Agronomy Research **9** (Special Issue II), 383–388, 2011

Production and Expenses of Enriched Composition Broiler Chicken Meat in Latvia

S. Cerina, V. Krastina and I. Vitina

Research Institute of Biotechnology and Veterinary Medicine "Sigra" of Latvia
University of Agriculture, Institūta 1, Sigulda, Latvia; LV–2150, e–mail: sigra@lis.lv

Abstract. Enriched composition of broiler chicken meat, in comparison with commercial mass production, contains increased levels of ω–6 and ω–3 fatty acids and carotenoids complex, which positively influence human health and prevent risk factors that cause various diseases. The aim of the investigations was to evaluate the possibility of obtaining an enriched composition broiler chicken meat and to evaluate the expenses of production in bio-economic aspects by using vegetable oils that contain an increased amount of ω–6 and ω–3 fatty acids level and an additive of carotenoids complex "Karotinas V". The feeding trial was carried out with cross ROSS 308 broiler chickens ranging in age from 1–42 days (n = 300). It was concluded that the combination of oils in broiler chicken feed for producing enriched composition meat is 1.0% flax seed, 1.0% rapeseed and 2.0% soybean oils and 0.1% carotenoids complex. Use of the composition resulted in broiler chicken meat with 27.4% ω–6 and with 8.3% ω–3 fatty acids in total lipids, which is about 3.9% and 3.2 % higher than in the commercial product. Poultry organism metabolic processes are essential factors that determine the carryover levels of fatty acids and carotenoids from feed to meat, and it is impossible to precisely evaluate and calculate these physiological processes in organisms, economically. In the trial, the expense of feed consumption per 1,000 broiler chickens was higher than by using commercial feed but increased the broiler chickens' live weight, providing a possible 15% increase in total sales revenues for 1,000 broiler chickens. The tested combination of oils resulted in increased levels of ω–6 and ω–3 fatty acids in broiler chickens' tissue: as a result, income was higher in the experimental group.

Key words: broiler meat, expenses, fatty acids

INTRODUCTION

In Latvia, poultry meat plays a significant role in the meat production sector. Consumers' demand for quality, healthy poultry meat products is increasing. Good quality and healthy poultry meat is characterised by a high content of polyunsaturated fatty acids (ω–6 and ω–3), vitamins, anti–oxidants (carotenoids) and mineral substances, and low level of saturated fatty acids and cholesterol (Holub, 2002; WHO, 2003). Researchers in Estonia have studied possibilities for increasing ω–6 and ω–3 fatty acids in broiler chicken, quail meat and fat (Hämmal et al., 2000; Tikk et al., 2002). Unfortunately production of enriched composition poultry meat containing an increased omega group fatty acids and carotenoids level has not been developed in Latvia. However, Latvia has every possibility to do so, based on the following:

production of the necessary feeding stuffs for producing enriched composition broiler chicken meat with an increased ω–6 and ω–3 content, the breeding of highly productive avian crosses, and an annual growth tendency related to the poultry consumption and production rate.

To obtain broiler chicken meat of an enriched composition, poultry daily ration was enriched with fatty acid–containing feeding stuffs: flaxseed and rapeseed oils in combination with conventionally used oils in poultry feeding: soybean and sunflower oils. It has been recorded that chickens could modify their lipid profile within a week after replacement of the dietary lipid source (Lopez–Ferrer et al., 2000). Therefore, there is considerable potential for the manipulation of the fatty acid profiles of poultry tissue by dietary means, thus increasing the supply of ω–3 suitable for human consumption (Coetzee & Hoffman, 2002).

Production of enriched composition meat requires additional expenses, possibly significantly increasing sale price. The price difference is primarily due to the costs of additional feeding stuffs included in the avian feed (Michella & Slaugh, 2000). The research aim is to assess economic aspects for production of enriched broiler chicken meat in trial conditions. The following tasks are defined to achieve the set of aims:

- to clarify the quality of available feeding stuffs, doses and costs of avian feeding for the production of enriched composition meat;
- to verify avian productivity and the quality of enriched composition broiler chicken meat as a result of practical trials;
- to assess production costs and possible revenues of enriched composition broiler chicken meat.

MATERIALS AND METHODS

The feeding trial was carried out with cross ROSS 308 broiler chickens, ranging in age from 1–42 days (n = 300; Table 1).

Table 1. Trial scheme for production of enriched composition broiler chicken meat.

Group	Feeding programme
Group 1–control**	Basic feed (BF)* content 4.0% soybean oil
Group 2–trial**	BF content 2.0% soybean oil, 1.0% rapeseed oil, 1.0% flaxseed oil and 0.1% carotenoids complex (feed additive “Karotinas V”-Lithuania)

* the content complies with the standard requirements

** in group 75 male and 75 female broilers

Nutritive value (ME, CP, Met, Lys, Fat, Mineral, Vitamine et al.) of the basic feed was the same for both broiler chicken groups. Broiler chickens of the control group were fed with basic feed containing 4.0% soybean oil. Basic feed of the trial group contained a combination of oils (4.0%): 2.0% soybean oil, 1.0% rapeseed oil and 1.0% flaxseed oil and 0.1% carotenoids complex additives containing antioxidants to increase the content of ω–3 and ω–6 fatty acids, and antioxidants carotenoids in the feed.

RESULTS AND DISCUSSION

The production of enriched composition broiler chicken meat, which was compared with commercial production broiler chicken meat, contained an increased ω–6 and ω–3 level and required avian feed that consists of fatty acid containing feeding stuff – seed oils (flaxseed, rapeseed, soybean). Thus the content of ω–6 and ω–3 fatty acids and costs per dose were assessed in locally produced (in Latvia) rapeseed and flaxseed oils. The content of these fatty acids in imported soybean oil frequently used in poultry farming was analysed comparatively (Table 2).

Table 2. Content and ratio of fatty acids in vegetable oils.

Parameters	ω–3, % of total lipids	ω–6, % of total lipids	ω–6:ω–3
Flaxseed oil	55.0	13.0	0.2:1.0
Rapeseed oil	9.0	20.0	2.8:1.0
Soybean oil	8.0	54.0	6.8:1.0

The largest ω–3 fatty acid content was in flaxseed oil amounting to 55.0%, which exceeded the respective level in rapeseed and soybean oils by 6–7 times. The largest ω–6 amount was in soybean oil amounting to 54.0% of total lipids, which was 3–4 times higher than in rapeseed and flaxseed oils (Table 2).

Rapeseed and soybean oils are almost equivalent in ω–3 content, but rapeseed oil contains a lower content of ω–6 fatty acids.

Flaxseed oil contains the most balanced amount ratio of ω–6 and ω–3 fatty acids, i.e. 0.2:1.0. Consequently to produce more economically profitable enriched composition broiler chicken meat with a higher content of ω–6 and ω–3 fatty acids and a more optimal ratio of fatty acids, the following oil blend shall be included into the feeding stuffs: oil with the highest and cheapest level of ω–3 fatty acids and oil with the highest and cheapest level of ω–6 fatty acids. Out of analysed oils, a blend of rapeseed oil and flaxseed oil correspond to such a test.

Basic parameters of broiler productivity are as follows: live weight, live weight gain, feed consumption and costs. During the trial period broiler chicken productivity was high. The average live weight for broiler chickens of sales age ranged between 2,822–3,044 g with the live weight gain per day equalling to 66.21–71.49 g (Table 3).

When using feed enriched with ω–6 and ω–3 fatty acids and carotenoids, the live weight of broilers and live weight gain per day were higher by 7.87% and 7.98% respectively than for broilers of the control group.

Table 3. Productivity of a broiler chicken.

Parameters	Group 1 – control	Group 2 – trial
Broiler chickens age daily live weight, g	41.30	41.30
Broiler chickens live weight at the age of 42 days, g	2,822.00	3,044.00
% to control	–	7.87
Live weight gain per day, g	66.21	71.49
% to control	–	7.98
Survival, %	98.00	99.00

During the breeding period, each broiler chicken consumed the following feed amount on average: in control 5.40 kg and trial 5.20 kg (Table 4).

Table 4. Feed consumption and feed costs in trial.

Parameters	Group 1 – control	Group 2 – trial
Feed consumption per one broiler during the breeding period, kg	5.40	5.20
Feed consumption for production of 1 kg live weight, kg	1.91	1.71
% to control	–	10.47
Feed price of 1 kg, LVL	0.207	0.220
% to control	–	6.30
Total feed costs for breeding one bird, LVL	1.12	1.14
% to control	–	1.79
Feed costs for production of 1 kg live weight gain, LVL	0.40	0.38
% to control	–	5.00

The costs of 1 kg feed fed to broilers ranged between LVL 0.207 and LVL 0.220. The mixture of oils included in the feed and costs of antioxidant doses were the factors determining the amount of feed costs in the trial group. Feed cost difference was LVL 0.013 or 6.3% compared with the control group (price in Latvia, 2010).

Feed consumption for production of 1 kg live weight was by 10.47% less than in the control group. Feed costs (0.38 LVL per kg) for production of 1 kg live weight gain were less than for the control group, mainly due to the fact that broiler chickens of the trial group had higher live weight gain per day.

Feeding broilers with control group feed broiler chickens meat in average contained 23.5% of ω–6 and 5.4% of ω–3 fatty acids of total lipids and 0.62 mg kg^{-1} carotenoids (Table 5).

Table 5. Quality indices of enriched composition of broiler chicken meat.

Parameters	Group 1 – control	Group 2 – trial	± to control
∑ ω–6 fatty acids, % of total lipids	23.50	27.40	3.90
∑ ω–3 fatty acids, % of total lipids	5.40	8.30	3.20
∑ (ω–6):∑(ω–3)	4.30:1.00	3.30:1.00	−1.00:1.00
∑ total carotenoids, mg kg^{-1} (antioxidant)	0.62	0.86	0.24

The use of the oil composition with 2.0% soybean, 1.0% rapeseed, 1.0% flaxseed oils and 0.1% of carotenoids complex, resulted in broiler chicken meat of the trial group with 27.4% ω-6 and with 8.3% ω-3 fatty acids in total lipids and 0.86 mg kg^{-1} total carotenoids. This content was about 3.9 and 3.2% of ω-6 and ω-3 fatty acids and 0.24 mg kg^{-1} carotenoids higher than in the commercial product.

Costs for the production of enriched composition meat were calculated to economically justify the developed variants of feed content enriched with fatty acids and the profitability of their application (Table 6). The calculations included the

productivity of the trial group broilers, average sales price of a broiler carcass, feed costs and other costs in Latvia in 2010.

Table 6. Revenues and expenses for breeding 1,000 broiler chickens for the production of enriched composition meat (according to the average trial data).

Parameters	Group 1 – control	Group 2 – trial
Number of broilers	1,000	1,000
Broilers survival, %	98.00	99.00
Average live weight of broilers at the age of 42 days, g	2,822.00	3,044.00
Total live weight of breeding broilers, kg	2,765.56	3,013.56
Total carcass weight of broilers, kg*	2,184.79	2,380.71
Carcass weight, kg ± vs. Group 1	–	195.92
Price of 1 kg carcass weight, LVL	1.60	1.60
Revenues for sales of carcass weight, LVL	3,495.67	3,809.14
Revenues, LVL ± vs. Group 1	–	313.47
Feed costs for growing 1,000 broilers, LVL	1,120.00	1,140.00
Other costs (excluding feed costs), LVL	523.33	523.33
Total costs, LVL	1,643.33	1,663.33
Difference between revenues and expenses, LVL	1,852.34	2,145.81
Profit, LVL ± vs. Group 1, LVL	–	293.47
Profit, LVL % Group 1, LVL	–	15.8

*live weight of broilersresults in 79% of carcass weight (according to the standards)

By using feed enriched with fatty acids, the total carcass weight of enriched composition broilers was by 195.92 kg bigger (per 1,000 broilers) than the carcass weight of the control group broilers. Revenue for sales of carcass weight was by LVL 313.47 higher in comparison with the control group. Total costs for producing enriched composition meat (feed consumption et al.) was by LVL 20.00 higher than for the control group. Profit from sales of enriched composition meat were by LVL 293.47 or 15.8% larger (per 1,000 broilers) than from the sales of the control group of broiler chickens. These better financial results were obtained because of the poultry survival indicator and the larger total live weight of trial broiler chickens.

CONCLUSIONS

1. By feeding broiler chickens with feed containing combination of oils - 2.0% of soybean, 1.0% of rapeseed, 1.0% of flaxseed oils and 0.1% of carotenoids complex "Karotinas V" - it was possible to produce enriched composition broiler chicken meat containing an increased amount of ω–3 fatty acids by 3.2% (8.3% of total lipids) and ω–6 fatty acids by 3.9% (27.4% of total lipids) and carotenoids by 0.24 mg kg^{-1} (0.86 mg kg^{-1}) in comparison with the control group.

2. Feed costs for production of enriched composition broiler chicken meat were by 6.28% higher than in a control feeding variant, although feed consumption for production of 1 kg live weight was by 10.47% less compared with the control group.

3. The potential profit from sales of enriched composition meat was by LVL 293.47 or 15.8% larger (calculating per 1,000 broilers) than from the sales of the control group broiler chickens.

REFERENCES

Coetzee, G. J. M. & Hoffman, L. C. 2002. Effects of various dietary n-3/n-6 fatty acids ratios on the performance and body composition of broilers. *S.Afr.J.Anim.Sci*, **29**, 175–184.

Hämmal, J., Tikk, V., Tikk, H. & Kuusik, S. 2000. On Affecting the Fatty Acids Composition of the Chicken Broilers` Fat. In Perkkiö S. (eds), Eighth Baltic Poultry Conference in Finland, Proceeding, Turku, pp. 22–24.

Holub, B. J. 2002. Clinical Nutrition: 4. Omega – 3 Fatty Acids in Cardiovascular Care. In *Can. Medical. Assoc*. **I**., 608–615.

Lopez-Ferrer, S., Baucells, M. D., Barroeta, A. C. & Grashorn, M. A. 2000. n–3 Enrichment of chicken meat. 1. Use of very long-chain fatty acids in chicken diets and influence on meat quality: Fish oil. *Poult.Sci*. **80**, 741–752.

Michella S. M. & Slaugh B. T. 2000. Producing and Marketing a Specialty Egg. In *Poultry Science*, **79**, (7), 975–976.

Tikk, H., Hämmal J., Tikk, V. & Kuusik, S. 2002. On Increasing ω-3 Fatty Acid Content in Quail Meat and Fat. In Sirvydis V. (eds) 10 th Baltic Poultry conference, Vilnius, pp. 68–72.

WHO, 2003. Population nutrient intake goals for preventing diet – related chronic diseases. In WHO Technical report series, 916. Diet, nutrition and the prevention of chronic disease. World Health Organization, Geneva, pp. 54–60.