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Effectiveness of fish oil and microalgae additives on Eicosapentaenoic Acid and Docosahexaenoic Acid concentrations in chicken eggs

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Abstract

Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA, 22:6) are necessary fatty acids in the human brain, cerebral cortex, retina, and skin components, and they can be formed from omega-3 fatty acids in the body. EPA and DHA can be obtained from marine fish and microalgae. This study aimed to reveal the effects of fish oil (FO) and microalgae EPA and DHA on laying hen diets on the egg EPA and DHA fatty acid compositions. For this purpose, 36 Super Nick Chick white laying hens at 54 weeks of age were divided into 3 treatment groups with 12 replicated. The experimental groups were as follows; T1: Control (sunflower oil, 3%), T2: Fish oil 3%, and, T3: Microalgae (MALG) group 1.5% +sunflower oil 1.5% were added to laying hen diets. Egg samples were collected at 28, 56, and 84 days, and egg yolk fatty acid composition was analyzed using gas chromatography. On d 28, the EPA ratio in the C group was higher than in fish oil and MALG-added groups and MALG groups EPA ratio was highr than FO group (P<0.01) and there were no significant differences at 56 and 84 in terms of EPA ratio %. The FO and MALG groups the DHA ratios were higher than that of the C group at 28, 56, 84, and in the overall period. (P<0.01). In the overall period, the C group's EPA ratio was higher than those of the FO and MALG-added groups (P<0.01). There were no significant differences among the FO and MALG groups in terms of EPA and DHA concentrations in egg yolks. In conclusion, FO and MALG addition can increase the DHA ratio but is not effective in increasing the EPA ratio in hen egg yolk.

Key words: *chicken egg, microalgae, fatty acids, DHA, EPA, sustainability*

INTRODUCTION

The ω-3 FAs are important for the body and must be received through diet because the body is unable to produce them. Dietary ω-3 FAs are integrated into the cell membranes of all tissues. Different ω-3 FAs are essential in a well-maintained ratio for a variety of developmental, physiological, biological, and health-promoting activities (Richardson, 2006). The ω-3 FAs are important nutrients that support the growth health and production of poultry (Simopoulos, 2011; Arias-Rico et al., 2018; Cherian, 2015; Lee et al., 2019).

Marine-derived oils which rich in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA, 22:6) content and they may be used efficiently for egg fortification, rather than alpha linolenic acid (ALA). Previous research revealed that EPA and DHA concentration in eggs may increase with 120 mg EPA and DHA supplementation from fish oil (FO) for 21 days when compared to 120 mg α-ALA supplementation from flaxseed per 100 g feed (Lemahieu *et al.*, 2015). Zhao *et al.* (2021) noted that the inclusion of 15 g/kg FO and 15 and 30 mg/kg krill oil inclusion to the diet caused an increase in egg's approximately 300 mg of EPA and DHA. Compared to krill oil addition, FO supplementation increased the retention of EPA and DHA in eggs. Another experiment showed that a 4 g/kg FO addition could increase 200 mg/kg of DHA in egg yolk (Cachaldora et al., 2014).

This study was conducted to determine the effects of adding FO, and DHA-rich

microalgae to laying hen diets on the egg yolk fatty acid composition of laying hens.

MATERIALS AND METHODS

Animals, experimental design and diets

This project's ethical issues have been assigned by the Erciyes University Institutional Animal Care and Use Committee (protocol 03.05.2023, no 23/101). In the experiment, a total of 36 Super Nick Chick white 54-week-old egg-laying hens were used. Animals were allocated into 3 different groups with 12 replicas in individual cages. The experimental groups were as follows; T1: Control (C, sunflower oil, 3%), T2: Fish oil 3% (FO), and, T3: Microalgae (DHA Gold) 1.5% Sunflower oil 1.5% (MALG) were added to laying hen diets for 98 days.

Before the experiment began, the animals were given a 14-day adaptation period. The body weight and egg production of animals was recorded and considered to minimize differences among the treatment groups.

The experimental feeds were produced from a similar nutrient composition (protein, energy, vitamins and minerals, and amino acids) for laying hens. Two ratios were calculated and differences in oil types (sunflower, fish oil) and microalgae+sunflower oil. The feed material and chemical components are provided in Table 1. Feeds were sealed with plastic caps and stored in a shaded area with the lid closed.

The hens were housed in individual laying hen cages (L45xW32xH35 cm) with 4 floors and 3 cages in every floor (4*3= 12 cages each block). The partitions were placed between the feeders to prevent the next chick feed consumption. The bird's room was a semi-controlled environment. The cages have contained one nipple drinker in each.

Table 1. Composition of diets

	Groups		
	Sunflower oil	Fish oil	Microalgae
Yellow corn	500.00	500.00	500.00
Wheat	33.97	33.97	30.00
Sunflower meal	120.00	120.00	120.00
Soybean meal 46	151.69	151.69	150.48
Vegetable oil[§]	30.00	30.00	26.00
Salt, NaCl	3.19	3.19	3.2
Vitamin and mineral premix*	2.00	2.00	2.00
Di-calcium phosphate	4.8	4.8	4.3
Limestone	94.15	94.15	94.47
Methionine	0.55	0.55	0.55
Multi-enzyme	0.5	0.5	0.5
Wheat bran	59.15	59.15	58.5
Microalgae	0	0	15
Total			1000
Chemical composition**			
Dry matter, %	92.02	92.16	92.61
Crude protein, %	17.00	17.00	17.00
Crude fat, %	5.37	5.38	5.38
Methionine, %***	0.36	0.36	0.36
Lysine, %***	0.77	0.77	0.77
Calcium, %***	3.70	3.70	3.70
Available phosphorus, %***	0.36	0.36	0.36
Metabolic Energy Kcal ME/kg****	2730	2730	2730

*Vitamin-mineral premix per kilogram of the diet; Vitamin A, 15,000 IU; Vitamin D3 2000 IU; Vitamin E, 40.0 mg; Vitamin B1 (thiamine), 3.0 mg; Vitamin K, 5.0 mg; Vitamin B6, 5.0 mg; Vitamin B12, 0.03 mg; Vitamin B2 (riboflavin), 6.0 mg; Biotin, 0.1 mg; Niacin, 30.0 mg; Folic acid, 1.0 mg, Calcium D-pantothenate, 12 mg; Choline chloride, 400 mg, Iron, 35.0 mg; Manganese, 80.0 mg; Zinc, 50.0 mg; Iodine 2.0 mg; Cobalt, 0.4 mg; Copper, 5.0 mg; Selenium, 0.15 mg assures. **Compositions are calculated according to NRC feedstuff tables (1994). ****ME values calculated according to TSE (1994).

The fatty acid (FA) profiles of treatment diets and eggs were determined according to the Shimadzu application catalog. The FA composition of eggs was analyzed determined at 28, 56, 84, and 98 days. In every period, a total of 24 eggs from all groups were used (8 eggs for each group). Every 2 egg yolks from same groups were put in the bag, then cooked with boiling water, after cooling they were stored at −20°C until analysis. The FA composition was analyzed by gas chromatograph (Shimadzu GC-2010 Plus, Japan) equipped

with a flame ionization detector and a 100 m × 0.25 mm ID HP-88 column. The results were expressed as g FA/100 g total FAs.

RESULTS

The effect of fish oil and microalgae supplementation on egg yolk EPA and DHA concentrations are presented in Table 2. On d 28, the EPA ratio in the C group was higher than FO and MALG added groups and the DHA ratio was lower in the C group compared to these groups (P<0.01). MALG addition to diets did not affect the EPA ratio on days 56 and 84, the DHA ratio FO and MALG groups were higher than the C group's egg yolk (P<0.01). In the overall period, in the C group, the EPA ratio was higher than FO and MALG-added groups, and the DHA concentration FO and MALG-supplemented group was significantly higher than that of the C group (P<0.01). There were no significant differences among the FO and MALG groups in terms of EPA and DHA concentrations in egg yolks.

Table 2. Effect of fish oil and microalgea supplementation on egg yolk EPA and DHA concentrations

	Oil sources			
	SFO	FO	MALG	P
Day 28				
EPA	0.20±0.03^{a}	0.05±0.01^{c}	0.12±0.04^{b}	0.001
DHA	0.23±0.06^{b}	0.78±0.06^{a}	0.90±0.02^{a}	0.001
Day 56				
EPA	0.073±0.004	0.018±0.003	0.048±0.002	0.153
DHA	0.0675±0.05^{b}	0.43±0.10^{a}	0.40±0.08^{a}	0.001
Day 84				
EPA	0.12±0.04	0.08±0.01	0.07±0.01	0.601
DHA	0.08±0.00^{b}	0.83±0.08^{a}	0.67±0.02^{a}	0.001
Overall period				
EPA	0.19±0.03^{a}	0.09±0.03^{b}	0.09±0.01^{b}	0.002
DHA	0.17±0.04^{b}	0.68±0.04^{a}	0.61±0.02^{a}	0.001

^{a,b,c}: Values with different superscripts in a row differ significantly, P: probability, **:p<0.01. SFO: Sunflower oil, FO: Fish oil, MALG: Microalgae, EPA: C20:5n3 Eicosapentaenoic acid, DHA: C22:6n3 Docosahexaenoic acid

DISCUSSION

In the current study, the composition of yolk fatty acids was significantly affected by dietary omega-3-rich oil treatments. The yolk DHA content increased with addition FO and MALG. The EPA concentration did not increase in FO and MALG groups, in contrast to decreased to the control diet. Kralik et al. reported that the addition of soybean and fish oil (0.-1.5%) to the diet significantly increased the EPA and DHA levels as the fish oil content increased. Świątkiewicz et al. (2020) found that the addition of 2% of algal oil, FO, soybean oil, rapeseed oil, linseed oil, camelina oil, or coconut oil did not affect performance traits. However, microalgae supplementation significantly increased egg yolk DHA and EPA values. Kim et al. (2016) Flax seed oil and microalgae, Huang et al. (1990) 1,2,3% menhaden fish oil, and Wen et al. (2019) 1%, 2%, 4%, and 8% microalgae, additions to the laying hen's diet was increased the DHA and EPA content on egg yolk. Kim et al. (2016) also noted that the Flax seed oil inclusion increased the ALA content of eggs more than microalgae.

The α-linolenic acid (**ALA**) is a precursor of n-3 PUFA and ALA is metabolized into EPA and DHA in the body. However, the synthesis of DHA may limit depend linoleik acid LA and ALA ratio and best convertion ratio is up to 4% (Shahidi and Ambigaipalan, 2018). Today, researchers are focusing on enriching eggs with EPA and DHA because of their benefits to human health. It can be changed by supplementing n-3 PUFA through non-feeding. It has been shown that the fatty acid profile of the eggs of chickens can be changed by adding a traditional n-3 PUFA source, α-linolenic acid sources, to the diet of chickens. It has been recommended that either fish oil rich in these sources or microalgae should be added to increase EPA and DHA in the eggs of chickens (Fraeye et al., 2012). In this study, both fish oil and microalgae supplementation provided a significant increase in DHA levels. Therefore, it was demonstrated in this study that both FO and MALG supplementation can be used effectively in making eggs functional in order to contribute to human health.

CONCLUSIONS

In conclusion, FO and MALG addition can increase the DHA ratio, but not effective in increasing the EPA ratio in chicken egg yolk.

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REFERENCES

Arias-Rico, J., Cerón-Sandoval, M.I., Sandoval-Gallegos, E.M., Ramírez-Moreno, E., Fernández-Cortés, T.L., Jaimez-Ordaz, J., Contreras-López, E. and Añorve-Morga, J., 2018. Evaluation of Consumption of Poultry Products Enriched with Omega-3 Fatty Acids in Anthropometric, Biochemical, and Cardiovascular Parameters Journal of Food Quality, 2018, 8

Cachaldora, P., García-Rebollar, P., Alvarez, C., Blas, J.C. DE and Méndez, & J., 2014. Effect of type and level of fish oil supplementation on yolk fat composition and n-3 fatty acids retention efficiency in laying hens British Poultry Science, 47:1, 37–41

Cherian, G., 2015. Nutrition and metabolism in poultry: Role of lipids in early diet Journal of Animal Science and Biotechnology, 6, 28 (Journal of Animal Science and Biotechnology)

Fraeye, I., Bruneel, C., Lemahieu, C., Buyse, J., Muylaert, K. and Foubert, I., 2012. Dietary enrichment of eggs with omega-3 fatty acids: A review

Huang, Z., Leibovitz, H., Lee, C.M. and Millar, R., 1990. Effect of dietary fish oil on .omega.-3 fatty acid levels in chicken eggs and thigh flesh Journal of Agricultural and Food Chemistry, 38, 743–747

Kim, J., Magnuson, A., Tao, L., Barcus, M. and Lei, X.G., 2016. Potential of combining flaxseed oil and microalgal biomass in producing eggs-enriched with n - 3 fatty acids for meeting human needs Algal Research, 17, 31–37 (Elsevier B.V.)

Konieczka, P., Barszcz, M., Choct, M. and Smulikowska, S., 2018. The interactive effect of dietary N-6: N-3 fatty acid ratio and Vitamin E level on tissue lipid peroxidation, DNA damage in intestinal epithelial cells, and gut morphology in chickens of different ages Poultry Science, 97, 149–158

Lee, S.A., Whenham, N. and Bedford, M.R., 2019. Review on docosahexaenoic acid in poultry and swine nutrition: Consequence of enriched animal products on performance and health characteristics Animal Nutrition, 5, 11–21 (Elsevier Ltd)

Lemahieu, C., Bruneel, C., Ryckebosch, E., Muylaert, K., Buyse, J. and Foubert, I., 2015. Impact of different omega-3 polyunsaturated fatty acid (n-3 PUFA) sources (flaxseed , Isochrysis galbana , fish oil and DHA Gold) on n-3 LC-PUFA enrichment (efficiency) in the egg yolk Journal of Functional Foods, doi: 10.1016/j.jff.2015.04.021 (Elsevier Ltd)

Richardson, A.J., 2006. Omega-3 fatty acids in ADHD and related neurodevelopmental disorders International Review of Psychiatry, 18, 155–172

Shahidi, F. and Ambigaipalan, P., 2018. Omega-3 Polyunsaturated Fatty Acids and Their Health Benefits

Simopoulos, A.P., 2011. Importance of the omega-6/omega-3 balance in health and disease: Evolutionary aspects of diet World Review of Nutrition and Dietetics, 102, 10–21

Świątkiewicz, S., Arczewska-Włosek, A., Szczurek, W., Calik, J., Bederska-ŁOjewska, D., Orczewska-Dudek, S., Muszyński, S., Tomaszewska, E. and Józefiak, D., 2020. Algal Oil as Source of Polyunsaturated Fatty Acids in Laying Hens Nutrition: Effect on Egg Performance, Egg Quality Indices and Fatty Acid Composition of Egg Yolk Lipids Annals of Animal Science, 20, 961–973

Wen, Z.G., Yan, H.J., Yang, P.L., Tang, J., Xie, M. and Hou, S.S., 2019. Dual functions of eicosapentaenoic acid-rich microalgae: Enrichment of yolk with n-3 polyunsaturated fatty acids and partial replacement for soybean meal in diet of laying hens Poultry Science, 98, 350–357

Zhao, Y., Shi, H., Wang, C., Yang, J., Xue, C., Jiang, X., Chen, G., Zhang, T. and Wang, Y., 2021. The enrichment of eggs with docosahexaenoic acid and eicosapentaenoic acid through supplementation of the laying hen diet Food Chemistry, 346, 128958