Livestock Science ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Effect of the *Camelina sativa* oil on the performance, essential fatty acid level in tissues and fat-soluble vitamins content in the livers of broiler chickens

Teresa Jaśkiewicz [a,*], Agnieszka Sagan [a], Iwona Puzio [b]

[a] *Department of Biological Bases of Food and Feed Technology, University of Life Sciences in Lublin, 20-612 Lublin, Poland*
[b] *Department of Animal Physiology, University of Life Sciences in Lublin, 20-950 Lublin, Poland*

ARTICLE INFO

Article history:
Received 4 January 2013
Received in revised form
27 March 2014
Accepted 2 April 2014

Keywords:
Camelina
Alpha-linolenic acid
Broiler chicken

ABSTRACT

Camelina (*Camelina sativa*) oil (CO) is rich source of α-linolenic acid. The diet for broiler chickens was supplemented with camelina oil and it was compared with diets supplemented with soybean oil (SO) and rapeseed oil (RO). A total of 90 one-day-old Ross 308 broiler chickens were used for a 35-d study, and chickens were allocated to 15 cages and 6 broiler chickens/cage. Cages were randomly assigned to three dietary treatments with five cages per treatment. The temperature and humidity were controlled, and broiler chickens had continuous access to feed and water. No differences were observed for growth performance. The addition of CO to the diet increased the α-linolenic acid content of the muscle tissues and abdominal fat ($P<0.001$). The α-linolenic acid content in the thigh muscle fat was 9.96% of fatty acids (FA) in the CO group and 1.51% of FA in the RO group, and the α-linolenic acid content in the breast muscle fat was 4.12% of FA in the CO group and 0.57% of FA in the RO group. The type of oil added to the diet had no effect on the accumulation of vitamins A and E in the livers of broiler chickens. The results of growth performance indicated that CO is similar to SO and RO as a dietary component. However, the type of oil impacted the fatty acid profile. These results showed the usefulness of CO in producing food enriched with α-linolenic acid.

1. Introduction

Because of the demand for renewable and environmentally friendly energy sources, *Camelina sativa* has received much attention from scholars and practitioners in many countries. In the past, the oil obtained from the seeds of the plant was primarily used for the production of paints, varnishes and lacquers, cold-pressed foods, and as feed for beef cattle. Currently, the main uses of *C. sativa* oil include biofuels for aviation, lubricants and cosmetics, and culinary (Francis and Warwick, 2009; Pilgeram et al., 2007).

C. sativa meal or expeller, obtained as a by-product of the oil production from the seeds, has been the subject of nutrition studies in recent years. For feeding chickens, meal or expeller has been used as a feed ingredient for layers (Cherian et al., 2009; Pilgeram et al., 2007) and broiler chickens (Aziza et al., 2010; Pekel et al., 2009; Ryhänen et al., 2007).

Camelina oil (CO), a rich source of α-linolenic acid (LNA) from the homologous series of $n-3$, reduces the PUFA $n-6$ to $n-3$ ratio in the diet. Chen et al. (2012) previously demonstrated the benefits of decreasing the $n-6$ to $n-3$ ratio mix feeds for broiler chickens. The decreasing $n-6$ to $n-3$ ratio can enhance the levels of cardiac antioxidant enzymes, and affect thymus immune function of fast growing broilers. The use of CO in diets for broiler chickens

* Corresponding author. Tel.: +48 81 5319647; fax: +48 81 4456973.
E-mail address: teresa.jaskiewicz@up.lublin.pl (T. Jaśkiewicz).

http://dx.doi.org/10.1016/j.livsci.2014.04.003

can improve the quality of poultry products. The development of various $n-3$-rich foods can increase dietary intake of $n-3$ fatty acids with little change in dietary habits.

The aim of this study was to determine the effects of CO in the diets on the growth performance, $n-3$ fatty acid content in abdominal fat and muscles, and the fat-soluble vitamin content in the livers of broiler chickens. The effectiveness of CO in the diet was compared with that of the diets supplemented with conventional oils, soybean oil (SO) and rapeseed oil (RO).

2. Materials and methods

2.1. Diets

The isocaloric diets were formulated to meet the nutrient requirements of broiler chickens based on the nutrition standard (Smulikowska and Rutkowski, 2005). The diets were supplemented with SO, RO, and CO (Table 1). Soybean oil and RO and other feed materials were obtained from a local commercial company (Agropol Company, Motycz, Poland). Camelina oil was obtained from the seeds of the domestic variety Borowska at a local mill farm (Markuszów, Poland). Seeds were ground using a cylindrical grinder with smooth rollers heated to 60 to 70 °C and subsequently extruded using a manual screw press.

2.2. Animals and housing

All of the procedures used throughout this study were approved by the Second Local Animal Welfare Committee at the University of Life Sciences (Lublin, Poland). A total of 90 one-day-old Ross 308 broiler chickens (BW=42 ± 3 g) were used for a 35-d study, and chickens were allocated to 15 cages with 6 broiler chickens per cage (three males and three females). Cages were randomly assigned to three dietary treatments with five cages per treatment. Broiler chickens were housed in the same place under the same controlled conditions. The temperature was maintained at 32 ± 1 °C in the first 3 d, and gradually reduced thereafter according to normal management practices. Broiler chickens were reared for 5 wk to obtain a body weight of approximately 2 kg, and they were fed the starter and grower diets for 3 and 2 wk, respectively (Table 1). They had ad libitum access to feed and water. The weight gain (every chicken) and feed intake (per cage) for each period were determined and the feed to gain ratio (F:G) was calculated.

2.3. Analytical methods

At the end of the rearing period, six birds per group (three males and three females), with average body weights,

Table 1
Composition and calculated nutrient content of the diet.[a]

Item	Starter (1–3 wk)			Grower (4–5 wk)		
	SO	RO	CO	SO	RO	CO
Ingredient (%)						
Wheat	61.65	61.65	61.65	73.82	73.82	73.82
Soybean meal, 46% CP	28.22	28.22	28.22	18.82	18.82	18.82
Soybean oil	6.91	0.00	0.00	4.07	0.00	0.00
Rapeseed oil	0.00	6.91	0.00	0.00	4.07	0.00
Camelina oil	0.00	0.00	6.91	0.00	0.00	4.07
Mineral and vitamin premix[b,c]	0.50	0.50	0.50	0.50	0.50	0.50
Dicalcium phosphate	0.24	0.24	0.24	0.43	0.43	0.43
Salt	0.10	0.10	0.10	0.10	0.10	0.10
Limestone	2.01	2.01	2.01	1.75	1.75	1.75
DL-Met	0.21	0.21	0.21	0.20	0.20	0.20
L-Lys	0.15	0.15	0.15	0.31	0.31	0.31
Calculated composition (%)						
Lys	1.19	1.19	1.19	1.12	1.12	1.12
Met	0.50	0.50	0.50	0.45	0.45	0.45
Met+Cys	0.86	0.86	0.86	0.78	0.78	0.78
Thr	0.74	0.74	0.74	0.61	0.61	0.61
Ca	0.96	0.96	0.96	0.88	0.88	0.88
Available P	0.43	0.43	0.43	0.39	0.39	0.39
Na	0.05	0.05	0.05	0.05	0.05	0.05
ME, kcal/kg	3.10	3.10	3.10	3.00	3.00	3.00
Analysed composition (%)						
Crude protein	20.40	20.67	20.11	17.78	17.60	17.94
Ether extract	8.47	8.24	8.80	5.80	5.73	5.86
Crude fibre	3.32	3.25	3.46	3.25	3.42	3.14
Ash	5.39	5.18	5.27	4.82	4.65	4.69

[a] SO=soybean oil, RO=rapeseed oil, and CO=camelina oil.

[b] Premix supplied per kilogram of starter diet: 12,500 IU of vitamin A, 4000 IU of vitamin D_3, 50 mg of vitamin E, 3.0 mg of vitamin K_3, 2 mg of vitamin B_1, 6 mg of vitamin B_2, 3.5 mg of vitamin B_6, 20 μg of vitamin B_{12}, 0.20 mg of biotin, 600 mg of choline, 30 mg of nicotinic acid, 15 mg of pantothenic acid, 1.5 mg of folic acid, 60 mg of Fe, 100 mg of Mn, 50 mg of Zn, 0.8 mg of I, 0.4 μg of Co, and 0.2 mg of Se.

[c] Premix supplied per kilogram of grower diet: 10,000 IU of vitamin A, 2000 IU of vitamin D3, 50 mg of vitamin E, 2.0 mg of vitamin K_3, 1.5 mg of vitamin B_1, 5 mg of vitamin B_2, 3 mg of vitamin B_6, 20 μg of vitamin B_{12}, 0.10 mg of biotin, 600 mg of choline, 25 mg of nicotinic acid, 12 mg of pantothenic acid, 1 mg of folic acid, 60 mg of Fe, 100 mg of Mn, 50 mg of Zn, 0.8 mg of I, 0.4 μg of Co, and 0.2 mg of Se.

Please cite this article as: Jaśkiewicz, T., et al., Effect of the *Camelina sativa* oil on the performance, essential fatty acid level in tissues and fat-soluble vitamins content in the livers of broiler chickens. Livestock Science (2014), http://dx.doi.org/10.1016/j.livsci.2014.04.003