Effect of preparation rich in omega-3 acids on the production and quality of eggs

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Summary

The research was carried out on 56 ISA Brown laying hens, which were equally divided in one control and one experimental group. The experimental group was fed with diets with added Pronova Biocare Epax TG preparation in the amount of 3.33%. The control group received commercial diets with no added preparation. Laying hens, being 9 months old, were monitored for their production of eggs and egg quality within the period of 28 days. Throughout this period, there were no statistically significant differences in live weights of laying hens (g) and daily food consumption (g) between control and experimental group ($P>0.05$). Differences in laying, as well as in physical characteristics of eggs (egg weight, egg shell weight and thickness, portions of egg yolk and albumen) were also not statistically significant ($P>0.05$). However, addition of Pronova preparation was efficient in changing the profile of fatty acids in egg yolk. Portion of SFA and MUFA in the control group was 31.42% and 41.09%, respectively, and in the experimental group it amounted to 34.05% and 39.95%, respectively. High statistical relevance ($P<0.001$) was marked when changing the content of omega-3 fatty acids (EPA and DHA) in a total of egg yolk fatty acids in experimental group. In comparison to the control group, the values were 3.15% to 1.74% in favour of experimental group.

Introduction

Omega-3 fatty acids are known to have positive influence on the decrease of plasmatic triglycerides, lowering of blood pressure, prevention of blood coagulation and thrombosis, and on the immunity enhancement, too (Calvani and Benatti, 2003). As stated by Barlow and Pike (1991), Mantzioris (2000) and Simopoulos (2000), positive effects on human health were noticed when consuming daily only 0.5 g of omega-3 fatty acids. Great importance is given to not only the ratio of omega n-6:omega n-3, which is ideally 1:1, but also to the omega-3 fatty acids type. Modification of omega n-6:omega n-3 ratio in the production process of eggs is achieved mostly through diets with supplemented linseed and rapeseed oil (Jiang *et al.*, 1991, Herber and Van Eiswyk, 1996, Ceylan *et al.*, 2004, Mirghelenj *et al.*, 2004), and less through feedstuffs of animal origin (Simopoulos, 2000, Cherian *et al.*, 2002). Supplementation of vegetable oils results in the decrease of omega n-6:omega n-3, mainly through the ratio of linoleic acid (C18:2n-6) to α-linolenic acid (C18:3n-3). Of all omega n-3 fatty acids, greater physiological relevance is given to polyunsaturated eicosapentaenoic acid, EPA, and docosahexaenoic acid, DHA (Ollis *et al.*, 1999, Simopoulos, 2000, Komprda *et al.*, 2003, Ivanković and Kralik, 2004). When manipulating the content of fatty acids in food, special attention needs to be paid to prevention of eventual negative influences on production and quality of eggs (Goencueoglu and Erguen, 2004). However, Shang *et al.*, 2004 pointed out lower production (lowered consumption rate, lower laying intensity and food utilization) and poorer quality of eggs (decreased weight of eggs and main parts) in laying hens fed with dietary oils supplementation, if compared with the control group. The objective of this research was to study the effect of oil rich in omega-3 fatty acids on production and quality of eggs.

Material and methods

Investigation was performed on 56 9-month old ISA Brown laying hens, which were equally divided in one control and one experimental group, and kept in cage of four. Laying hens of the control group were fed with commercial diets. In the diets fed to the experimental group, 3.33% of maize was substituted by Pronova Biocare Epax 3000 TG (Table 1). Along with other fatty acids of omega-3 group, this oil contains 15.36% eicosapentaenoic acid (EPH) and 9.99% docosahexaenoic acid (DHA).

No particular feeding and watering regime was applied. A 16-hour lighting regime per day was applied throughout the experiment. Live weights of laying hens were controlled at the beginning, as well as at the end of experiment. Food consumption was calculated per cage. Ten eggs of each group were randomly chosen every week to calculate weights of eggs, yolks, albumen, and egg shell weight and thickness. Portions of albumen, egg yolk and shell are presented in % of a whole egg. The content of fatty acids in the lipids of egg yolk was determined on 10 samples of each group by the Chrompack CP-9000 chromatograph with flame ionization detector (Csapo *et al.*, 1986). Portions of saturated (SFA) and unsaturated fatty acids (MUFA), as well as eicosapentaenoic (EPA, C20:5n-3) and docosahexaenoic acid (DHA, C22:6n-3) are presented as percentage in a total of fatty acids of egg yolk.

Table 1 Composition and content of fatty acids in diets.

Components	Control group	Experimental group
Maize	47.63	44.30
Soybean cake 40%	10.00	10.00
Toasted soybean	21.67	21.67
Sunflower cake	5.00	5.00
Dehydrated lucerne	1.67	1.67
Calcium granules	4.33	4.33
Limestone	6.67	6.67
Phosphonal	1.67	1.67
Salt	0.33	0.33
Methionine	0.12	0.12
Premix PN-K-PIG	0.58	0.58
Bolifor FA 2000 S	0.33	0.33
Pronova Biocare	0.00	3.33
TOTAL	100.00	100.00
Content of fatty acids		
SFA	18.66	21.87
MUFA	26.52	27.04
EPA+DHA	0.00	6.02

Research results were shown as arithmetic mean ($\bar{x}$), standard deviation (s), standard error of the mean (s $\bar{x}$) and coefficient of variance (C_v). Differences in investigated traits were determined by the t-test, on three significance levels (5% $P<0.05$, 1% $P<0.01$ and 0.1% $P<0.001$), using Statistica v.6.0 computer software.

Results and discussion

Production characteristics are overviewed in Table 2. At the end of experiment, live weight of laying hens did not differ with respect to different diet compositions. Decrease in live weight was about equal in both groups (13.5 g in control and 15.04 g in experimental group). Food consumption between groups was not statistically significant (P>0.05). During the experiment, mortality of hens did not occur.

Table 3 presents weights of eggs and their main parts (albumen, yolk, shell), ratio of albumen to yolk and the shell thickness. Adding of Pronova preparation to hen diets did not have statistically significant effect (P>0.05) on quality characteristics and egg composition. Heavier egg yolk was produced by hens which had diets with oil rich in omega-3 fatty acids (18.97 g: 18.88 g). Heavier (8.75 g: 8.46g) and thicker egg shell was found in hens of control group (0.403 g: 0.399 g).

Table 2 Production characteristics.

Characteristic	Statistical mark	Control group	Experimental group	t-test
Live weight / beginning of experiment (g) (n=28)	$\bar{x}$	2000.11	2070.04	n.s.
	s	216.14	197.67	
	$s\bar{x}$	40.85	37.36	
	Cv	10.81	9.55	
Live weight / end of experiment (g) (n=28)	$\bar{x}$	1986.61	2055.00	n.s.
	s	192.30	167.93	
	$s\bar{x}$	36.34	31.74	
	Cv	9.68	8.17	
Eggs Total		756.00	753.00	
Eggs per hen		27.00	26.89	
Laying intensity, %		97.39	96.03	
Food consumption (g/day) (n=7)	$\bar{x}$	116.33	116.00	n.s.
	s	0.52	0.69	
	$s\bar{x}$	0.20	0.26	
	Cv	0.45	0.59	

n.s. = non significant, P>0.05

Table 3 Weights of eggs and main parts.

Characteristic	Statistical mark	Control group	Experimental group	t-test
Egg weight, g	$\bar{x}$	64.57	64.37	n.s.
	s	3.70	4.11	
	$s\bar{x}$	0.58	0.65	
	Cv	5.72	6.39	
Albumen weight, g	$\bar{x}$	36.94	36.94	n.s.
	s	3.00	2.96	
	$s\bar{x}$	0.47	0.47	
	Cv	8.11	8.00	
Egg yolk weight, g	$\bar{x}$	18.88	18.97	n.s.
	s	1.56	1.71	
	$s\bar{x}$	0.25	0.27	
	Cv	8.26	9.02	
Albumen : yolk ratio	$\bar{x}$	1.968	1.963	n.s.
	s	0.210	0.239	
	$s\bar{x}$	0.033	0.038	
	Cv	10.68	12.18	
Egg shell weight, g	$\bar{x}$	8.75	8.46	n.s.
	s	0.93	0.92	
	$s\bar{x}$	0.15	0.15	
	Cv	10.63	10.86	
Egg shell thickness, mm	$\bar{x}$	0.403	0.399	n.s.
	s	0.031	0.022	
	$s\bar{x}$	0.005	0.003	
	Cv	7.65	5.57	

n.s. = non significant, P>0.05

Portion of albumen, yolk and shell (%) in eggs of both groups is presented in Figure 1. Higher portion of albumen (57.37%: 57.18%) and yolk (29.49% : 29.25%) was established in eggs of experimental group, whereas eggs produced by hens of control group had higher portion of shell (13.57%:13.14%). However, stated differences between groups were not statistically relevant (P>0.05).

In the research of Shang *et al.* (2004), high portions of conjugated linoleic acid (CLA) had highly significantly (P<0.01) affected the food consumption, change in live weight, weight of eggs, as well as weight of yolk and albumen. Furthermore, in the same research, dietary supplementation of oils in high amounts also had statistically very significant effect (P<0.01) on portions of yolk and albumen, and the differences in portions of egg shell were statistically significant (P=0.04). Designed eggs on the US market (Cherian *et al.*, 2002) have 25.6%-33.4% of yolk, 56.3%-64.5% of albumen and 9.5%-10.8% of shell, with the ratio of yolk to albumen ranging between 39.6% to 59%. Research results referring to thinner shell in eggs produced by hens fed with Pronova supplementation, are in accordance with results obtained by Leeson and Atteh (1995), who claimed weaker absorption of minerals if poultry was fed with diets containing more saturated fatty acids. Shang *et al.* (2004) also pointed out that the increase of oils in hen diets (CLA in form of free fatty acid) had statistically highly relevant influence (P<0.01) on the decrease of shell thickness.

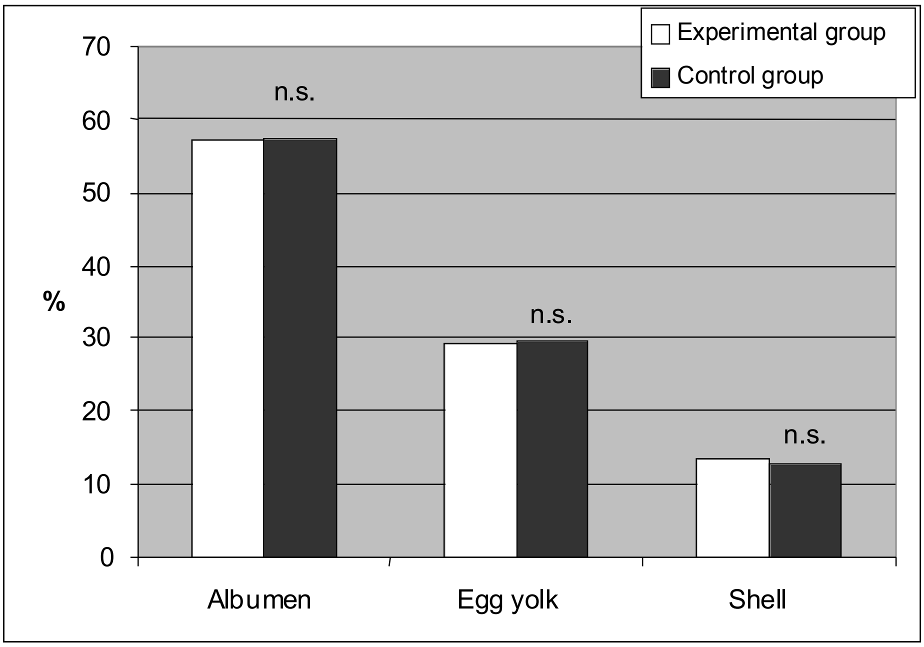

Figure 1 Portion of main parts (%) in eggs (n=40).

Content of SFA, MUFA and EPA+DHA in the lipids of egg yolk are presented in Figure 2. When compared to the experimental group, laying hens in control had smaller portion of saturated fatty acids in egg yolk (31.42% : 34.05%). However, these hens had higher content of MUFA in egg yolk than the hens of experimental group, being 41.09% and 39.95%, respectively. Statistically highly significant differences (P<0.001) are determined in the contents of EPA+DHA between groups. Portion of EPA+DHA in the lipids of egg yolk of experimental and control group was 3.15% and 1.74%, respectively. Compared to the control group, experimental group had 181% higher portion of desirable polyunsaturated fatty acids. In the research of Jiang *et al.* (1991), content of SFA fluctuated between 30.2% and 35.5%, content of MUFA from 34.5 to 55.4%, whereas the content of EPA+DHA in the total of fatty acids was 0.5-3.0%. According to Simopoulos (2000), content of SFA, MUFA and EPA+DHA in retail eggs were 80.7, 115.4 and 1.1 mg/g egg yolk, respectively. In his research, retail eggs also had lower content of SFA and higher content of MUFA than eggs laid by hens which were fed with fish flour supplement. Cherian *et al.* (2002) compared the content of fatty acids among retail and other "designed" eggs available on the US market. The most favourable content of SFA (33.3%), MUFA (48.4%) and DHA (1.4%) was determined in egg yolk lipids of laying hens which were fed diets without added fats of animal origin. When comparing effects of linseed and sunflower oil supplementation, Galobart *et al.* (2002) found out more favourable content of SFA (29.83%: 32.27%), MUFA (43.36%: 38.80%) and EPA+DHA (1.57% :0.73%) in laying hens fed with supplemented linseed oil. Shang *et al.* (2004) found out that the increase of CLA in diets (0-6%) increased SFA content (32.39-49.88%), but decreased MUFA (35.38-15.26%) in the lipids of egg yolk. Content of EPA+DHA in a total of fatty acids (Goencueoglu and Erguen, 2004) ranged between 0.74% (4% of sunflower oil) and 1.96% (4% linseed oil).

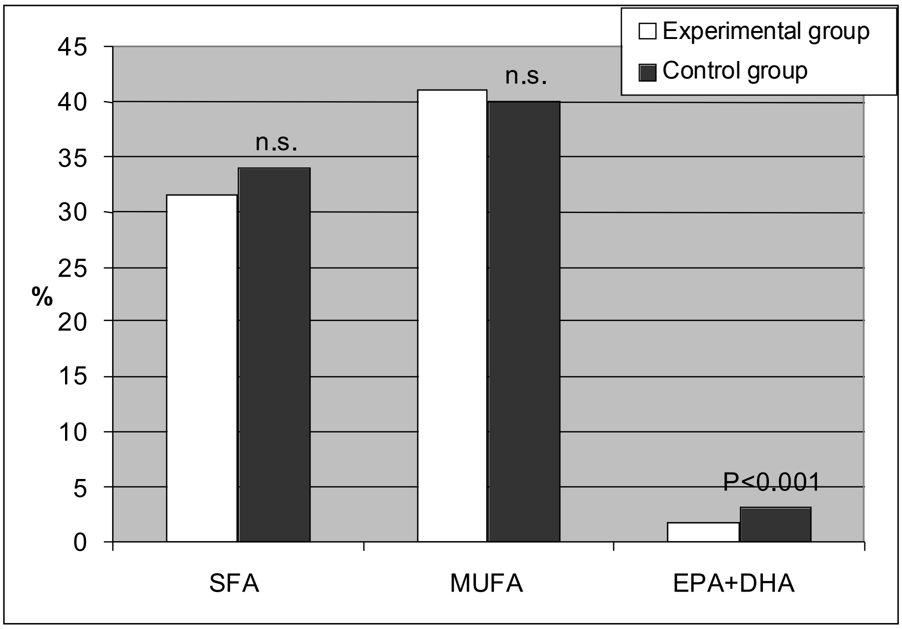

Figure 2 Content of SFA, MUFA and EPA+DHA in eggs.

Conclusion

Based on the data obtained through investigating what effect oil rich in omega-3 fatty acids has on production and quality of eggs, the following can be concluded:

- Between investigated groups, there were no differences with respect to production characteristics (weight of laying hens, food consumption, laying intensity) and quality of eggs (weight of egg, albumen, yolk, shell, shell thickness, albumen: yolk ratio and relative portion of main parts to egg).
- Supplementation of oil rich in omega-3 fatty acids (in amount of 3.33%) significantly altered composition of fatty acids in egg yolk. Content of EPA+DHA in a total of fatty acids in control and experimental group was 1.74% and 3.15%, respectively.
- At the end of the 28-day investigation, content of desirable polyunsaturated fatty acids in the egg yolk lipids of experimental group was 181% higher, when compared to the control group, which was fed with commercial diets.

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Production of Lipids Rich in Omega 3 Fatty Acids from the Halotolerant Effect of dietary n-3 series fatty acids on sperm production in the length on broilers - CABI. The effect of branched chain amino acids on proteosynthesis in Reduction in behavior problems with omega3 ...Â The effect of stunning method (gas vs. electrical) on some breast meat quality traits was evaluated on 128 breasts (P. major muscles) of 106 day-old female BUT-Big6 turkeys (8.9 kg live wt) reared under intensive conditions. The birds were processed on a commercial processing plant using either electrical (E) or gas (G) stunning system.Â Effect of garlic (allium sativum) supplementation on egg quality - CABI. Read more. Ã—. Report "Effect of preparation rich in Omega-3 acids on the production XXI European Symposium on the Quality of Poultry Meat. Bergamo, Italy, Sept. 15-19. (Paper 121).Â The objectives of this study were to determine the effects of marinade injection and vacuum steam precooking on yields, some compositional changes and bound water content as raw chicken breasts were processed to marinated, precooked, and grilled products, and to evaluate marinated product sensory characteristics.