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Influence of Addition of Linseed on the Diet on Meat Quality of Piglets

Đorđe Okanović[1], Dragan Palić and Nebojša Ilić
Institute for Food Technology, Bulevar cara Lazara 1, 21 000 Novi Sad, Serbia

Abstract: The aim of this study was to estimate the influence of diet supplemented with linseed rich additive under commercial name Vitalan on omega-fatty acids content in piglet meat. The main ingredient in Vitalan is extruded linseed, that contribute the diet is rich in omega-3 fatty acids. Piglets were divided in control and experimental group and reared to 33 kg of average live weight. Experimental group was fed the standard diet enriched with 2.5% of Vitalan. After the end of fattening period, the meat samples from both groups were analyzed for omega-3 and omega-6 fatty acids content in raw and oven- roasted meat. The ratio between omega-6 and omega-3 acids was established. Additionally, other parameters, such as weight gain, health and behaviour of piglets were observing during the study. The treatment with linseed enriched diet resulted in higher omega-3 acids content, which lowered ratio between omega-6 and omega-3 acids in meat, thus making it better for a human nutrition from a health perspective.

Keywords: piglets, extruded linseed, meat, omega fatty acids

Introduction

Animal production is the most intensive branch of agricultural production and it is very significant segment of industry for manufacturers as well as for processors (slaughter house industry) and consumers. An increase of animal production is the base for improvement of nutrition via high quality animal products for ever growing consumer population. Animal products are high quality foods, with particular nutritive and biological attributes, so that they are irreplaceable for regular nutrition and represent basic sources of valuable proteins. Also, there is good opportunity to export these products, giving them strategic character in food supply chain (Okanovic, 2007).

In the developed part of the world there is a general agreement in terms of a clearly defined attitude according to which the quality is primary importance and a major competitive advantage, while the quantity itself is only one of the integral elements of quality (Okanović at al. 2006).

It is now generally recognized that dietary fats play an important role in human health. Among dietary fats major role belongs to polyunsaturated fatty acids (PUFA) with n-3 PUFA being most beneficial for human health. There is a great deal of evidence that n-3 PUFAs have anti-inflammatory, antithrombogenic and hypotriglyceridemic properties, they inhibit the formation of atherosclerotic plaques, prevent arrhythmias and have activity against some cancers such as breast, colon and prostate cancer (Rose and Conolly , 1999; Connor, 2000). At the same time increased levels of n-6 fatty acids are associated with an increase in chronic diseases (Givens et al., 2006). Because of n-3 PUFA beneficial effects and the fact that western diet is very rich in n-6 fatty acids (Enser et al., 2000) the nutritional authorities have recommended the diet rich in n-3 polyunsaturated fatty acids and that n-6/n-3 ratio should be lowered to between 1 and 4 instead of the current 15-20:1 (Simopoulos, 2002).

One way to improve this ratio is by modifying the fatty acids composition in meat, which is important part of human diet and natural source of fatty acids. Animal diet determines the fatty acid composition in meat and by changes in the diet, fatty acids ratio in meat and its nutritional value can be modified. This

[1] Corresponding author, e-mail: djordje.okanovic@fins.uns.ac.rs

is usually done by feeding animals with the feed which is enriched with fish oil or fish meal as sources of n-3 (omega-3) PUFAs or by feeding with meals containing seeds or oils rich in n-3 fatty acids (Raes et al., 2004; Kouba, 2003).

The aim of this study was to investigate the influence of supplemented linseed diet rich in n-3 (omega-3) polyunsaturated fatty acids on fatty acid composition and in particular omega-3 fatty acid content and n-6/n-3 ratio in raw and roasted pork meat.

Materials and Methods

Animals and diet

The total 24 pigs, Pietrain x (Landrace x Great Yorkshire) were used in the study. The first study has been conducted at the pig farm 'Sabo Janos', Jermenovci, Serbia. The piglets were divided into two groups and fed with two types of diet, a standard diet and diet enriched with Vitalan (Vitalac, France). Piglets from control group were fed the common diet and experimental group was fed the standard diet enriched with 2.5% of Vitalan. Vitalan contains 85% extruded linseed and the rest are wheat bran and antioxidants. The composition of both diets is shown in Table 1. The piglets were fed from the weaning, at 35 days of age, till the age of 79 days, and approximatly 33 kg of live weight, when they were slaughtered. Total feed consumption, daily weight gain and feed conversion ratio were monitored. The animals were fed *ad libitum*.

Table 1. Composition of experimental diets for piglets

	Control group	Experimental group
Vitalan	-	2.5%
Vitamins	8.0%	8.0%
Acidifier	2.0%	2.0%
Maize	38.0%	38.0%
Barley	31.8%	29.3%
Soybean meal	20.0%	20.0%
Mineral adsorbents	0.2%	0.2%
Total	100.0%	100.0%

Slaughter and sampling

The animals were slaughtered and samples of meat (*m. longissimua dorsi*), 6 pieces (200g each) from both groups were collected and kept in the refrigerator at 4^0C. A half of the samples were roasted in the oven at the temperature of 80-85^0C until the temperature in the centre of the meat reached 69^0C (approximately 1 hour). After 24 hours, the samples were sent to the laboratories of Food Technology Institute in Novi Sad, where fatty acid analysis and sensory evaluation were performed.

Fatty acid analysis

The preselected meat samples were homogenized with food processor and fat was extracted from 1 g of each sample. From the extracted lipids fatty acid methyl esters were prepared with boron trifluoride/methanol solution. Obtained samples were analyzed by a gas chromatograph Agilent 7890A system with FID, auto-injection module for liquid and headspace sampling, equipped with fused silica capillary column (DB-WAX 30 m, 0.25mm, 0.50 um). The fatty acids were identified by comparison with standards from Supelco 37 component FAME mix and data from PUFA NO.2, Animal source BCR-163 beef/pork fat blend. Results were expressed as mg of fatty acids per 100 g of tissue (mg/100g) and as a ratio between omega-6 and omega-3 fatty acids.

Results and discussion

All piglets were healthy, vivacious, without visible clinical symptoms, similar in size and shape, with shiney bristles. Results of monitoring the avarage weight, average weight gain, total feed consumption and feed conversion ratio are shown in the Table 2.

From the results shown in Table 2, it is evident that piglets from the treatment group fed with diet enriched with extruded linseed (Vitalan) consumed 40 kg of feed while the piglets from the control group fed with the diet without enrichment consumed 45 kg of feed. Even though they consumed less feed, the piglets from the treatment group, with Vitalan enrichment, were more weighty (34 kg) than the piglets from the control group (32 kg).

Table 2. Average weight and weight gain of piglets, total feed consumption and feed conversion ratio

Group	Average weight, kg			Average weight gain, (kg/day)		Total feed consumption, (kg)	Feed conversion ratio, (kg/kg)
	0	35th day	79th day	1-35 day	35-79 day		
Control	1.70	9.50	32.00	0.209	0.477	45.00	2.14
Experimental	1.70	10.00	34.00	0.251	0.557	40.00	1.63

The daily weight gain of piglets fed with Vitalan enrichment had higher weight gain (557 g daily) than the piglets from the control group (477 g).

Piglets from the experimental group that were fed the extruded linseed diet, had better feed utilization compared to the control group, as shown by feed conversion. The feed conversion ratio in the treatment group was 2.14 kg of feed per 1 kg of weight gain, while in the control group was 1.63 kg/kg per 1 kg.

The results of this study showed that piglets fed by feed mixture enriched with extruded linseed (Vitalan) had better performances than piglets from the control group.

Various diet affected the meat quality. Sensory evaluation gave unanimous opinion that roasted meat of piglets fed the enriched diet had pleasant colour and, it was juicy, soft and of superb taste.

Fatty acid composition (table 3) confirmed that meat is high quality from the health aspect (Table 3.).

Obtained results shown in the table 3, it is evident that linseed enriched diet resulted increasing omega-3 fatty acid content in the experimental group (5.27 mg/100 g of meat) compared to the control group (0.54 mg/100 g of meat). It noticeably contributes to the more favourable omega-6/omega-3 ratio in the experimental group (3.79) in the comparison to the control group (23.97).

Table 3. Omega fatty acids content in piglet meat (mg/100g of meat)

Group		Omega-3		Omega-6		Omega-6/Omega-3	
		mg/100g meat	Sd	mg/100g meat	Sd	mg/100g meat	Sd
Fresh meat	Control	0.54	0.11	13.07	2.89	23.97	0.70
	Experimental	5.27	0.37	19.97	1.01	3.79	0.08
Roasted meat	Control	0.62	0.14	12.58	1.47	20.77	4.25
	Experimental	3.96	1.37	17.92	2.23	4.77	1.12

Similar results were obtained with roasted meat. Omega-3 fatty acid content is higher in the roasted meat fed with enriched diet (3.96 mg/100 g of meat) than in meat from the control group (0.62 mg/100 g of meat). Also, the omega-6 to omega-3 ratio was much more favourable in the treatment group (4.77) than in the control group (20.77).

Conslusion

Based on the results of this study, it can be concluded.

Piglets fed diet enriched with extruded linseed (experimental group) compared to the control group achieved higher weight (35 kg compared to 30 kg) with lower feed consumption (40 kg compared to 45 kg).

Piglets from the experimental group compared to the control group had a better feed conversion ratio (1.63 compared to 2.14 kg of feed per kg of weight gain) and better daily weight gain (557 g compared to 477 g).

Omega-3 fatty acids content in the fresh piglet meat of experimental group was much higher than in the control group (5.27 compared to 0.54 mg/100 g of meat) due to that the ratio of omega-6 to omega-3 fatty acids is much more favourable in the experimental group (3.79) compared to the control group (23.97).

Omega-3 fatty acids content in the roasted meat was much higher in the experimental group than in the control group (3.96 compared to 0.62 mg/100 g of meat) which also makes the omega-6 to omega-3 fatty acids ratio much more favourable in the experimental group of piglet (4.77) compared to the control group (20.77).

From the data presented in this study it is evident that use of the extruded linseed enriched diet significantly elevated the content of omega-3 fatty acids and improved the ratio of omega-6 and omega-3 fatty acids to the desired level of approximately 4.

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