THE DIFFERENCES IN THE CONTENT OF FATTY ACID IN THE MUSCLE AND FAT OF MANGALICA BREED INFLUENCED BY THE ADDITION OF FLAX AND SUNFLOWER IN THE FEED

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Abstract

The aim of the experiment was to determine the impact of flax and sunflower in the diet on the content of fatty acid in the meat and fat of mangalica breed. The experiment included 18 pigs of mangalica breed. The pigs were divided into the group of 8 pigs fed by the addition of flax and the group of 10 pigs fed by the addition of sunflower. The groups have equal sexes. The experiment was conducted from 30 to 100 kg live weight. Samples for the analysis of fatty acids were taken from the *musculus longissimmus dorsi* (MLD), *musculus semimembranosus* (MSM), *musculus aductor* (MA) and backfat and kidney fat. The selected groups of fatty acids were determined from the homogenate of muscle res. fat tissue using FT IR Nicolet 6700. The experimental groups were compared by the analysis of variance using SPSS-20. From the results we can conclude that in the group fed by the addition of flax, we found a higher content of polyunsaturated fatty acids in all the analyzed samples of muscle and fat, the saturated fatty acids were higher in the group fed sunflower diet. These differences were statistically no significant. Statistical significance at $P<0.05$ was confirmed only in the difference between the oleic acid in MLD, MA and stearic acid in the MSM. It was found no statistical difference in the content of fatty acids in fat of any of the monitored parameters.

Key words: fatty acids, sunflower, flax, meat and fat, pigs

It is reported that a higher content of flax in the diet should lead to a higher content of polyunsaturated fatty acids in pork. Levels of nutrients in the feed mixture may be influenced by the different nutrients composition and their content in the feed mixture (Kodeš et al., 2001). The addition of linseed has an impact on the quality of fat (Vehovský et al., 2012), while it affects the percentage of lean meat (Okrouhlá et al., 2012). Linseed has a higher content of MUFA and PUFA. But there is a difference between the requirements of consumers and producers. Consumers are interested in a higher content of PUFA by reason of healthier diet, while the increase in the PUFA brings producers complications in the durability of meat and fat (Warnants et al., 1999). In hog breeding it tends to increase the n - 3 PUFA and decrease n - 6 PUFA in fat (Azain, 2004). Their content can be significantly influenced by the composition of fat in feed mixture for growing pigs. This can be achieved by using the feed that will include linseed (Wood et al., 2004; Václavková, Bečková, 2007).

Material and Methods

In the study, 18 pigs of mangalica breed were used. The pigs were divided into a group of 8 pigs fed by addition of flax (4 barrows and 4 gilts) and experimental group of 10 pigs fed by the addition of sunflower (5 barrows and 5 gilts). Both groups of pigs were fed the same diet, the difference was in the content of flax and sunflower in the diet represented by 10%.

The fattening period in pigs lasted from 30 to 100 kg. The pigs were slaughtered at an average live weight of 103,5 kg and the dissection of carcasses was done according to standard practices STN 466164.

Samples for the analysis of fatty acids were taken from the thoracic vertebrae (MLD), thigh (MSM and MA), backfat and kidney fat during the dissection of the right half carcass 24 hours *post mortem*. Carcasses were chilled at 3 –4°C overnight. The samples from the meat and fat (50 g) were labelled separately and stored frozen at -19°C ±0.5°C for 14 days until analysis.

Selected groups of fatty acids were determined from samples of muscle and fat using the FT IR method (Nicolet 6700). The analysis of infrared spectra of muscle res. fat homogenate was done by the method of molecular spectroscopy. The experimental groups were compared by the analysis of variance and the basic statistical parameters were done using software package SPSS-20.

Results and Discussion

From our results we can conclude that in the fat of selected muscles, we observed a higher content of unsaturated fatty acids in the group of pigs fed sunflower mixture, while the content of monounsaturated and polyunsaturated fatty acids was higher in the group of pigs fed linseed. In the fat deposit, we found similar tendency in the fatty acid content, as in the muscles. The differences between the experimental groups were not statistically significant. A statistically significant difference was found in the content of oleic acid, while the group fed linseed have showed lower values in MLD and MA compared to the group fed sunflower. The higher content of stearic acid in the MSM was found in the group fed sunflower, the difference was statistically significant at P <0.05. Więcek et al. (2010) showed that animals fed mixture which contained oil from linseed, reached a higher content of n - 3 PUFA from fatty acid profile in the thigh and backfat what was confirmed in our experiment but there were no statistically significant differences between the groups of the fatty acids. According to Vehovský et al. (2012) it was found that 15% linseed in the feed mixture of pigs can affect the composition of fatty acids positively in the backfat, which is reflected in a reduced SFA and increased n - 3 PUFA in the selected tissue, what is consistent with our results. D`Arrigo et al. (2002) reported that the addition of linseed in the feed mixture of pigs and related changes in the profile of n - 3 fatty acids were showed in neutral lipids of fat deposit, as also in the structural lipids of muscle, what was evident even in our results but without the statistical significance. According to reports of Kouba et al. (2003) and Azain (2004), was showed that the addition of linseed in the pigs' diet can increase the content of n - 3 PUFA without negative impact on the quality of slaughtered animals, it was showed in our results and confirmed in the thigh of muscles and fat deposit.

Table 1. Composition of the diets

Components	**Sunflower mixture**	**Flax mixture**
Barley	10,00 %	10,00 %
Wheat 11 %	10,00 %	10,00 %
Corn	50,00 %	50,00 %
Soybean meal	10,00 %	10,00 %
Premix	3,00 %	3,00 %
Sunflower/flax	10,00 %	10,00 %
Lucerne	7,00 %	7,00 %

Table 2. Nutrient composition of the complete feed mixtures (fatty acids in g.100g FAME)

Nutrients	**Sunflower mixture**	**Flax mixture**	**Nutrients**	**Sunflower mixture**	**Flax mixture**
Dry matter	89,81%	89,79 %	Fat	6,79%	5,23 %
ME_0	13,04 MJ	12,68 MJ	Palmitic acid	8,70	8,34
NL	13,26%	13,75 %	Stearic acid	2,56	2,57
Lysine	8,20 g	8,21 g	Oleic acid	32,60	18,33
CysH	2,78 g	2,95 g	Linoleic acid	63,89	52,69
MetS	2,71 g	2,88 g	Alfa-*linoleic acid*	0,77	4,49
Threonine	7,72 g	4,68 g	Polyunsaturated fatty acids	53,46	68,38
Tryptophan	4,24 g	4,53 g	Monounsaturated fatty acids	32,95	18,54
Crude protein	6,93 %	7,36 %	Saturated fatty acids	11,98	11,66

Conclusion

The meat from mangalica has a higher content of PUFA and MUFA but lower content of saturated fatty acids. Higher content of linseed in complete feed mixture influenced the content of fatty acid, which improved the rate between MUFA / PUFA by reducing the percentage of MUFA and increasing PUFA. A lower ratio of MUFA / PUFA is more suitable for human health, such as preventing the development of lifestyle diseases. It is also important the lower ratio of n - 6 / n - 3 PUFA.

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Table 3. The content of fatty acids in the selected muscles of mangalica breed fed flax and sunflower supplement in the feed

Trait	flax MLD (n=8) mean±sd	sunflower MLD (n=10) mean±sd	flax MA (n=8) mean±sd	sunflower MA (n=10) mean±sd	flax MSM (n=8) mean±sd	sunflower MSM (n=10) mean±sd
Saturated fatty acids	36,67±0,85	36,91±0,98	36,71±1,45	36,55±1,41	35,13±2,00	35,38±1,38
Monounsaturated fatty acids	50,98±1,59	50,67±1,48	48,91±1,41	49,26±1,21	53,59±1,59	52,98±1,68
Polyunsaturated fatty acids	12,34±1,02	11,85±0,87	14,15±1,73	13,20±1,23	10,52±0,83	10,08±1,85
ω3 polyunsaturated fatty acids	0,60±0,05	0,63±0,04	0,67±0,05	0,63±0,07	0,61±0,04	0,61±0,08
ω6 polyunsaturated fatty acids	10,89±1,03	10,39±0,91	13,02±1,96	12,19±0,83	8,86±1,06	8,74±1,87
Palmitic acid	24,47±0,22	24,41±0,11	24,44±0,14	24,38±0,15	24,33±0,16	24,38±0,15
Stearic acid	11,24±0,31	11,12±0,15	11,18±0,24	11,00±0,24	**10,96±0,21** [a]	**11,15±0,19** [b]
Oleic acid	**42,29±1,49**[a]	**43,91±1,11**[b]	**40,84±2,90** [a]	**43,30±2,70** [b]	44,44±2,82	44,67±4,09
Alfa linoleic acid	0,27±0,03	0,27±0,02	0,31±0,03	0,29±0,02	0,24±0,03	0,23±0,02

a,b P <0.05

Table 4. The content of fatty acids in the backfat and kidney fat of mangalica breed fed flax and sunflower supplement in the feed

Trait	Flax mixture backat (n=8) mean±sd	Sunflower mixture backfat (n=10) mean±sd	Flax mixture kidney fat (n=8) mean±sd	Sunflower mixture kidney fat (n=10) mean±sd
Saturated fatty acids	38,65±2,24	39,61±2,99	44,91±2,54	45,54±2,40
Monounsaturated fatty acids	51,86±2,28	50,80±1,84	45,41±2,19	44,96±2,08
Polyunsaturated fatty acids	9,53±0,62	9,43±0,84	9,39±0,86	9,09±0,63
ω3 polyunsaturated fatty acids	0,64±0,04	0,63±0,06	0,62±0,05	0,60±0,05
ω6 polyunsaturated fatty acids	8,45±0,46	8,38±0,64	8,28±0,62	8,10±0,54
Palmitic acid	23,75±1,03	24,16±1,02	26,28±0,83	26,41±0,83
Stearic acid	10,77±1,66	11,38±1,69	15,42±1,78	15,75±1,59
Oleic acid	44,36±2,21	43,52±1,44	38,99±1,71	38,62±1,51
Alfa linoleic acid	0,55±0,04	0,54±0,06	0,50±0,04	0,50±0,05

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