Acta Agraria Kaposváriensis (2010) Vol 14 No 2, 97-102
Kaposvári Egyetem, Állattudományi Kar, Kaposvár
Kaposvár University, Faculty of Animal Science, Kaposvár

Production costs of broiler meat with conventional nutritive composition and with n-3 PUFA enrichment

I. Kralik, Z. Gajčević-Kralik, Z. Tolušić
Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, 31000 Osijek, Trg sv. Trojstva 3., Croatia

ABSTRACT

Nutritive quality of broiler meat can be influenced through feeding treatments. The research involved 60 Ross 308 broilers divided into 3 groups (C, A and B). In the first three weeks of fattening, broilers were fed starter diets balanced at 24% of crude proteins and 12.5 MJ ME/kg. Experimental period involved last three weeks of fattening. Dietary treatments differed in the source of supplemented oils: C (5% sunflower oil SO), A (2.5% fish oil FO+2.5% sunflower oil SO) and B (2.5% fish oil FO+2.5% linseed oil LO). For the purpose of cost calculation per feeding treatment the following data were considered: average broiler live weight, feed consumption and conversion, and costs of feeding mixtures. Total costs of broiler fattening refer to variable and fixed costs. At the end of fattening period average broiler weights were: A 2836 g, C 2713 g and B 2648 g. Calculation of feed costs per kg of live weight were: C 0.60 €, A 0.58 € and B 0.66 €. Total costs of broiler production per kg of live weight were: C 1.43 €/kg, A 1.38 €/kg and B 1.51 €/kg. It is to conclude that modification of feed composition could reduce the n-6/n-3 PUFA ratio from 10.81% to 1.78% in broiler breasts and from 12.40% to 2.05% in thighs. However, modification of feeding treatments in groups C, A and B affected production costs per one broiler, being 3.88 €, 3.93 € and 4.03 €, respectively.
(Keywords: broilers, diet composition, fattening costs)

INTRODUCTION

There is a growing consumption of broiler meat not only in Croatia, but also worldwide. This can be explained by broilers' meat satisfactory nutritive and organoleptic traits, as well as by its reasonable pricing. According to Croatian *Statistical Yearbook* (2009), consumption of fresh meat per a household member in Croatia in 2008 was 44.68 kg, of which 16.96 kg was poultry meat. From a nutritive point of view, broiler meat is a dietetic product rich in protein and low in fat (*Kralik et al.,* 2001). Content and profile of fatty acids in poultry meat depend on the composition of fatty acids in poultry diets. Dietary mixtures used for intensive fattening of broilers usually contain high level of saturated fatty acids, and relatively low level of unsaturated fatty acids. Contemporary researches focus on possibilities to modify fatty acid content in poultry products (meat and eggs). Oils originating from sea organisms are known to be rich source of essential n-3 fatty acids (eicosapentaenoic acid-EPA and docosahexaenoic acid-DHA). However, it was proven that those oils added to broiler diets in higher amounts had negative effects on meat organoleptic traits in the sense of „fishy" odor and taste, which were unacceptable to consumers (*Scaife et al.,* 1994). Linseed and rapeseed oils or seeds can be used as supplements for broiler diets as an alternative to fish flour or oil (*Ajuyah et al.,* 1991). Significant scientific results are achieved on the respective topic, which resulted in the availability of different animal products labeled as „functional food" on markets in many countries. Referring to poultry products as functional food, eggs enriched with omega-3 fatty acids are available on Croatian market. This research elaborates the effects of different feeding treatments on the enrichment of meat with n-3 PUFA and on lowering of n-6/n-3 PUFA ratio. Furthermore, following the trends of growing supplies and demands for functional food, this research also presents costs of production of broiler meat with conventional nutritive composition and with enriched n-3 PUFA content.

MATERIALS AND METHODS

The research was carried out on 60 broilers of Ross 308 provenience. Within the first three weeks of fattening all broilers consumed starter mixture balanced at 24% crude protein and 12.5 MJ ME/kg. The experimental part involved the last three weeks of fattening. After the 21st day, broilers were divided into three groups (C, A and B). Group C was given diets that contained 5.0% SO, group A had diets supplemented with 2.5% FO+2.5% SO, and group B had diets with 2.5% FO+2.5% LO. Diets were balanced at 20% crude protein and 13.50 MJ ME/kg. Feeding and watering was *ad libitum* within automatic watering and feeding system. Average weekly weight gains per groups, feed consumption (g) and feed conversion (g/g) were calculated every 7 days. At the end of fattening period, after a 10-hour long starvation, broilers were slaughtered and samples of breasts and thighs were taken for analysis of fatty acid content in muscle lipids. The Chrompack CP-9000 chromatograph equipped with flame ionization detector was used for determination of fatty acids in muscle tissue. Referring to achieved production results and fixed and variable costs of each feeding treatment, the total costs of broiler production were calculated. Research results were processed in Statistica for Windows v.7.1. (*StatSoft Inc.,* 2005). Testing of significance differences between groups was performed by variance analysis (ANOVA). The F-value was compared with theoretic F-value at three significance levels (5% $P<0.05$; 1% $P<0.01$ and 0.1% $P<0.001$). Significance of differences between mean values was determined by the Fischer's LSD-test. The production costs of broiler meat of conventional and modified composition were calculated on the basis of production results and costs of dietary mixtures.

RESULTS AND DISCUSSION

At the end of fattening period, the highest live weight had broilers of group A, then group C and lastly group B (2830.53 g; 2713.94 g and 2648.31 g, respectively; $P>0.05$). As shown in the *Table 1,* in the last three fattening weeks group A consumed more feed (4117 g) than groups B and C (3950 g and 3744 g, respectively). Group A achieved the highest weight gain (2032 g), while groups C and B had almost equal gains (1887 g and 1852 g, respectively). The most favorable feed conversion was determined in group C (1.98 g/g), and then in groups A (2.03 g/g) and B (2.13 g/g).

In comparison with group C, presented research results indicated that modified feeding treatments for groups A and B affected the alteration of fatty acid profile in lipids of both breasts and thighs. As seen in *Table 2*, breast of group C contained higher portion of SFA than breasts of groups A and B ($P>0.05$). Content of SFA in thighs was statistically significantly lower in group A than in groups B and C (25.23%; 27.26% and 27.33%, respectively; $P<0.05$). Compared to groups C and A, statistically significantly higher portion of MUFA in broiler breasts and thighs was determined for group B, which was fed diets supplemented with fish and linseed oils (P<0.05). As broilers in groups C and A had diets with sunflower oil (5.0% and 2.5%, respectively), the portion of n-6 PUFA in their breasts (P<0.001; P<0.05) and thighs (P<0.001) was statistically significantly higher than of group B, which did not have sunflower oil added to diets.

Table 1

Total consumption, weight gain and feed conversion in the last three weeks of fattening

Fattening period	Indicators	Groups		
		C	A	B
4^{th}–6^{th} week	Consumption, g	3744	4117	3950
	Weight gain, g	1887	2032	1852
	Feed conversion, g/g of gain	1.98	2.03	2.13

C: 5.0% SO; A: 2.5% FO + 2.5% SO; B: 2.5% FO + 2.5% LO

Table 2

Content of fatty acids in broiler meat (% of total fatty acids)

Fatty acids	Groups		
	C	A	B
Breasts			
SFA	34.49±4.66	34.64±3.23	32.29±1.98
MUFA	$19.12±4.01^{b}$	$18.46±2.21^{bc}$	$24.34±1.69^{a}$
Σ n-6 PUFA	$36.23±3.71^{A}$	$31.67±3.18^{a}$	$25.62±0.96^{bB}$
Σ n-3 PUFA	$3.35±0.25^{C}$	$11.11±0.62^{B}$	$14.44±1.15^{A}$
Thighs			
SFA	$27.26±1.58^{a}$	$25.23±1.58^{b}$	$27.33±1.03^{a}$
MUFA	$22.91±1.62^{ab}$	$21.53±2.15^{b}$	$25.41±1.61^{a}$
Σ n-6 PUFA	$42.92±2.05^{A}$	$41.09±0.94^{A}$	$30.91±0.77^{B}$
Σ n-3 PUFA	$3.54±0.17^{C}$	$11.26±1.01^{B}$	$15.17±1.28^{A}$

^{a,b,c} P<0.05; ^{A,B,C} P<0.001

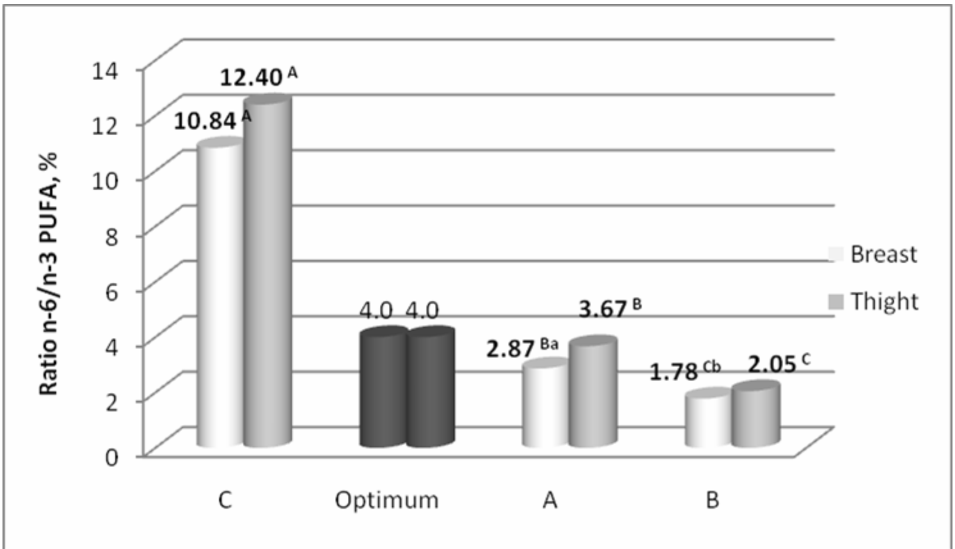
Supplementation of fish oil and linseed oil to diets fed to groups A and B resulted in the increased portion of n-3 PUFA in meat of breasts and thighs. Group B had statistically significantly higher (P<0.001) content of n-3 PUFA in breasts and thighs than groups A and C (breasts: 14.44%; 11.11% and 3.35%, respectively; thighs: 15.17%; 11.26% and 3.54%, respectively).

Some scientists stated that people had changed their nutritional habits as they had increased the favorable n-6/n-3 PUFA ratio of 1–4:1 per diet to the high 15–20:1 (*Simopoulos,* 1998; *Sanders,* 2000). According to previous results of *Kralik et al.* (2006) referring to n-6/n-3 PUFA ratio of broiler meat available on Croatian market, breast and thigh meat had the ratio of 9.07–11.40:1, and 11.04–15.55:1, respectively. In the present research into effects of broiler diet modification, the n-6/n-3 PUFA ratio was reduced from 10.84% to 1.78% in breast muscles, and from 12.40% to 2.05% in thigh muscles

(*Figure 1*). Costs of feed per each group (C, A and B), as well as total costs of production per one broiler are presented in *Table 3* and *Table 4.*

Figure 1

The n-6/n-3 PUFA ratio in broiler meat



[a,b] $P<0.01$; [A,B,C] $P<0.001$

Table 3

Costs of diets according to feeding treatments

Groups	Cost of diets (€/kg)		Diet consumption (kg)		Costs of feed (€/kg)		Broiler weight (kg)
	ST	F1	ST	F2	ST	F3	
C	0.336	0.336	1.090	3.744	0.366	1.25	2.713
A	0.336	0.318	1.090	4.117	0.366	1.31	2.836
B	0.336	0.356	1.090	3.950	0.366	1.41	2.648

ST: starter mixture; F: finisher mixture/1, 2, 3 different groups

As presented in *Table 3,* costs of fattening were equal in all groups for the first three weeks of fattening as all broilers consumed the same starter mixture. Differences with respect to feed costs occurred when broilers started to consume different finisher mixtures. Costs of feed depended on the type of supplemented oil. Finisher diets for groups C, A and B cost 0.336 €/kg, 0.318 €/kg, and 0.356 €/kg, respectively. Costs of feed over three experimental weeks of fattening per kg of live weight depended on the amount of consumed feed and end weight of broilers. Costs per kg of live weight were the lowest for group A, followed by groups C and B (1.38 €/kg, 1.43 €/kg, 1.51 €/kg, respectively). Considering the research objective (enrichment of broiler meat with omega 3 fatty acids), differences in costs per kg of feed were justified.

Table 4

Total cost in broiler production (€/kg of live weight)

Groups	C	A	B
Fixed costs			
One-day chicken (€/pcs.)	0.68	0.68	0.68
Other costs* (€)	1.57	1.57	1.57
Total fixed costs (€/pcs.)	2.25	2.25	2.25
Variable costs			
Costs of diets (€/pcs.)	1.63	1.67	1.77
Total costs			
Total costs (€/pcs.)	3.88	3.93	4.03
Costs (€/kg of live weight)	1.43	1.38	1.51

* water, electricity, litter, vaccination, labor

CONCLUSIONS

On the basis of obtained research results, it can be concluded that supplementation of different oils (sunflower, fish and linseed oil) to broiler diets affected the change of fatty acid profile in broiler meat. Furthermore, modification of broiler diets resulted in lowering of the n-6/n-3 PUFA ratio from 10.84%:1 to 1.78%:1 in breasts, and from 12.40%:1 to 2.05%:1 in thighs. However, it should be emphasized that modification of broiler diets through supplementation of different oils affected the costs per kg of broiler feed and consequently the costs per kg of live weight (C 1.43 €/kg, A 1.38 €/kg and B 1.51 €/kg). But, if considering the production objective, which was to enrich broiler meat with omega 3 fatty acids, differences in costs per kg of feed, as well as in costs per kg of live weight are acceptable and justified.

REFERENCES

Ajuhay, A.O., Lee, K.H., Hardin, R.T., Sim, J.S. (1991). Changes in the yield and in the fatty acid composition of whole carcass and selected meat portions of broiler chickens fed full-fat oil seeds. Poultry Science. 70. 2304-2314.

Kralik, G., Škrtić, Z., Galonja, M., Ivanković, S. (2001). Chicken Meat in Human Nutrition for Health. Poljoprivreda. 7. 32-36.

Kralik, G., Gajčević, Z., Hanžek, D. (2006). Quality of Chicken Carcass and Meat Within the Domestic Market. Krmiva. 48. 89-68.

Sanders, T.A.B. (2000). Polyunsaturated fatty acids in food chain in Europe. Am. J. Clin. Nutr., 71. 176-178.

Scaife, JR., Moyo, J., Galbraith, H., Michie, W., Campbell, V. (1994). Effect of different supplemental fats and oils on the tissue fatty acid composition and growth of female broilers. British Poultry Science. 35. 1. 107-18.

Simopoulos, A.P. (1998). Overview of evolutionary aspects of omega-3 fatty acids in the diet. World Rev. Nutr., 83. 1-11.

StatSoft Inc. (2005) Statistica for Windows v.7.1.

Statistical Yearbook of the Republic of Croatia (2009).

Corresponding authors:

Igor Kralik
Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture
HR-31000 Osijek, Trg sv. Trojstva 3., Croatia
Tel.: +385 31 224272; fax: +385 31 207015
e-mail: ikralik@pfos.hr