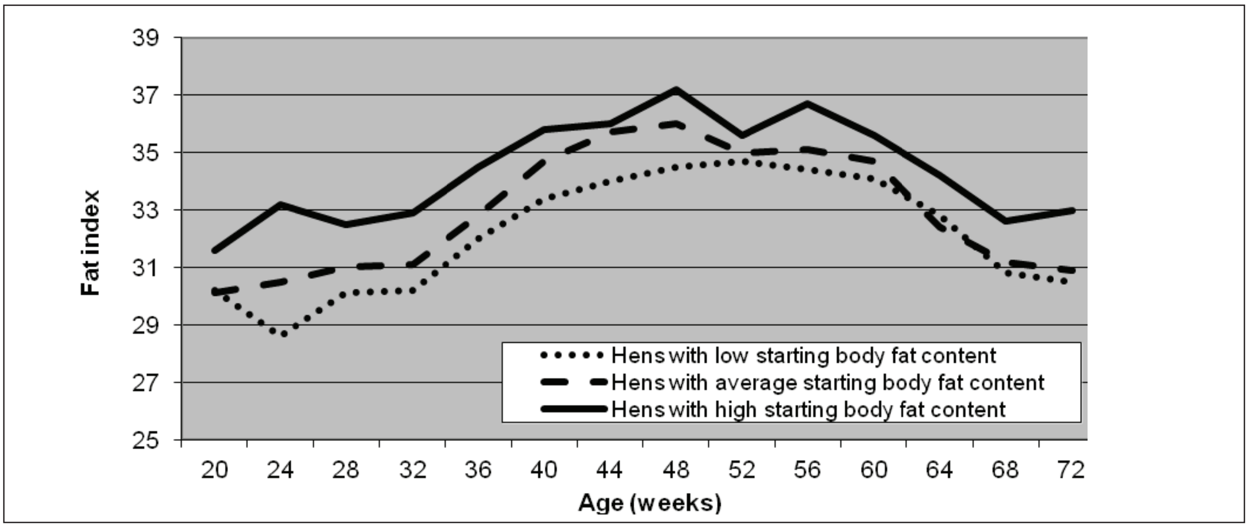

Figure 1. Changes in the body fat content of TETRA BLANCA laying hens started the egg laying period with low, average or high body fat content

The body fat content showed an increasing tendency till 48-52 weeks of age and a decreasing tendency thereafter in all of the experimental groups. The differences in the body fat content of the two extreme groups were statistically proven between 24 and 48 weeks of age ($P<0.05$).

The total egg production of the hens started the egg laying period with high body fat content was less by 11 and 12 eggs per hen on average than that of the hens started the egg production with average or low body fat content (281±25, 292±20 and 293±10, respectively). Although these differences were not statistically proven in this experiment ($P>0.05$), they are noteworthy for the egg producers in general.

The composition of the produced eggs was mainly not affected by the starting body fat content of the hens significantly ($P>0.05$; Table 2).

Table 2. Composition of the eggs produced by TETRA BLANCA laying hens started the egg production with different body fat content

Traits (%)	Age (weeks)	Starting body fat content		
		Low	Average	High
Yolk ratio	32	29.4±4.6	28.0±2.4	29.2±3.6
	52	29.1±2.4	30.1±1.7	30.6±2.7
	72	28.8±4.3	27.6±3.8	28.1±2.7
Albumen ratio	32	57.8±4.5	59.2±2.6	58.4±3.9
	52	57.6±2.6	57.2±2.5	57.1±2.7
	72	55.4±3.9	54.9±3.1	55.0±3.4
Egg shell ratio	32	13.2±1.3	12.7±1.7	13.1±1.1
	52	12.3±0.7	12.3±1.3	12.1±0.8
	72	13.3±1.4	14.1±1.4	14.3±1.6
Eggs' dry matter content	32	24.4±0.7	24.3±1.1	24.3±0.9
	52	24.8±1.5	24.9±0.8	24.7±0.8
	72	24.7±1.3	24.8±0.9	25.0±1.0
Eggs' crude protein content	32	12.7±0.3	12.7±0.3	12.6±0.2
	52	12.5^{b}±0.6	12.4^{ab}±0.3	12.1^{a}±0.2
	72	12.6±0.3	12.7±0.6	12.8±0.4
Eggs' crude fat content	32	9.6±0.5	9.4±0.9	9.5±0.8
	52	10.0±1.1	10.1±0.7	10.2±0.8
	72	10.1±1.2	10.3±0.8	10.3±1.0

[a, b] Different letters in the same row indicate significant differences ($P<0.05$)

The increase in the body fat content of the hens in the first phase of the egg laying period was similar to our former results, but its decrease in the second part of the egg laying period was not observed in our former experiment (Szentirmai et al., 2013).

The non-significant effect of the starting body fat content of the TETRA BLANCA hens on the composition of their produced eggs was similar to our former results, where the production of TETRA SL laying hens was examined (Szentirmai et al., 2014).

CONCLUSION

Based on the results it was concluded that the starting body fat content of the TETRA BLANCA hens has significant effect on the changes in their body fat content, but it has no significant effect on the composition of their eggs produced in the first egg laying period. The total egg production of the hens was not affected significantly by the starting body fat content of the hens, but the lower production of the hens starting the egg laying period with high body fat content seems to be remarkable.

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