THE POSSIBILITY OF INCREASING THE AMOUNT OF LINOLENIC ACID IN THE BROILER MEAT

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Keywords: broiler, meat quality, abdominal fat, linolenic acid

Background

Great importance in human nutrition is given to polyunsaturated fatty acids (PUFA, omega 3), especially to linolenic acid (C18:3), eicosapentaenoic acid (C20:5) and docosahexaenoic acid (C22:6) because they decrease the risk of cardiac diseases (Leaf and Weber, 1988; Barlow and Pike, 1991). According to Lettner and Zollitsch (1993) replacement of soybean oil with rape seed oil of "00" sorts (0, 2, 3 and 4%) in the diet results in the tendency of improvement of final live weights and gain of the chicken as well as in changed profile of fatty acids in abdominal fat. According to Holsheimer (1991) and Zollitsch et al. (1993) it is possible to achieve good results in broiler feeding by usage of rape seed oil ("00" sort) instead of animal fat or soybean oil. Beside, the content of fatty acids in fatty tissue is changed. Content of palmitic, stearic and linoleic is decreased, and content of oleic and linolenic is increased. Morion and Woodroof (1963), as well as Scaife et al. (1990) showed in their researches that chicken fat mainly contains palmitic and stearic acid (C16:0 and C18:0) of the saturated, and oleic and linoleic (C18:1 and C18:2) of the unsaturated fatty acids. In smaller quantities there are linoleic and arachidonic (C18:3 and C20:4) as well as some other unsaturated fatty acids with 5 or 6 double bonds. The composition of fatty acids in meat and in abdominal fat can change in respect to the source and the amount of fats in the diet (Blanch et al., 1992; Gualtieri et al., 1993).

The objective of this research was to determine the influence of different diet compositions on chemical composition of the meat and on profile of fatty acids in abdominal fat of the fattening chickens.

Methods

The research was carried out on 20 samples of red and white meat, as well as on abdominal fat, originated from Ross 208 hybrid chicken (10 from the 1st group, 10 from 2nd group). Chickens were fed in the boxes until the age of 42 days, ad libitum. From the 1st till 28th day chicken were fed starter diet (A) with 22% of crude protein and 12.40 MJ ME/kg, while from 22nd till 42nd day they were fed finisher diet (B) with 18.6% of crude protein and 12.50 MJ ME/kg. Basic difference in the diets for the 1st and 2nd group could be seen from the following scheme:

Chicken group	Foodstuff	Diet	
		A	B
1.	Sunflower meal %	2.5	4.5
	Animal fat %	3.5	3.5
2.	Rapeseed meal %	2.5	4.5
	Rapeseed oil %	3.5	3.5

Beside the ingredients mentioned above the diets contained corn, wheat, soybean meal, fish meal, yeast, limestone and premix.

During the 42nd day, after 12 hours of fasting, chickens were transported to the slaughterhouse, slaughtered and processed "ready for grill". The samples of breast muscle (m. pectoralis thoracicus) were taken for the chemical analysis of white meat, while red meat analysis were carried out on the homogenised samples of all of the muscles of thighs and drumsticks. In both cases used muscles were without skin and visible fatty tissue. The water content was determined by drying the samples on 105 °C till constant weight, fats were determined by Soxhlet method, proteins using Kjeldahl method, and ash was determined by burning the samples on 550 °C. The samples of the chicken fat were analysed on the gas chromatographic device using ISO 5508 method (1990).

The results of the research were processed by Excel 5.0 for Windows software.

Results and discussion

The content of water, fat, proteins, and ash in white and red chicken meat is shown in the table 1. It is obvious from the data that there are significant differences in the contents of the main ingredients between white and red meat. Red meat is richer in fats than white meat from both groups. The water content is highly significantly lower, and the fat content is higher in the white meat of the 1st group than in 2nd group of the chicken. The differences in the chemical composition of the red meat between groups of chicken are not significant. The results of the research are within the boundaries found by Kralik et al. (1993) and Petričević et al. (1993) for the meat of fattening chicken.

The diet composition influenced the content of saturated fatty acids in abdominal fat of broilers (table 2). The share of palmitic acid was highly significantly lower ($P<0.01$) in 2nd group than in the 1st group of the chickens. The chickens from the 2nd group also had significantly less ($P<0.05$) stearic acid than chickens from the 1st group. The content of the linolenic as well as oleic acid was highly significantly higher ($P<0.001$) in 2nd group compared to the 1st group of the chickens. Similar results were obtained by Olomu et al. (1975), Holsheimer (1991), Zollitsch et al. (1993) and Lettner and Zollitsch (1993), with the exemption of the share of linolic acid which was not significantly changed in this research. The results of this study are in agreement with the statements of Blanch et al. (1992) and Gualtieri et al. (1993) refered to the conclusion that composition of the chicken fat could be changed in respect to the source and the amount of fat in the diet.

Table 1. Mean values and variability of the water, fat, protein and ash contents in the broiler meat

Indicator	1st group		2nd group	
	$\bar{x}$	s	$\bar{x}$	s
White meat				
Water, %	75.40	0.49	74.39**	0.21
Fat, %	0.95	0.37	1.74**	0.13
Protein, %	22.58	0.78	22.78	0.31
Ash, %	1.07	0.03	1.09	0.07
Red meat				
Water, %	76.78	1.05	76.34	0.87
Fat, %	2.55	0.74	2.90	0.65
Protein, %	19.56	0.80	13.76	0.98
Ash, %	1.09	0.04	0.98	0.06

**P<0.01

Table 2. Mean values (%) and variability of the fatty acids in the abdominal fat

Fatty acid		1st group		2nd group	
		$\bar{x}$	s	$\bar{x}$	s
Myristic	(C14:0)	0.76	0.052	0.51	0.083
Palmitic	(C16:0)	22.76	0.778	18.71**	1.190
Palmitoleic	(C16:1)	6.56	1.422	4.45***	0.602
Heptadekanoic	(C17:0)	0.19	0.064	0.21	0.083
Stearic	(C18:0)	5.17	0.341	4.44*	0.526
Oleic	(C18:1)	43.32	0.891	48.30***	1.717
Linoleic	(C18:2)	19.34	1.474	19.44	2.214
Linolenic	(C18:3)	0.75	0.075	2.50***	0.550

*P<0.05 **P<0.01 ***P<0.001

Conclusion

The results of the research about the usage of rape seed meal and oil (2nd group) as the replacement for sunflower meal and animal fat (1st group) enable the definition of the following conclusions:

1. The differences in the contents of water and fat in the white meat were highly significant (P<0.01) between the groups of chicken.
2. In the abdominal fat of 2nd group of chickens very significantly higher (P<0.001) content of linolenic acid was found as well as of some other unsaturated fatty acids, compared to the 1st group of chickens.

Pertinent literature

1. Barlow, S., Pike, I.M. (1991): Humans, animals benefit from omega 3 polyunsaturated fatty acids. Feedstuffs 63 (19), 18-26.
2. Blanch, A., Barroeta, A.C., Cabre, M., Puchal, F. (1992): Changes in the degree of saturation of the carcass fat depositions caused by different dietary fat sorces in broiler chickens. Proceedings of World's Congress, vol. 3, 665.
3. Gualtieri, M., Pali, B.M., Rapaccini, S. (1993): Fatty acid composition of broilers meat as influenced by diet supplemen-tation with fish oil. Proceedings of 11 European Symposium on the Quality of Poultry Meat 136-141.
4. Holsheimer, J.P. (1991): Nutrition and Product Quality. Quality of Poultry Products, 1.Poultry Meat. Proceedings of the 10th European Symposium.
5. Kralik, Gordana, Petričević, A., Maltar, Zlata, Senčić, Đ. (1993): Utjecaj genotipa i spola pilića na prinos i kakvoću mesa. Stočarstvo, 47, 1-2, 39-47.
6. Leaf, A., Weber, P.C. (1988): Cardiovascular effects of ω-3 fatty acids. N. Eng. J. Med. 318:549.
7. Lettner, F., Albar, A.M., Leigeb, R. (1983): Einfluss von Rapsschrot auf die Lehlachtkörperqualität bei Mastküken. Die Bodenkultur 34, 65-73.
8. Lettner, F., Zollitsch, W.(1993): Ersatz von Sojaöl durch Rapsöl im Hühnermastfutter.
9. Morion, J.E., Woodroof, J.G.(1963): The fatty acidcomposition of breast, thigh and skin tissues of chickens broilers as influenced by dietary fats. Poultry Sci. 42, 1202-1207.
10. Olomu, J.M., Robblee, D.R., Clandinin, D.R., Hardin, R.T.(1975): Utilization of Full-Fat Rapeseed and Rapeseed Meals in Rations for Broiler Chickens. Canadian Journal of Animal Science, 55, 461-469.
11. Petričević, A., Kralik, Gordana, Maltar, Zlata (1993): Neki pokazatelji prehrambene kakvoće mesa Ross i Arbor Acres pilića. Stočarstvo, 46, 11-12, 351-356.
12. Scaife, J.R., Moyo, J., Galbraith, H., Michie, W.(1990): Effect of different dietary supplemental fats and oils on growth performance and fatty acid composition of tissues in female broilers. Proceedings of the Nutrition Society 49, 2, 130 A.
13. Zollitsch, W., Wetscherek, W., Lettner, F.(1993): Einsatz von Rapsöil im Hühnermastfutter. Arch. Geflügelkunde, 56 (4), 182-186.