

## CHOLESTEROL CONTENT IN EGGS DURING THE LAYING PERIOD

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### Abstract

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The aim of this study was to determine the actual cholesterol content in the eggs of breeding hybrid Hisex Brown from a large scale poultry farm in dependence on the lay period. The eggs were collected during the whole lay period at 10-week intervals. The average content of cholesterol per egg increased from  $153.45 \pm 12.39$  to  $263.90 \pm 14.83$  mg. The lowest values ( $153.45 \pm 12.39$  mg) were found in eggs at the beginning of the lay period ( $P < 0.01$ ). Thereafter the cholesterol content was rising at 10<sup>th</sup> ( $180.26 \pm 11.16$  mg), 20<sup>th</sup> ( $208.22 \pm 18.19$  mg) and the 30<sup>th</sup> ( $263.90 \pm 14.83$  mg) week of the laying period. At the 30<sup>th</sup> week of the lay it reached the peak. At the 40<sup>th</sup> week ( $236.72 \pm 26.23$  mg) we recorded a mild decrease ( $P < 0.05$ ), followed by no changes till the end of lay.

Cholesterol content expressed per 100 g of egg yolk mass varied from  $1185.76 \pm 110.12$  mg to  $1549.80 \pm 107.87$  mg. Its highest concentration ( $P < 0.01$ ) was found at the beginning of the lay period. At the 10<sup>th</sup> and the 20<sup>th</sup> week the cholesterol content decreased and increased in the 30<sup>th</sup> week again ( $P < 0.05$ ). Then the cholesterol content mildly decreased till the end of the lay period.

At the beginning of the laying period the actual concentration of cholesterol per 100 g of yolk was the highest ( $P < 0.01$ ) whereas the weight of eggs matter and yolk was the lowest. Our results indicate that the cholesterol intake from egg in humans is not only dependent on the yolk weight consumed but also on the phase of the laying period.

*Egg yolk, egg matter, hens, Hisex Brown*

From the public health point of view cholesterol is a very often discussed theme. Its content in food has been studied and discussed by many authors (Ingr et al. 1987; Suchý et al. 1995; Vorlová and Kopřiva 1994; Campo 1995; Lewis et al. 2000; Choi et al. 2001; Komprda et al. 2001; Precht 2001).

From this point of view the eggs are considered one of the most controversial foodstuffs. Cholesterol and its esters are found only in egg yolk, where they form emulsion of low density lipoproteins (LDL), very low density lipoproteins (VLDL) and high density lipoproteins (HDL). The HDL so called "good cholesterol" accounts for 8 % of dehydrated yolk (Belitz and Grosch 1992; Stadelman et al. 1995). These egg yolk lipoproteins known as vitellogenins have qualities and biochemistry similar to the mammalian serum lipoproteins. They are synthesized in the liver and secreted into the blood from where they are caught by the target cells. The cells for vitellogenins are oocytes (Voet and Voetová 1995). According to Stadelman (1995), average cholesterol content per one egg is 213 mg. Similar values varying from 210 to 240 mg are reported by Belitz and Grosch (1992). Ingr et al. (1987) found cholesterol values of RIW x LB hybrid from 122 to 408 mg per egg; Suchý et al. (1995) reported in laying hens of ISABROWN values from 228 to 363 mg and Campo (1995) described values of 220 mg in F2 cross hybrids.

Cholesterol content in the eggs is influenced by genetic factors, diet composition, lay intensity, layer age and medical treatment (Ingr et al. 1987; Ingr et al. 1988; Benešová

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1992; Campo 1995; Pesti and Bakalli 1998; Al Ankari et al. 1998; Garcia and Albala 1998; Elkin and Yan 1999).

High intake of cholesterol in foods affects the blood cholesterol levels in humans. Therefore the relation of cholesterol intake and the consumption of eggs were studied by many authors. From the experiment of Hu et al. (1999), carried out with 40 thousand men and 80 thousand women follows that the consumption of one egg daily may not increase the risk of heart diseases in healthy people. Levy et al. (1996) studied a diet with two eggs daily during 3 weeks and detected both an increase of plasma LDL cholesterol and a decrease of HDL cholesterol by 11%.

The aim of our study was to find out the actual cholesterol content in eggs of one of the most widespread and the most effective laying hybrid Hisex Brown during the lay period.

#### Materials and Methods

Egg samples were collected at a large-scale producer Velké Pavlovice during the year 1999 from the large production hen farm to record the variability of cholesterol content in dependence on the lay period. Layers of Hisex Brown from the cage poultry farm were fed a feed mixture for poultry N1 AGP and N2 AGP. Eggs were collected at 10-week-intervals from the beginning of the lay period (20<sup>th</sup> week of age) each to the 60<sup>th</sup> week of the lay. Always 20 eggs from every set were analysed. Each sample was analysed in triplicate.

The egg yolk and egg white were separated, and weighed. In egg yolk, cholesterol was determined by the method of Ingr and Simeonová (1983) using the Bio-La-test and the photometric detection based on Liebermann-Burchard reaction.

The results were processed by STAT – Plus programme using the correlation analysis and Student's *t*-test (Matoušková et al. 1992).

#### Results and Discussion

Table 1 summarises the results of egg analyses from high producing layers during the entire laying period. The mean cholesterol content per 100 g of the fresh egg matter varied from  $368.20 \pm 22.54$  mg to  $437.63 \pm 24.61$  mg. At first lower cholesterol levels were stabilised (at about 30<sup>th</sup> of lay week). Our results are similar to the values detected in the study of Ingr et al. (1987). These authors found the average content 400 mg per 100 g of fresh egg matter. According to Kovacs et al. (1998) the cholesterol content in eggs increases until the 45<sup>th</sup> week of age and after sluggish period the cholesterol content decreases towards the end of the production period.

Table 1  
Cholesterol content per 100 g of fresh egg matter in individual weeks of the laying period

Week of sampling	Yolk weight (g)	Egg matter weight (g)	Cholesterol in fresh egg matter (mg/100 g)		
			Mean $\pm$ SD	Maximum	Minimum
1	9.9 $\pm$ 0.6**	41.5 $\pm$ 2.2**	369.77 $\pm$ 29.85	417.96	318.20
10	15.0 $\pm$ 1.0**	49.0 $\pm$ 2.1**	368.20 $\pm$ 22.54	403.23	335.19
20	17.6 $\pm$ 1.1**	56.2 $\pm$ 3.6**	370.50 $\pm$ 32.36	422.71	311.20
30	19.3 $\pm$ 1.3**	60.3 $\pm$ 1.2*	437.63 $\pm$ 24.61	476.50	403.86
40	17.5 $\pm$ 1.7*	57.0 $\pm$ 6.2	415.30 $\pm$ 46.02	472.19	331.36
50	17.9 $\pm$ 1.4	57.8 $\pm$ 5.5	412.25 $\pm$ 42.11	474.21	340.55
60	18.0 $\pm$ 1.4	58.1 $\pm$ 5.4	410.50 $\pm$ 41.32	477.43	349.45

\* $P < 0.05$ , \*\* $P < 0.05$

Cholesterol content per one egg and per 100 g of yolk during the production period is presented in Fig. 1. Cholesterol content in egg varied during the observed periods of the lay from  $153.45 \pm 12.39$  to  $263.90 \pm 14.83$  mg ( $P < 0.01$  till the 30<sup>th</sup> week,  $P < 0.05$  at the 30<sup>th</sup> – 40<sup>th</sup> week, thereafter the differences were not significant). The lowest values ( $P < 0.01$ ) were found in eggs at the beginning of the lay period. Then the cholesterol content

increased to the 30<sup>th</sup> lay week when it reached the highest value and after a mild decrease ( $P < 0.05$ ) it remained unchanged until the end of laying. Similar results with the same statistically significant differences were found for the yolk weight.

Cholesterol concentration per 100 g of yolk during the following weeks of the laying period varied from  $1185.76 \pm 110.12$  mg to  $1549.80 \pm 107.87$  mg and the highest concentration ( $P < 0.01$ ) was at the beginning, later at the 10<sup>th</sup> and 20<sup>th</sup> lay week it has decreased and the cholesterol content increased again to the 30<sup>th</sup> week ( $P < 0.05$ ).

The highest cholesterol concentration in yolk of the youngest layers at the beginning of the laying period may be explained by the low weight of yolk compared to the total weight of egg content. Results of our study show that in

these eggs a sort of "cholesterol accumulation" in yolk appears. Cholesterol values in yolk were the same as those in the study of Ingr et al. (1988), who reported the values of cholesterol content in laying hybrids from 1200 to 1500 mg per 100 g of yolk. Fluctuation of cholesterol content in eggs of hybrids during the production period shown in the study of Ingr was observed also in our study. However, contrary to his experiment we found the highest yolk cholesterol concentration at the beginning of the lay period.

High coefficients of correlation were found between yolk cholesterol content and yolk weight ( $r = -0.55$ ;  $P < 0.05$ ) and between yolk cholesterol content and fresh egg matter content weight ( $r = -0.43$ ;  $P < 0.05$ ). Low correlation coefficient was found between egg cholesterol content and its yolk content  $r = -0.19$ . This non-significant relationship between egg and yolk differs from the results of Suchý et al. (1995), who demonstrated a high correlation coefficient ( $r = 0.45$ ). Correlation detected in our study could be influenced by high yolk cholesterol content in eggs of layers at the beginning of lay period.

Although there are new analytical methods (chromatographic and enzymatic) available for cholesterol determination in foodstuffs we used the photometric method which is relevant for cholesterol determination in eggs because of similar constitution with plasma lipoproteins.

In conclusion, our results indicate that average cholesterol intake in humans from one egg is 217 mg, but it may vary between 153 to 264 mg. Although in small eggs laid at the beginning of the laying period is the weight of yolk the lowest, the cholesterol concentration per 100 g of yolk appears to be the highest.

### Obsah cholesterolu ve vejcích v průběhu snáškového období

Cílem této studie bylo sledování obsahu cholesterolu ve vejcích nosného hybridu Hisex hnědý z velkokapacitního chovu v závislosti na době snášky. Vejce byla odebírána v průběhu celého snáškového období v intervalu 10 týdnů. Průměrný obsah cholesterolu ve vejcích se zvyšoval v závislosti na období snášky od  $153.45 \pm 12.39$  do  $263.90 \pm 14.83$  mg. Nejnižší hodnoty ve vejcích byly zjištěny na počátku (do 30. týdne) snáškového období ( $P < 0.01$ ). Obsah cholesterolu ve vejcích stoupal v 10. týdnu ( $180.26 \pm 11.16$  mg), 20. ( $208.22 \pm 18.19$  mg) a 30. ( $263.90 \pm 14.83$  mg), kdy dosáhl vrcholu. Ve 40. týdnu ( $236.72 \pm 26.23$  mg) jsme zjistili mírný pokles ( $P < 0.05$ ). Potom zůstal vyrovnaný až do konce snášky.

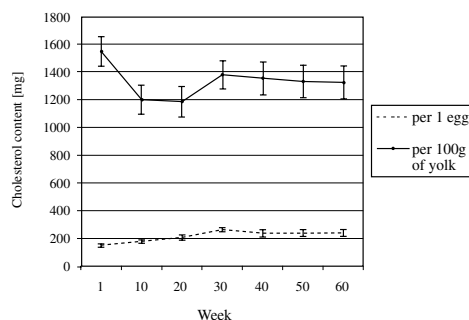


Fig. 1. Cholesterol content per egg and per 100 g of yolk  $\pm$  SD.

Průměrné hodnoty koncentrace cholesterolu na 100 g žloutku se pohybovaly od 1185.76 ± 110.12 mg do 1549.80 ± 107.87 mg. Nejvyšší koncentrace ( $P < 0.01$ ) byla zjištěna na počátku snášky. V 10. a 20. týdnu došlo k poklesu a ve 30. týdnu došlo opět k jeho zvýšení ( $P < 0.05$ ). Potom obsah cholesterolu mírně klesal až do konce snášky.

Absolutní koncentrace cholesterolu na 100 g žloutku byla nejvyšší na počátku snášky ( $P < 0.01$ ), přestože hmotnost těchto vajec byla nejnižší. Naše výsledky ukazují, že příjem cholesterolu z vajec je u lidí závislý nejen na hmotnosti žloutku, ale také na snáškovém období.

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