Variation in fatty acids in chicken meat as a result of a lupin-containing diet

E. Straková, P. Suchý, I. Herzig, P. Hudečková, Š. Ivanko

Department of Nutrition, Animal Husbandry and Animal Hygiene, Faculty of Veterinary Hygiene and Ecology, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic

ABSTRACT: This study was designed to verify the effect of diets containing lupin meal on the composition of fat in meat from fattened broiler chickens. It follows from the results that an increasing level of lupin meal (E1 and E2) resulted in a gradual decrease in the average level of saturated fatty acids (SFAs) in fat in breast and thigh muscles from experimental chickens as compared to the control group. This decrease was characterized by a significant ($P \leq 0.05$) to highly significant ($P \leq 0.01$) reduction in the level of palmitic acid, which is the most common fatty acid. Diets containing lupin meal showed an increase in monounsaturated fatty acids (MUFAs). Particularly oleic acid contributed significantly to an overall increase in MUFAs ($P \leq 0.01$). Polyunsaturated fatty acids (PUFAs) from the n-6 group showed only a slight decrease in fat in meat from chickens in the experimental group. Linoleic acid as the most common PUFA found in the fat from chicken muscles showed a significantly lower level in breast muscles in the E2 group ($P \leq 0.05$) as compared to the control and the E1 group. A similar trend was also observed for γ-linolenic acid in fat from breast muscles. The level of arachidonic acid in fat from muscles in experimental groups also decreased. The levels of PUFAs n-3 in fat from chicken muscles were found to increase in experimental groups. Of all PUFAs n-3 examined in fat from breast and thigh muscles, α-linolenic acid was found at the highest levels. Its levels in fat from muscles varied with an increasing amount of lupin meal in a diet. However, a highly significant increase ($P \leq 0.01$) was confirmed only in thigh muscles. A rise in PUFAs n-3 which is associated with the dietary supplementation of lupin meal is particularly beneficial as it affected the Σ PUFAs n-3:Σ PUFAs n-6 ratio, thereby enhancing the nutritional value of chicken meat with regard to human nutrition.

Keywords: broiler; lupin; breast meat; thigh meat; fat; PUFA

Seeds of the genus *Lupinus* are characterized particularly by a high content of proteins. Because of the potential use of lupins in human and animal nutrition close attention is therefore given to the content of proteins. Much less attention is given to the content of oil, especially its quality. Unlike proteins, the levels of which in the seed vary among individual varieties in a relatively wide range (30–50%), the levels of oil are considerably lower (5–10%). This is also confirmed by some authors, for example by RothMaier and Kirchgessner (1993), who reported 7.6% of crude fat in white lupin and 4.6% of crude fat in yellow varieties. Uzun et al. (2007) showed that the mean level of fat in two varieties of white lupin was 10.75%. According to Smulikowska et al. (1995), 95–98% of the overall fat contained in seeds is located in the cotyledon. From the dietetic aspect, the quality of oil depends particularly on the levels of unsaturated fatty acids (FAs), especially polyunsaturated fatty acids

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(PUFAs) and their mutual ratio (n-3/n-6 PUFAs). As reported by Uzun et al. (2007), oleic acid is the most common acid from the group of monounsaturated fatty acids (MUFAs) found in lupin oil. From the dietetic aspect, lupin oil is a high-quality oil. RothMaier and Kirchgessner (1993) reported that the fat in lupin seeds contained high levels of unsaturated fatty acids, particularly linoleic acid. When analysing lupin flour, Boschin et al. (2007, 2008) also detected high levels of linoleic acid and n-3 fatty acids (particularly α-linolenic acid) in 6 varieties of white lupin. Because of this range of fatty acids, lupin seeds show a favourable n-3/n-6 ratio. Favourable levels of essential fatty acids and their favourable ratios in lupin oil can be used to design the diets of farm animals in order to enhance the nutritional quality of animal products. As reported by Mieczkowska and Smulikowska (2005), lupin in diets increased the concentration of oleic acid and α-linolenic acid in chicken fat. The authors concluded that lupin seed could be used as a source of α-linolenic acid in chicken diets to modify the composition of fatty acids in somatic lipids, thereby enhancing the dietetic properties of meat from broiler chickens. The inclusion of lupin seeds in diets for monogastric animals can improve the value of raw materials and foodstuffs originating from these animals. In this respect, feeds with optimized levels of essential fatty acids will have a substantial effect on the nutritional value of chicken meat, as reported by Enser (1999) or Barroeta (2007). According to Weber (2001), PUFAs in particular are utilized very effectively from the feed. Similar findings were also reported by Zelenka et al. (2006, 2008) who used flaxseed oil. These authors found that diets supplemented with oil enriched with essential fatty acids at favourable ratios will provide poultry meat with an improved nutritional value, which can be declared a functional foodstuff.

The main aim of the present study was to investigate how the diets for broiler chickens supplemented with lupin meal containing fatty acids would affect the composition of fat in muscles and whether they would enhance the nutritional value of chicken meat, which is an important foodstuff in human nutrition.

MATERIAL AND METHODS

The experiment was performed in an accredited experimental livestock stable at the Department of Nutrition, Animal Husbandry and Animal Hygiene, University of Veterinary and Pharmaceutical

Table 1. The formulation of feeds and the feed administration schedule during the experiment

Ingredients (kg)	BR 1 (Day 1–15)			BR 2 (Day 15–30)			BR 3 (Day 30–42)		
	C	E1	E2	C	E1	E2	C	E1	E2
Wheat	41.20	37.21	34.03	47.73	44.53	41.54	47.92	49.80	47.77
Maize	15.00	15.00	15.00	15.00	15.00	15.00	20.00	20.00	20.00
Soybean meal	35.80	23.87	11.23	29.60	19.73	9.87	24.00	13.33	6.66
Lupin	0.00	15.51	31.03	0.00	12.83	25.65	0.00	8.67	17.33
D,L-Met	0.30	0.40	0.50	0.25	0.35	0.39	0.20	0.25	0.28
L-Lys	0.30	0.50	0.70	0.23	0.29	0.32	0.12	0.17	0.18
L-Thr	0.12	0.22	0.22	0.08	1.12	0.12	0.05	0.07	0.07
MCP*	1.18	1.18	1.18	1.00	1.00	1.00	0.90	0.90	0.90
NaCl	0.38	0.38	0.38	0.38	0.38	0.38	0.36	0.36	0.36
Ground limestone	1.62	1.63	1.63	1.63	1.63	1.63	1.55	1.55	1.55
Soybean oil	3.60	3.60	3.60	3.60	3.60	3.60	4.10	1.40	4.40
Premix mikrop	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

*monocalcium phosphate; the premix of specifically active substances used by the producer contained: vitamin A 1 600 000 IU; vitamin D3 500 000 IU; alpha-tocopherol 10 000 mg; vitamin K3 300 mg; vitamin B1 800 mg; vitamin B2 1 300 mg; vitamin B6 600 mg; vitamin B12 3 mg; biotin 30 mg; folic acid 500 mg; niacinamide 6 000 mg; calcium pantothenate 2 500 mg; betaine 50 000 mg; butylhydroxytoluene 3 400 mg; propyl gallate 1 200 mg; ethoxyquin 540 mg; ferrous sulphate monohydrate 10 000 mg; manganese oxide 16 000 mg; zinc oxide 16 000 mg; copper sulphate 1 700 mg; potassium iodide 200 mg; sodium selenite 30 mg; cobalt sulphate 50 mg; phytase 50 000 FTU; glucanase 24 000 BGU; xylanase 1 100 000 EXU

Sciences in Brno, CR. Chickens (ROSS 308) were divided into three groups: control group C – 70 chickens (35 females and 35 males), experimental group E1 (35 females and 35 males), experimental group E2 (35 females and 35 males). Chickens were fed according to the technological procedure specifically designed for ROSS 308 broiler chickens. Experimental feed mixtures differed in the percentage of a meal prepared from the AMIGA lupin cultivar to partially replace soybean extracted meal, as indicated in Table 1.

The proportions of fatty acids in the lupin meal were (g/100 g of fat): caproic acid 0.012, caprylic acid 0.002, capric acid 0.023, lauric acid 0.017, myristic acid 0.122, palmitic acid 7.83, palmitoleic acid 0.386, heptadecanoic acid 0.057, cis-10-heptadecenoic acid 0.046, stearic acid 1.845, oleic/elaidic acid 48.016, linolenic/linolelaidic acid 13.767, linolenic acid 7.077, arachic acid 0.938, cis-11-eicosanoic acid 3.555, cis-11,14-eicosadienoic acid 0.24, heneicosanoic acid 0.094, cis-11,14,17-eicosatrienoic acid 0.055, behenic acid 3.014, erucic acid 1.412, tricosanoic acid 0.13, lignoceric acid 0.691, nervonic acid 0.06. To satisfy the animal's demand for amino acids, the diets were enriched with synthetic amino acids such as L-lysine, L-threonine, and D, L-methionine.

In the course of the experiment, chickens were weighed on Days 1, 15, 30, and 42 to monitor growth intensity. Chickens aged 42 days were slaughtered and 20 chickens in each group (10 females and 10 males) were subjected to the chemical analysis of breast and thigh muscles. Chickens to be analysed were selected according to the average weight of a particular group.

In order to evaluate the quality of fat, gas chromatography was carried out to determine the levels of individual fatty acids using a GC 2010 SHIMADZU GAS CHROMATOGRAPH *(Shimadzu, Japan*). Crude fat was determined by direct ether extraction according to Soxhlet. The extraction of fat from meat for determining the composition of fatty acids, especially PUFAs, was performed according to Hara and Radin (1978).

The results were processed by the statistical programme Unistat CZ, Version 5.6 for Excel to evaluate the mean values and respective differences by means of multiple comparisons using Tukey's HSD test at a significance level $P \leq 0.01$ and $P \leq 0.05$.

RESULTS AND DISCUSSION

The performance parameters showed that lupin seed-based diets failed to have a conclusive effect on the development of chicken live weight in the course of feeding (Table 2). It can be seen that live weight in experimental chickens slightly decreased at the end of the fattening period (Day 42). No significant differences in average live weight were confirmed on the particular days of the fattening period. The conversion of feed mixtures (1.82 kg and 1.87 kg) in both experimental groups E1 and E2 was lower as compared to the control (1.70 kg). Interestingly, the administered diets had a positive effect on the qualitative composition of fat in muscles, as documented in Tables 3, 4, 5, and 6. It follows from Table 3 that the presence of lupin meal in a diet gradually lowered the mean level of SFAs in fat from breast muscles 20.538 g per 100 g of fat (E1) and 19.176 g per 100 g of fat (E2), as compared to the control 20.986 g per 100 g of fat (C). A similar trend was observed in thigh muscles (21.574 g per 100 g of fat (E1) and 20.174 g per 100 g of fat (E2) as compared to the control 22.421 g per 100 g of fat (C). Palmitic acid as an SFA was present in both breast and thigh muscles of chickens at the highest levels. The diets containing lupin meal particularly resulted in a significant ($P \leq 0.05$) to highly significant ($P \leq 0.01$) decrease in the levels of myristic acid, palmitic acid and stearic acid and in a significant ($P \leq 0.05$) to highly significant ($P \leq 0.01$) increase in the levels of arachidic acid and behenic acid in breast and thigh muscles of fattened chickens. Generally, the supplementation of lupin meal to feed mixtures lowered the levels of major and frequently occurring SFAs in chicken muscles (Table 3).

Table 2. Variation in the live weight (x ± SD) of broilers during the experiment, expressed in kg

Groups	Day 1	Day 15	Day 30	Day 42
Control	0.043 ± 0.003	0.412 ± 0.073	1.514 ± 0.256	2.793 ± 0.398
Experimental 1	0.043 ± 0.003	0.414 ± 0.060	1.534 ± 0.182	2.706 ± 0.356
Experimental 2	0.043 ± 0.003	0.405 ± 0.065	1.489 ± 0.214	2.654 ± 0.416

Table 3. The levels of saturated fatty acids in fat (x ± SD) from the breast and thigh muscles of chickens expressed in g per 100 g of fat

Acid	Breast muscles			Thigh muscles		
	C	E1	E2	C	E1	E2
Caproic	0.008 ± 0.003	0.006a ± 0.002	0.010a ± 0.006	0.004 ± 0.002	0.005 ± 0.004	0.005 ± 0.008
Caprylic	0.004 ± 0.001	0.004 ± 0.001	0.006 ± 0.006	0.004 ± 0.001	0.005 ± 0.001	0.006 ± 0.005
Capric	0.009a ± 0.004	0.008B ± 0.002	$0.012^{a,B}$ ± 0.006	0.009 ± 0.004	0.011 ± 0.006	0.012 ± 0.007
Lauric	0.015 ± 0.001	0.015 ± 0.001	0.014 ± 0.002	0.016 ± 0.002	0.016 ± 0.001	0.016 ± 0.002
Myristic	0.312^{A} ± 0.038	0.288^{b} ± 0.028	$0.260^{A,b}$ ± 0.030	0.330^{a} ± 0.061	0.308 ± 0.026	0.296^{a} ± 0.029
Palmitic	15.399^{A} ± 1.597	0.138 ± 0.067	15.307^{B} ± 1.102	0.126 ± 0.015	$14.002^{A,B}$ ± 0.882	0.131 ± 0.017
Heptadecanoic	16.969^{A} ± 1.503	0.133 ± 0.026	16.240 ± 1.079	0.145 ± 0.024	15.452^{A} ± 1.120	0.145 ± 0.022
Stearic	5.029^{a} ± 0.485	4.691 ± 0.394	4.625^{a} ± 0.492	4.875^{a} ± 0.484	4.727 ± 0.770	4.087^{a} ± 1.240
Arachidic	0.056^{A} ± 0.009	$0.066^{A,B}$ ± 0.008	$0.075^{A,B}$ ± 0.009	0.064^{A} ± 0.008	$0.081^{A,B}$ ± 0.017	$0.102^{A,B}$ ± 0.018
Behenic	0.016^{A} ± 0.005	$0.027^{A,B}$ ± 0.005	$0.041^{A,B}$ ± 0.010	0.017^{A} ± 0.044	$0.036^{A,B}$ ± 0.007	$0.053^{A,B}$ ± 0.009
Σ Saturated FAs	20.986^{A} ± 0.221	$20.538^{A,B}$ ± 0.156	$19.176^{A,B}$ ± 0.146	22.421^{A} ± 0.214	$21.574^{A,B}$ ± 0.194	$20.174^{A,B}$ ± 0.246

^{a,b,c}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.05$)

^{A,B,C}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.01$)

Table 4. The levels of MUFAs in fat from breast and thigh muscles of broilers (x ± SD), expressed in g per 100 g of fat

Acid	Breast muscles			Thigh muscles		
	C	E1	E2	C	E1	E2
Myristoleic	0.120 ± 0.154	0.066 ± 0.017	0.084 ± 0.129	0.088 ± 0.026	0.073 ± 0.018	0.096 ± 0.128
Palmitoleic	2.582 ± 0.669	2.546 ± 0.474	2.182 ± 0.419	3.209^{a} ± 0.763	2.890 ± 0.527	2.692^{a} ± 0.362
cis-10-hepta-decenoic	0.040 ± 0.012	0.050 ± 0.009	0.069 ± 0.099	0.053^{A} ± 0.007	0.059 ± 0.013	0.064^{A} ± 0.005
Oleic	25.786^{A} ± 3.935	28.825^{A} ± 2.217	27.552 ± 2.299	29.270^{A} ± 3.143	$31.963^{A,B}$ ± 2.018	32.758^{B} ± 1.791
cis-11-eico-senoic	0.233^{A} ± 0.310	$0.349^{A,B}$ ± 0.078	$0.455^{A,B}$ ± 0.038	0.248^{A} ± 0.019	$0.410^{A,B}$ ± 0.024	$0.549^{A,B}$ ± 0.036
Erucic	0.013^{A} ± 0.002	$0.032^{A,B}$ ± 0.004	$0.048^{A,B}$ ± 0.011	0.009^{A} ± 0.005	$0.038^{A,B}$ ± 0.006	$0.063^{A,B}$ ± 0.008
Nervonic	0.024 ± 0.016	0.018 ± 0.015	0.024 ± 0.015	0.013 ± 0.012	0.007 ± 0.008	0.018 ± 0.026
Σ MUFAs	28.798^{A} ± 0.728	31.886^{A} ± 0.402	30.414^{A} ± 0.430	32.890^{A} ± 0.568	$35.440^{A,B}$ ± 0.373	$36.240^{A,B}$ ± 0.337

^{a,b,c}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.05$)

^{A,B,C}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.01$)

Table 5. The levels of PUFAs n-6 FAs in fat from breast and thigh muscles of broilers (x ± SD), expressed in g per 100 g of fat

Acid	Breast muscles			Thigh muscles		
	C	E1	E2	C	E1	E2
Linoleic	23.426^{a} ± 3.612	23.625^{b} ± 2.145	$20.307^{a,b}$ ± 4.616	25.648 ± 1.919	25.698 ± 2.211	24.911 ± 1.809
γ-linolenic	0.198^{a} ± 0.042	0.188 ± 0.021	0.164^{a} ± 0.048	0.204 ± 0.032	0.197 ± 0.019	0.199 ± 0.034
cis-11,14-eico-sadienoic	0.379^{A} ± 0.083	0.295^{A} ± 0.061	0.332 ± 0.066	0.233^{A} ± 0.058	0.198^{A} ± 0.033	0.198^{A} ± 0.025
cis-8,11,14-eico-satrienoic	0.346^{A} ± 0.108	0.250^{A} ± 0.042	0.287 ± 0.070	0.203^{A} ± 0.049	0.167^{A} ± 0.031	0.174^{A} ± 0.030
Arachidonic	1.658 ± 0.542	1.345 ± 0.438	1.601 ± 0.430	0.992^{a} ± 0.342	0.763^{a} ± 0.243	0.817 ± 0.219
Docosatetraenoic	0.498^{A} ± 0.157	0.367^{A} ± 0.122	0.442 ± 0.118	0.268^{A} ± 0.099	0.176^{A} ± 0.056	0.172^{A} ± 0.054
Σ PUFAs n-6	26.205^{A} ± 0.757	26.070^{B} ± 0.472	$23.133^{A,B}$ ± 0.891	27.548^{A} ± 0.417	27.199^{B} ± 0.432	$26.471^{A,B}$ ± 0.362

^{a,b,c}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.05$)

^{A,B,C}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.01$)

MUFAs increased (Table 4) as a result of the use of diets containing lupin meal. The levels of MUFAs in fat from breast and thigh muscles were higher than those in the control (breast muscles: 31.886 g per 100 g of fat (E1) and 30.414 g per 100 g of fat (E2) as compared to 28.798 g per 100 g of fat (C) in the control group, thigh muscles: 35.440 g per 100 g of fat (E1) and 36.240 g per 100 g of fat (E2) as compared to the control group 32.890 g per 100 g of fat). As documented in Table 4, a significant ($P \leq 0.05$) to highly significant ($P \leq 0.01$) increase in unsaturated acids from the MUFA group (particularly in oleic acid, cis-11-eicosenoic acid and erucic acid) was detected in both experimental groups for both breast and thigh muscles. Oleic acid was a predominant MUFA detected in breast and thigh muscles, which might be associated with its high level in lupin oil, as confirmed by the results published by Uzun et al. (2007). Similar findings were made in the experiments performed by Mieczkowska and Smulikowska (2005), who reported an increased level of oleic acid in chicken fat after the dietary supplementation of lupin.

The overall levels of PUFAs from the n-6 group decreased in fat from the meat of experimental chickens (Table 5). As compared to the control group (fat in breast muscle reached the level of 26.205 g per 100 g of fat) both experimental groups showed a decrease in PUFAs to 26.070 g per 100 g of fat (E1) and 23.133 g per 100 g of fat (E2). Similarly, the levels of fat in thigh muscles decreased to 27.199 g per 100 g of fat (E1) and 26.471 g per 100 g of fat (E2), as compared to the control group with 27.548 g per 100 g of fat (C). The levels of FAs both in breast and in thigh muscle in chickens highly significantly decreased ($P \leq 0.01$), namely for cis-11, 14-eicosadienoic acid, cis-8,11,14-eicosatrienoic acid, and docosatetraenoic acid. Linoleic acid as the most common acid detected in fat from chicken muscles decreased significantly ($P \leq 0.05$) only in fat from breast muscles in the E2 group as compared to the C control group and the E1 experimental group. A similar trend was also found for γ-linolenic acid in breast muscles. Decreasing levels of PUFAs n-6 including arachidonic acid were observed in both experimental groups. However, only the difference between the control group (C) and the experimental group (E1) in the case of thigh muscles was proved significant.

The levels of PUFAs n-3 in chicken fat increased in experimental groups. The level of PUFAs n-3 in fat in breast muscles increased from 3.275 g per

Table 6. The levels of PUFAs n-3 in fat from breast and thigh muscles of fattened broilers (x ± SD) expressed in g per 100 g of fat

Acid	Breast muscles			Thigh muscles		
	C	E1	E2	C	E1	E2
α-linolenic	2.511 ± 0.461	2.876 ± 0.297	3.066 ± 1.148	2.818^{A} ± 0.213	$3.186^{A,B}$ ± 0.294	$3.436^{A,B}$ ± 0.260
cis-11,14,17-eico-satrienoic	0.065^{a} ± 0.018	$0.053^{a,b}$ ± 0.011	0.066^{b} ± 0.016	0.060 ± 0.106	0.035 ± 0.006	0.039 ± 0.007
cis-5,8,11,14,17-eico-sapentaenoic	0.121 ± 0.026	0.104^{b} ± 0.017	0.126^{b} ± 0.030	0.075 ± 0.015	0.072 ± 0.017	0.083 ± 0.016
cis-4,7,10,13,16,19-doco-sapentaenoic	0.254 ± 0.097	0.227^{B} ± 0.090	0.328^{B} ± 0.124	0.145 ± 0.105	0.120 ± 0.068	0.164 ± 0.196
Docosapentaenoic	0.324 ± 0.099	0.275^{B} ± 0.092	0.357^{B} ± 0.101	0.181 ± 0.070	0.141 ± 0.048	0.162 ± 0.050
Σ PUFAs n-3	3.275^{A} ± 0.140	3.535^{A} ± 0.101	$3.943^{A,B}$ ± 0.284	3.279^{A} ± 0.102	$3.557^{A,B}$ ± 0.087	$3.884^{A,B}$ ± 0.106

^{a,b,c}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.05$)
^{A,B,C}mean values with same superscripts in the same parameter differ significantly ($P \leq 0.01$)

Table 7. Variation in the ratios of individual groups of fatty acids in breast and thigh muscles of chickens

	Breast muscles			Thigh muscles		
	C	E1	E2	C	E1	E2
Σ SFAs:Σ NSFAs	1:2.78	1:2.99	1:2.99	1:2.88	1:3.07	1:3.30
Σ PUFAs n-3:Σ PUFAs n-6	1:8.00	1:7.37	1:5.87	1:8.40	1:7.65	1:6.82

100 g of fat in the control group (C) to 3.535 g per 100 g of fat or 3.943 g/100 g of fat in experimental groups E1 and E2, respectively, while in thigh muscles it increased from 3.279 g/100 g of fat in the control group (C) to 3.557 g/100 g of fat or 3.884 g/100 g of fat in experimental groups E1 and E2, respectively. The increased levels of PUFAs n-3 in muscles from experimental chickens are consistent with those in lupin oil, which is also confirmed by the findings reported by Boschin et al. (2007, 2008). α-linolenic acid was a major PUFA n-3 detected both in breast and in thigh muscles while other FAs n-3 were present only in a small amount, as documented in Table 6. The levels of α-linolenic acid in muscles increased with the increasing portion of lupin meal in a diet fed to experimental chickens. The results obtained are in good agreement with the findings published by Mieczkowska and Smulikowska (2005) that lupin seed as a part of the diet is an important source of α-linolenic acid and may have a favourable effect on the levels of FAs in lipids from broiler chickens. A highly significant increase ($P \leq 0.01$) in α-linolenic acid was confirmed only in thigh muscles. Other FAs n-3, cis-5,8,11,14,17-eicosapentaenoic acid, cis-4,7,10,13,16,19-docosapentaenoic acid, and docosapentaenoic acid present in fat from breast muscles (except for cis-11,14,17-eicosatrienoic acid) showed a significant ($P \leq 0.05$) to highly significant ($P \leq 0.01$) increase, particularly in the E2 group, as compared to the E1 group. In the case of thigh muscles, the differences between mean levels of the above-mentioned FAs were found to be insignificant.

Variations in the levels of individual groups of fatty acids in fat from the muscles of fattened chickens also caused the ratio of these acids to change (Table 7), resulting in an improvement in the nutritional value of produced meat. Feed and the optimum levels of FAs are among the critical factors that affect the nutritional value of produced meat. A similar conclusion was also reported by Enser (1999), Webera (2001) or Barroeta (2007). A direct relationship between the spectrum of FAs in fat contained in a diet and the quality of produced poultry meat was confirmed by Zelenka et al. (2006, 2008), who tested flaxseed oil, which is of high nutritional value, in their experiments.

It follows from our results that lupin meal (lupin oil) containing high levels of essential FAs has a favourable effect on the composition of fat in the muscles of fattened chickens. The supplementation of the diet with lupin meal resulted in decreased levels of NSFAs. One positive effect of the diets based on lupin meal is that the levels of PUFAs n-3 increased, which lowered the Σ PUFA n-3:Σ PUFA n-6 ratio both in breast and in thigh muscles, thereby enhancing the nutritional value of chicken muscles with respect to human nutrition. Our analyses of AMIGA seed revealed that lupin oil is of high quality, particularly in respect to the n-3:n-6 FAs ratio (1:1.9). We think this is a major factor that affected the nutritional quality of chicken muscles.

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Corresponding Author

Prof. Ing. Eva Straková, Ph.D., Department of Nutrition, Animal Husbandry and Animal Hygiene, Faculty of Veterinary Hygiene and Ecology, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic
Tel. +420 541 562 672, fax +420 541 562 675, e-mail: strakovae@vfu.cz