Annals of Warsaw University of Life Sciences – SGGW
Animal Science No 57 (3), 2018: 269–280
(Ann. Warsaw Univ. of Life Sci. – SGGW, Anim. Sci. 57 (3), 2018)
DOI 10.22630/AAS.2018.57.3.26

The effect of oil type in diet in broiler chicken on pro-health and organoleptic properties of meat

ANNA MILCZAREK, MARIA OSEK, TERESA BANASZKIEWICZ
Faculty of Natural Sciences, Siedlce University of Natural Sciences and Humanities

Abstract: *The effect of oil type in diet in broiler chicken on pro-health and organoleptic properties of meat.* The studies covered the analysis of the pro-health and organoleptic properties of the meat of chickens for fattening fed with mixtures oiled with three different oils. The research material consisted of 36 samples of pectoral and legs muscles. Samples were collected from 42-day old birds from three feeding groups. Group I chickens received mixtures oiled with soybean oil, while groups II and III chickens were fed with mixtures oiled with rapeseed oil and linseed oil, respectively. The use of rapeseed or linseed oil in mixtures for chickens for fattening does not affect the content of basic ingredients in muscles, but significantly reduced the proportion of crude fat in pectoral muscle. The differentiation of the fatty acids content in oils was reflected in muscle lipids. The obtained results provide grounds to recommend oiling of compound mixtures primarily with linseed oil, as it increases ($P < 0.01$) the content of PUFA n-3. However, it should be taken into account that taste qualities will thus deteriorate.

Key words: broiler chickens, muscles, fatty acids, basal nutrients

INTRODUCTION

Healthy nutrition is needed in the development and preservation of human health. It means that it is necessary to cover the body's needs for energy and nutrients, including fat (EFSA 2010). Currently, consumption of the above mentioned ingredient, with regard to quantity and quality as well, is one of the most common dietary mistakes. The high proportion of fat in a diet is commonly associated with the risks of the so-called civilization diseases (obesity, cardiovascular disease, tumours, etc.). However, it is indispensable in the human diet, as it is a carrier of polyunsaturated fatty acids belonging to the families of omega-6 and omega-3, that are particularly important to health. They must be delivered with food in right proportions. According to Daley et al. (2010) and Gibbs et al. (2010), the superiority of omega-6 acids over omega-3 acids should not be greater than four times, while in the average diet it is 10–20 times. The deficiency of polyunsaturated fatty acids from the n-3 family in human nutrition can be supplemented by introducing the best of its sources to the diet, such as linseed oil, or the use of food products enriched with these acids in a direct or indirect way. Meat is such a product. It is a source of protein of high nutritional value and fat, but also of a number of pro-health ingredients (Marco et al. 2013, Puvača et al. 2014, Valavan et al. 2016). Due to the fact that the largest controversy concern meat lipids, the recent years studies focused on improvement of the profile of fatty acids of intramuscular fat in the pro-health direction. It is based on feeding the animals with properly selected fats. Studies by various authors (Schneiderová et al. 2007, Konieczka et al. 2017, Li et al. 2017) indicate the physiological ability of animals to incorporate fatty acids from diet into abdominal and intramuscular fat. Introduction of feed biocomponents rich in polyunsaturated fatty acids (PUFA) to the diet of chickens allows for their increased content in the tissues of birds. However, the experiments carried out have proved that the effectiveness of this treatment depends mainly on the type and quantity of feed material used in mixtures for chickens. What is more, the quantity and quality of fat affect the quality of meat related to organoleptic values, such as the smell in particular (Wood and Enser 1997, Betti et al. 2009, Jankowski et al. 2012). Marco et al. (2013) and Valavan et al. (2016) state that inclusion of n-3 lipid sources in broiler ration had no adverse effect on meat quality in terms of organoleptic assessment such as appearance, juiciness, flavour, tenderness and overall acceptability scores.

The purpose of the studies was to assess the pro-health and organoleptic properties of meat of chickens fed with mixtures oiled with three different vegetable oils.

MATERIAL AND METHODS

The research material consisted of 36 samples of muscles of pectoral muscles

TABLE 1. Feed ingredients and nutritive value of the mixtures

Item	Mixtures	
	starter	grower
Feed ingredients (g·kg^{-1})		
Maize	503.2	539.5
Soybean meal	410.0	364.5
Oil*	45.00	55.00
L-lysine, DL-methionine, limestone, monocalcium phosphate, salt	36.80	36.00
Premix**	5.00	5.00
Nutritive value per 1 kg of mixtures		
ME-EM (MJ)	12.53	12.77
Crude protein (g)	217	199
Crude fibre (g)	25.9	25.2
Lysine (g)	11.7	9.7
Methionine + cysteine (g)	8.9	8.4
Calcium (g)	9.1	8.9
Phosphorus available (g)	4.2	4.1
Sodium (g)	1.6	1.7

* Soybean oil – group I, rapeseed oil – group II, linseed oil – group III.
** Premix starter in starter mixtures, premix grower in grower mixtures.

and muscles from legs of Ross 308 chickens for fattening. Samples were collected from 42-day old chickens from three feeding groups (I, II, III). All mixtures were prepared in-house based on maize meal, post-extraction soybean meal. The experimental factor were oil: soybean (group I), rapeseed (group II) or linseed (group III) introduced into the starter and grower mixtures (Table 1).

Basal nutrients and fatty acid profile in muscles after stored by 2 weeks in frozen were analysed. Dry matter, ash, crude protein and ether extract contents in the carcass samples were determined according to AOAC International (2011) procedures No 934.01, 942.05, 984.13 and 920.39, respectively. The fatty acid profile in oils and in muscles was determined by gas chromatography (Folch et al. 1957). The fat extracted with light petroleum underwent the processes of alkaline hydrolysis using 0.5 n solution of NaOH in absolute methanol, then the released fatty acids were converted to methyl esters using 4% hydrogen chloride in methanol. The obtained esters were separated on a GC column and their total acid content was determined. A gas chromatograph was used for chromatographic separation. The fatty acid concentrations were expressed in g per 100 g of tissue because this nutritionally reflects possible changes in the fatty acid profile better than the percentage content as it takes the fat content in 100 g of tissue into account. Based on the percentage (% of the total) of fatty acids, we calculated the atherogenic (AI) and thrombogenic (TI) indexes, as well as the hypocholesterolemic-to-hypercholesterolemic fatty acids ratio (HH) according to Ulbricht and Southgate (1991) and Santos-Silva et al. (2002):

$$AI = (C12:0 + 4 \times C14:0 + C16:0) / [\Sigma MUFA + \Sigma(n\text{-}6) + \Sigma(n\text{-}3)]$$

$$TI = (C14:0 + C16:0 + C18:0) / [0.5 \times \Sigma MUFA + 0.5 \times \Sigma(n\text{-}6) + 3 \times \Sigma(n\text{-}3) + \Sigma(n\text{-}3) / \Sigma(n\text{-}6)]$$

$$HH = [(C18:1n\text{-}9 + C18:2n\text{-}6 + C20:4n\text{-}6 + C18:3n\text{-}3 + C20:5n\text{-}3 + C22:5n\text{-}3 + C22:6\text{-}n) / (C14:0 + C16:0)].$$

Sensory evaluation of the muscles was performed after thermal treatment. Muscles (not frozen) were heated in 0.8% NaCl water solution (with a 1 : 2 meat-to-water proportion) until attaining 75°C in the geometric center of the sample. The assessment was carried out by a panel of six qualified subjects. The samples were evaluated for: flavour, tenderness, juiciness and palatability, according to a five-point scale: 1 (the lowest score) through 5 (the highest score) (Baryłko-Pikielna and Matuszewska 2014).

The results obtained were developed by one-way analysis of variance ($P < 0.05$ and $P < 0.01$) and calculating the mean values for the groups and the (SD). The significance of differences between mean values of the analysed characteristics was determined by means of the Duncan test (post-hoc) with Statistica 12.5.

RESULTS AND DISCUSSION

The determined profile of fatty acids of oils (soybean, rapeseed, linseed) used to oil mixtures is shown in Table 2.

TABLE 2. Fatty acids profile (g·100 g^{-1}) of oils

Item	Oils		
	soybean	rapeseed	linseed
C 14:0	0.05	0.07	0.04
C 16:0	12.37	4.83	4.62
C 16:1	0.07	0.12	0.05
C 18:0	2.11	1.38	3.02
C 18:1	22.38	68.13	20.41
C 18:2 n-6	57.96	17.70	17.97
C 18:3 n-3	4.73	6.45	53.69
C 20:0	0.18	0.43	0.15
C 20:1	0.12	0.84	0.10
C 22:0	0.16	0.27	0.05
Others	0.08	0.16	0.06
Σ SFA	14.70	6.68	7.75
Σ UFA	85.22	93.16	92.19
Σ MUFA	22.53	69.01	20.55
Σ PUFA	62.69	24.15	71.64
PUFA n-6/n-3	12.63	2.78	0.34
AI	0.15	0.05	0.05
TI	0.27	0.09	0.04
HH	2.18	16.77	15.91

SFA – saturated fatty acids; UFA – unsaturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; AI – atherogenic index; TI – thrombogenic index; HH – the ratios of hypocholesterolemic and hypercholesterolemic fatty acids.

It was proven that rapeseed and linseed oil contained more than three times less linoleic acid C 18:2 n-6, but more (linseed oil in particular – approx. 11 times) linolenic acid C 18:3 n-3 compared to soybean oil. The content of the above mentioned acids contributed to the narrowing of the total n-6 to n-3 PUFA ratio. In soybean oil, it was 12.63, in rapeseed oil – 2.78 and in linseed oil – 0.34. From the point of view of human nutrition, the most favourable proportion of n-6 to n-3 PUFA was found in rapeseed oil. The obtained own results are similar to data of Osek et al. (2004), Schneiderová et al. (2007) and Konieczka et al. (2017). The authors state that the fatty acid profile of oil depends on a number of factors, for example: the species and variety of seeds, method of pressing or conditions of product storage.

Significantly higher body weight of broilers from groups I and II at the age of 42 days in comparison with group III was proved (Table 3). Lower feed conversion ratio in broilers fed with mixtures containing soybean and rapeseed oils in comparison with birds of group III

TABLE 3. Rearing and post-slaughter results of broiler chickens

Item	Group						*P*
	I		II		III		
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	
Body weight in day 42 (kg)	2.20b	0.03	2.21a	0.04	2.15ab	0.03	< 0.05
FCR (kg)	1.46b	0.02	1.54a	0.03	1.62ab	0.04	< 0.05
Dressing percentage (%)	76.10	1.26	76.40	1.48	75.50	1.28	0.921
Share in cold carcass (%)							
Muscles total including	44.4b	2.8	46.8ab	2.3	45.0a	1.9	< 0.05
breast	21.6	1.8	23.4	2.6	21.9	1.5	0.344
thigh	13.0	1.2	13.9	1.1	13.2	0.8	0.104
drumstick	9.8	1.2	9.5	1.2	9.9	1.1	0.125
Skin with subcutenous fat	12.9	1.9	13.0	1.5	13.1	1.7	0.103
Abdominal fat	2.2	0.8	2.2	0.6	2.3	0.4	0.090

a, a and b, b – in line the means marked with the same small letters differ statistically significantly at $P \leq 0.05$.

was also found. No influence of the oil type on dressing percentage and broiler fatness was observed, whereas the best shore of muscle ($P \leq 0.05$) in bird groups was found.

The introduction of soybean, rapeseed or linseed oils into mixtures for chickens for fattening did not affect the content of basic ingredients in muscles, except for crude fat (Table 4).

The smallest level of fat was found in the muscles of birds fed with mixtures oiled with rapeseed oil, and the statistically significant difference was confirmed against group I ($P < 0.01$) and group III ($P < 0.05$). The use of linseed oil (instead of soybean oil) in chicken diets significantly reduced the amount of lipids in the pectoral muscle only.

According to Zelenka et al. (2006), the addition (1, 3, 5 and 7%) of linseed oil to compound mixtures for chickens for fattening does not affect the crude fat content in both types of muscles, but its significant amount (7%) decreases ($P \leq 0.05$) the content of protein in pectoral muscles. Osek et al. (2004) indicate a significant influence of the type of oil used to oil mixtures for chickens on fat content in meat, as in pectoral muscles and in muscles of legs of chickens fed with mixtures oiled with linseed oil, smaller amount of this ingredient was found than in the muscles of birds fed with mixtures with rapeseed or soybean oil. Kanakri et al. (2017) state that the type of fat used in mixtures for chickens does not affect the content of crude fat in pectoral muscles and muscles of legs.

The fatty acid profile in muscle lipids (pectoral muscles and muscles of legs) was a reflection of the fatty acid profile of the oils used to oil mixtures for chickens (Table 5 and 6). Significantly ($P < 0.01$) more α-linolenic acid was found in both muscle of birds fed diets

TABLE 4. Basal nutrients (%) of muscles

Item	Groups						*P*
	I		II		III		
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	
Pectoral muscles (*N* = 18)							
Dry matter	25.57	0.31	25.36	0.29	25.41	0.39	0.336
Crude ash	1.16	0.02	1.16	0.01	1.14	0.01	0.235
Crude protein	22.73	0.16	22.92	0.18	22.82	0.28	0.801
Crude fat	1.65 Aa	0.20	1.23 Aa	0.16	1.41 Ba	0.12	< 0.01
Leg muscles (*N* = 18)							
Dry matter	25.15	0.30	25.40	0.29	25.41	0.34	0.249
Crude ash	1.00	0.02	1.00	0.01	0.99	0.01	0.744
Crude protein	18.69	0.16	19.24	0.19	19.09	0.31	0.125
Crude fat	5.46 Aa	0.16	5.16 Aab	0.09	5.33 Bb	0.24	< 0.01

a, a and b, b – in line the means marked with the same small letters differ statistically significantly at $P \leq 0.05$.
A, A and B, B – in line the means marked with the same capital letters differ statistically significantly at $P \leq 0.01$.

with linseed or rapeseed oil compared to chickens receiving the mixtures with soybean oil. Such relations were also noted by Bou et al. (2005), Haug et al. (2007) and Marco et al. (2013) after the introduction of linseed oil to mixtures for chickens for fattening. Significantly lower level of saturated fatty acids, including hypercholesterolemic acids (OFA), and a higher proportion of PUFA in chicken muscles after introduction of rapeseed or linseed oils to mixtures is a confirmation of the results of Osek et al. (2004). Similarly, Kanakri et al. (2017) noted significantly less SFA and more PUFA in the muscles of chickens fed with mixtures containing linseed oil.

The calculated ratio of PUFA n-6 to n-3 in muscles clearly indicates that linseed oil most preferably modifies the fatty acid profile in the pro-health direction. Compared to the muscles of chickens fed with mixtures with rapeseed oil, and especially with soybean oil, this ratio was many times lower. Similarly, Nguyen et al. (2003) showed a narrowing of the n-6 to n-3 PUFA ratio in individual pieces of carcass after the introduction of rapeseed oil (approx. 2.5-fold) or linseed oil (approx. 10-fold) to the diet of chickens for fattening.

Considering the type of muscles of chickens for feeding, it has been shown that leg muscles are a better source of fatty acids from the omega-3 family, due to the higher content of fat, and thus fatty acids. Jarosz and Bułhak-Jachymczyk (2008) recommend to consume 2 g of α-linolenic acid and 200 mg of LC-PUFA n-3 per day in order to narrow the proportion of n-6 to n-3 acids in the human diet.

The fatty acid profiles also enabled the evaluation of the lipid fraction's nutritional quality index (INQ). The atherogenic-

TABLE 5. Fatty acids profile (g·100 g^{-1}) of pectoral muscles ($N = 18$)

Item	Group						*P*
	I		II		III		
	$\overline{x}$	*SD*	$\overline{x}$	*SD*	$\overline{x}$	*SD*	
C 14:0	0.004	0.001	0.004	0.001	0.004	0.001	0.234
C 16:0	0.366 A	0.001	0.399 AB	0.013	0.359 B	0.001	< 0.01
C 16:1	0.082 Aa	0.001	0.072 Ba	0.005	0.062 Aa	0.003	< 0.01
C 18:0	0.065 ab	0.002	0.072 b	0.001	0.074 a	0.006	< 0.05
C 18:1	0.588 ABa	0.009	0.893 Aa	0.189	0.639 Ba	0.007	< 0.01
C 18:2 n-6	0.120 A	0.001	0.176 A	0.001	0.171 A	0.002	< 0.01
C 18:3 n-3	0.003 A	0.001	0.016 A	0.001	0.086 A	0.001	< 0.01
C 20:1	0.002 A	0.001	0.004 AB	0.001	0.002 B	0.001	< 0.01
C 20:2	0.002 AB	0.001	0.001 A	0.0001	0.001 B	0.001	< 0.01
C 20:3	0.001	0.001	0.001	0.001	0.001	0.001	0.511
C 20:4	0.001 ABa	0.001	0.005 Aa	0.001	0.004 Ba	0.001	< 0.01
Others	0.004	0.001	0.005	0.001	0.005	0.001	0.238
Σ SFA	0.433 A	0.001	0.475 A	0.013	0.438 B	0.006	< 0.01
Σ UFA	0.792 A	0.001	1.170 A	0.014	0.968 A	0.007	< 0.01
Σ MUFA	0.666 A	0.002	0.970 A	0.014	0.704 A	0.010	< 0.01
Σ PUFA	0.126 A	0.001	0.200 A	0.001	0.264 A	0.004	< 0.01
PUFA n-6/n-3	39 A	1.147	11 A	0.799	2 A	0.006	< 0.01
AI	0.482 ABa	0.002	0.356 Ba	0.016	0.387 Aa	0.002	< 0.01
TI	1.013 A	0.001	0.665 A	0.033	0.368 A	0.006	< 0.01
HH	1.909 ABa	0.006	2.713 Aa	0.136	2.480 Ba	0.005	< 0.01

Explanations as in Table 2.
a, a and b, b – in line the means marked with the same small letters differ statistically significantly at $P \leq 0.05$.
A, A and B, B – in line the means marked with the same capital letters differ statistically significantly at $P \leq 0.01$.

ity (AI) and thrombogenicity (TI) indexes and the ratios of hypocholesterolemic and hypercholesterolemic fatty acids (HH) could therefore be determined. According to Turan et al. (2007), nutritional quality indexes can indicate a sample's potential for plaque aggregation. In other words, low AI and TI values indicate high quantities of anti-atherogenic fatty acids in oil or intramuscular fat. Ouraji et al. (2009) reported that AI and TI higher than 1 are harmful for human health. The values for the both indexes (AI and TI) showed that linseed and rapeseed oils had beneficial effects on pro-healthy properties of meat. The lower the AI and TI index values, the healthier the food. This is because these indexes report the relationship between fatty acids in food and their contribution to the prevention of coronary dis-

TABLE 6. Fatty acids profile (g·100 g^{-1}) of leg muscles (N = 18)

Item	Group						P
	I		II		III		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	
C 14:0	0.017 AB	0.001	0.013 B	0.001	0.013 A	0.001	< 0.01
C 16:0	1.571 ABa	0.029	1.213 Ba	0.021	1.267 Aa	0.025	< 0.01
C 16:1	0.413 AB	0.022	0.284 A	0.014	0.277 B	0.012	< 0.01
C 18:0	0.254 a	0.013	0.199 ab	0.009	0.250 b	0.033	< 0.05
C 18:1	2.631 Ba	0.283	2.755 Aa	0.045	2.448 ABa	0.164	< 0.01
C 18:2 n-6	0.519 A	0.004	0.566 A	0.002	0.637 A	0.037	< 0.01
C 18:3 n-3	0.036 A	0.002	0.065 A	0.005	0.396 A	0.158	< 0.01
C 20:1	0.014 a	0.001	0.014 b	0.002	0.010 ab	0.002	< 0.05
C 20:2	0.003	0.001	0.003	0.001	0.003	0.001	0.590
C 20:3	0.003	0.001	0.003	0.001	0.003	0.001	0.630
C 20:4	0.012 A	0.001	0.010 B	0.001	0.008 A	0.001	< 0.05
Others	0.019	0.001	0.016	0.002	0.018	0.001	0.170
Σ SFA	1.813 A	0.013	1.425 A	0.031	1.530 A	0.054	< 0.01
Σ UFA	3.629 ABa	0.014	3.719 Ba	0.031	3.782 Aa	0.036	< 0.01
Σ MUFA	3.055 B	0.014	3.073 A	0.029	2.735 AB	0.173	< 0.01
Σ PUFA	0.574 Ba	0.001	0.647 Aa	0.001	1.047 ABa	0.194	< 0.01
PUFA n-6/n-3	14 A	0.0369	9 A	0.699	2 A	0.423	< 0.01
AI	0.446 AB	0.004	0.340 B	0.009	0.350 A	0.004	< 0.01
TI	0.916 A	0.012	0.669 A	0.026	0.439 A	0.108	< 0.01
HH	2.047 AB	0.023	2.789 A	0.089	2.726 B	0.030	< 0.01

Emplanations as in Table 2.
a, a and b, b – in line the means marked with the same small letters differ statistically significantly at $P \leq 0.05$.
A, A and B, B – in line the means marked with the same capital letters differ statistically significantly at $P \leq 0.01$.

eases (Turan et al. 2007, Cutrignelli et al. 2008).

Sensory evaluation of the muscles included: flavour, juiciness, tenderness and palatability (Figs. 1, 2).

Oiling mixtures with rapeseed or linseed oils worsened the flavour and palatability of pectoral muscles, and consequently the average for four rated traits (P < 0.05). Significant reduction of organoleptic qualities of muscles of chickens fed with mixtures containing 5% linseed oil was demonstrated by Osek et al. (2005), while Marco et al. (2013) did not note a decrease in the sensory qualities of meat of chickens fed with mixtures oiled with linseed oil. Meat from turkeys fed with mixtures oiled with rapeseed or linseed oils has significantly worse taste, while the muscles of birds having diets

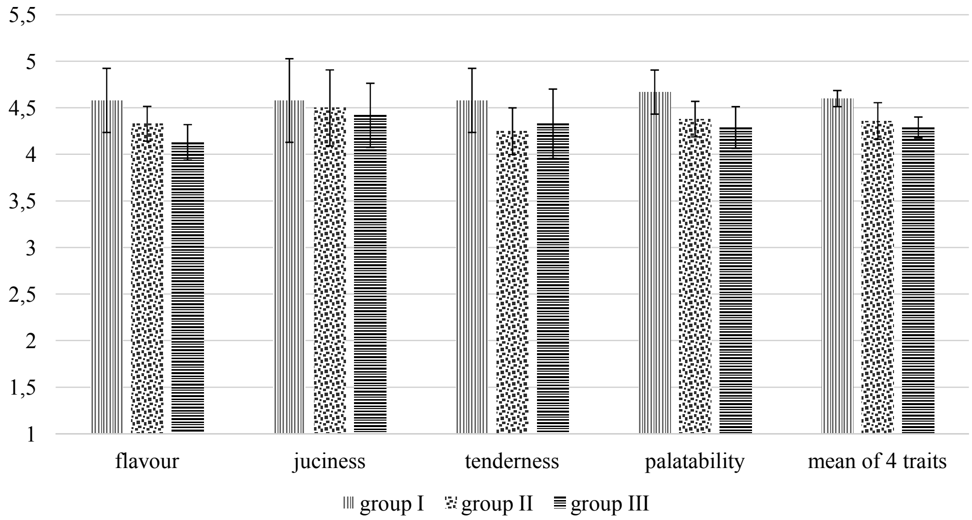

FIGURE 1. Sensory evaluation of pectoral muscles (point)

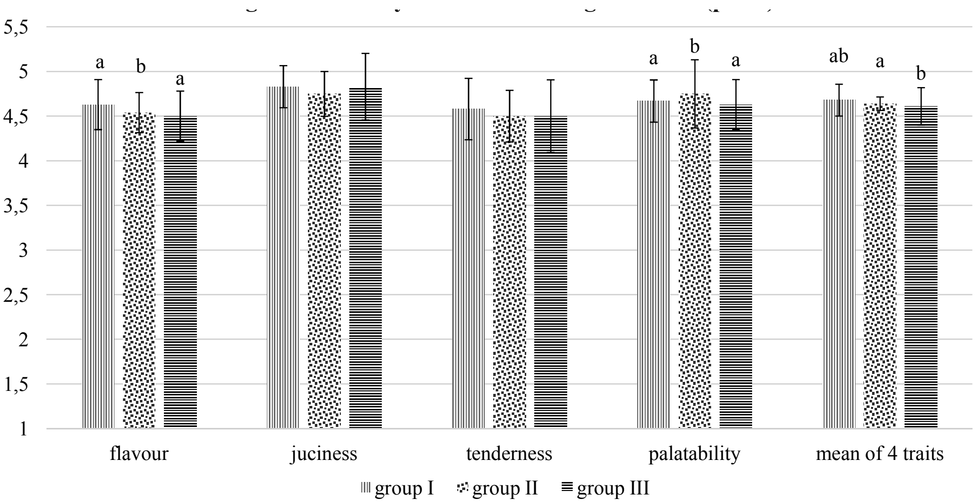

FIGURE 2. Sensory evaluation of thigh muscles (point)

with linseed oil received the lowest evaluation (Jankowski et al. 2012).

CONCLUSIONS

Oiling compound mixtures with rapeseed oil or linseed oil significantly reduced the content of crude fat in the pectoral muscles of chickens for fattening.

The contribution of fatty acids in oils has been reflected in muscle lipids. The most advantageous ratio of n-6 to n-3 PUFA was found in the muscles of chickens receiving mixtures with linseed oil.

The use of rapeseed or linseed oils in the mixtures worsened the smell and taste of pectoral muscles, and consequently the average for four rated traits ($P < 0.05$). Paying attention to the pro-health properties of the meat of chickens for fattening, the obtained results provide grounds to recommend oiling of compound mixtures primarily with linseed oil, as it increases ($P < 0.01$) the content of PUFA n-3. However, it should be taken into account that taste qualities will thus deteriorate.

Acknowledgements

Studies were funded from the statute theme 212/04/5.

REFERENCES

AOAC 2011: Official Methods of Analysis. In: W. Horwitz (Ed.), 18th ed. AOAC International. Gaithersburg, MD, USA.

BARYŁKO-PIKIELNA N., MATUSZEWSKA I. 2014: Sensoryczne badania żywności. Podstawy. Metody. Zastosowania. 2nd edn. Wydawnictwo Naukowe PTTZ, Kraków [in Polish].

BETTI M., SCHNEIDER B.L., WISMER W.V., CARNEY V.L., ZUIDHOF M.J., RENEMA R.A. 2009: Omega-3-enriched broiler meat. 2. Functional properties, oxidative stability, and consumer acceptance. Poultry Sci. 88 (5): 1085–1095.

BOU R., GUARDIOLA F., BARROETA A.C., CODONY R. 2005: Effect of dietary fat sources and zinc and selenium supplements on the composition and consumer acceptability of chicken meat. Poultry Sci. 84 (7): 1129–1140.

CUTRIGNELLI M.I., CALABRŇ S., BOVERA F., TUDISCO R., D'URSO S., MARCHIELLO M., PICCOLO V., INFASCELLI F. 2008: Effects of two protein sources and energy level of diet on the performance of young Marchigiana bulls. 2. Meat quality. Ital. J. Anim. Sci. 7 (3): 271–285.

DALEY C.A., ABBOTT A., DOYLE P.S., NADER G.A., LARSON S. 2010: A review of fatty acids profiles and antioxidant content in grass-fed and grain-fed beef. Nutr. J. 9: 1–12.

EFSA 2010: Panel on Dietetic Products, Nutrition, and Allergies (NDA). Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, *trans* fatty acids, and cholesterol. European Food Safety Authority (EFSA), Parma, Italy, 1461.

FOLCH J., LEES M., SLOANE STANLEY G.H. 1957: A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226: 497–509.

GIBBS R.A., RYMER C., GIVENS D.I. 2010: Long-chain n-3 PUFA: intake in the UK and the potential of a chicken meat to increase them. In: Proceedings of the Nutrition Society. The Summer Meeting of the Nutrition Society, Guildford, UK 69: 144–155.

HAUG A., EICH-GREATOREX S., BERNHOFT A., WOLD J.P., HETLAND H., CHRISTOPHERSEN O.A., SOGN T. 2007: Effect of dietary selenium and omega-3 fatty acids on muscle composition and quality in broilers. Lipids Health Dis. 6: 29.

JANKOWSKI J., ZDUŃCZYK Z., MIKULSKI D., JUSKIEWICZ J., NACZMANSKI J., POMIANOWSKI J.F., ZDUŃCZYK P. 2012: Fatty acid profile, oxidative stability, and sensory properties of breast meat from turkeys fed diets with a different n-6/n-3 PUFA ratio. Eur. J. Lipid Sci. Technol. 114 (9): 1025–1035.

JAROSZ M., BUŁHAK-JACHYMCZYK B. 2008: Normy żywienia człowieka. Podstawy prewencji otyłości i chorób niezakaźnych. Wydawnictwo Lekarskie PZWL, Warszawa.

KANAKRI K., CARRAGHER J., HUGHES R., MUHLHAUSLER B., GIBSON R. 2017: The effect of different dietary fats on the fatty acid composition of several tissues in broiler chickens. Eur. J. Lipid Sci. Technol. 120 (1), 1700237: 1–13.

KONIECZKA P., CZAUDERNA M., SMULIKOWSKA S. 2017: The enrichment of chicken meat with omega-3 fatty acids by dietary fish oil or its mixture with rapeseed or flaxseed. Effect of feeding duration. Dietary fish oil, flaxseed, and rapeseed and n-3 enriched broiler meat. Anim. Feed Sci. Tech. 223: 42–52.

LI S., VESTERGREN A.S., WALL H., TRATTNER S., PICKOVA J., IVARSSON E. 2017: Feeding steam-pelleted rapeseed affects expression of genes involved in hepatic lipid metabolism and fatty acid composition of chicken meat. Poultry Sci. 96 (8): 2965–2974.

MARCO D.J.M., ACDA S.P., ROXAS D.B., MERCA F.E. 2013: Effect of omega-3 fatty acid enriched feed supplement on broiler performance and carcass quality. Philipp. J. Vet. Anim. Sci. 39 (1): 53–62.

NGUYEN C.V., SMULIKOWSKA S., MIECZKOWSKA A. 2003: Effect of linseed and rapeseed or linseed and rapeseed oil on performance, slaughter yield and fatty acid deposition in edible parts of the carcass in broiler chickens. J. Anim. Feed Sci. 12: 271–288.

OURAJI H., SHABANPUR B., ABEDIANKENARI A., SHABANI A., NEZAMI A., SUDAGAR M., FAGHANI S. 2009: Total lipid, fatty acid composition and lipid oxidation of Indian white shrimp (*Fenneropenaeus indicus*) fed diets containing different lipid sources. J. Sci. Food Agr. 89: 993–997.

OSEK M., JANOCHA A., MILCZAREK A., KLOCEK B. 2005: Wyniki produkcyjne i poubojowe oraz walory smakowe mięsa kurcząt brojlerów żywionych mieszankami natłuszczanymi różnymi olejami roślinnymi. Rośliny Oleiste – Oilseed Crops 26: 527–536.

OSEK M., WASIŁOWSKI Z., JANOCHA A. 2004: Wpływ różnych olejów roślinnych na skład podstawowy i profil kwasów tłuszczowych mięsa kurcząt. Rocz. Nauk. Zoot., Supl. 20: 235–238.

PUVAČA N., LUKAČ D., LJUBOJEVIĆ D., STANAĆEV V., BEUKOVIĆ M., KOSTADINOVIĆ LJ. PLAVŠA N. 2014: Fatty acid composition and regression prediction of fatty acid concentration in edible chicken tissues. World Poultry Sci. J. 70: 585–592.

SANTOS-SILVA J., BESSA R.J.B., SANTOS-SILVA F. 2002: Effect of genotype, feeding system and slaughter weight on the quality of light lambs. II. Fatty acid composition of meat. Livest. Prod. Sci. 77 (2–3): 187–194.

SCHNEIDEROVÁ J., ZELENKA D., MRKVICOVÁ E. 2007: Poultry meat production as a functional food with a voluntary n-6 and n-3 polyunsaturated fatty acids ratio. Czech J. Anim. Sci. 52 (7): 203–213.

TURAN H., SÖNMEZ G., KAYA Y. 2007: Fatty acid profile and proximate composition of the thornback ray (*Raja clavata* L. 1758) from the Sinop coast in the Black Sea. J. Fishscicom (2): 97–103.

ULBRICHT T.L.V., SOUTHGATE D.A.T. 1991: Coronary heart disease: Seven dietary factors. Lancet 338: 985–992.

WOOD J.D., ENSER M. 1997: Factors influencing fatty acids in meat and the role of antioxidants in improving meat quality. Brit. J. Nutr. 78, Suppl. 1: 49–60.

VALAVAN S.E., SELVARAJ P., MOHAN B., SIVAKUMAR K., EDWIN S.C., KUMARESAN G., BHARATHIDHASAN A. 2016: Production of chicken designer meat by manipulating fatty acids composition with Omega-3-fatty acids feed ingredients. Indian J. Anim. Sci. 86 (4): 472–477.

ZELENKA J., SCHNEIDEROVÁ D., MRKVICOVÁ E. 2006: Linseed oils with different fatty acid patterns in the diet of broiler chickens. Czech J. Anim. Sci. 51 (3): 117–121.

Streszczenie: *Wpływ rodzaju oleju w dietach kurcząt brojlerów na właściwości prozdrowotne i organoleptyczne mięsa.* W pracy dokonano analizy właściwości prozdrowotnych i organoleptycznych mięsa kurcząt rzeźnych żywionych mieszankami natłuszczanymi trzema różnymi olejami. Materiał badawczy stanowiło po 18 próbek mięśni piersiowych i nóg kurcząt Ross 308. Próbki pobrano od 42-dniowych ptaków z trzech grup żywieniowych. Kurczęta grupy I otrzymywały mieszanki natłuszczane olejem sojowym, a kurczęta II i III grupy mieszanki natłuszczone odpowiednio olejem rzepakowym i lnianym. Zastosowanie w mieszankach dla kurcząt brojlerów oleju rzepakowego lub lnianego nie wpłynęło na zawartość składników podstawowych w mięśniach, ale istotnie zmniejszyło w nich udział tłuszczu surowego (wyjątek mięśnie nóg ptaków żywionych mieszanką zawierającą olej lniany). Zróżnicowanie udziału kwasów tłuszczowych w olejach znalazło swoje odzwierciedlenie w lipidach mięśni. Mając na uwadze prozdrowotne walory mięsa kurcząt brojlerów, otrzymane wyniki upoważniają do zalecania natłuszczania mieszanek paszowych przede wszystkim olejem lnianym, bowiem zwiększa ($P \leq 0{,}01$) on udział PUFA n-3. Należy jednak liczyć się z pogorszeniem jego walorów smakowych.

Słowa kluczowe: kurczęta brojlery, mięśnie, kwasy tłuszczowe, składniki podstawowe

MS received 20.02.2018

MS accepted 29.05.2018

Authors' address:
Anna Milczarek
Katedra Żywienia Zwierząt i Gospodarki Paszowej
Wydział Przyrodniczy
Uniwersytet Przyrodniczo-Humanistyczny w Siedlcach
ul. Prusa 14, 08-110 Siedlce
Poland
e-mail: anna.milczarek@uph.edu.pl