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EFFECT OF LINSEED AND SUNFLOWER SEEDS IN PIG DIET TO FATTY ACID CONTENT IN THE PORK FROM MANGALITSA

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ABSTRACT

The aim of study was to evaluate the effect of linseed and sunflower seed in diet of fattening Mangalitsa pigs on fatty acid content in the meat. Eighteen Mangalitsa pigs were divided into two groups: diet with 10 % of sunflower seed addition (group S) and diet with 10 % of linseed addition (group L). Pigs received feed mixture and water by *ad libitum system.* The fattening period lasted from 30 kg to 100 kg of body weight. The diet with linseed addition significantly increased proportion of oleic acid, vaccenic acid and DHA compared to diet with sunflower seed addition ($P < 0.05$). However, the total percentage of saturated fatty acid as well as polyunsaturated fatty acid in meat was increased by sunflower seed diet, but the total percentage of monounsaturated fatty acid was decreased compared with linseed

diet. It can be concluded, that there are not significance differences in total proportion of fatty acids in meat between diets with sunflower seed addition and linseed addition for fatteners of Mangalitsa with exception of differences in oleic acid, vaccenic acid and DHA.

Keywords: linseed; Mangalitsa; MUFA; PUFA; SFA; sunflower

INTRODUCTION

The Mangalitsa is a rustic pig breed and it is a typical representative of the fatty pig breeds. The average total mass consists of 30 % - 35 % meat and 65 % - 70 % fat tissue (Egerszegi et al., 2003). The fat of Mangalitsa is softer and easier to digest by human with higher content of polyunsaturated fatty acids compared to fat from pig meat breeds (Parunović et al., 2013).

Generally, pork meat is an excellent source of nutritive compounds which are essential in human nutrition (Cordis et al. 2015). Numerous factors such as genetic factors, breed, sex, energy intake as well as fatty acids composition of the diet influence the fatty acids content of the fatty and muscle tissues of pigs (Petrović et al. 2014). The fatty acid content of aliments is of highly great importance with respect to healthy human nutrition. While saturated fatty acids are regarded a risk factor for cardiovascular diseases, the polyunsaturated fatty acids are considered as assisting in the prevention of cardiovascular diseases (Csápo and Salamon, 2013).

Fatty acid content of pork can be easily manipulated trough the feeding regime. In pig diet, an emphasis is laid on the omega -3 fatty acid vegetable oils such as soy, olive, linseed, sunflower or rapeseed

(Václavková et al. 2015). The human nutritionists recommend a higher intake of polyunsaturated fatty acids (PUFA), especially n-3 PUFA at the expense of n-6 PUFA (Raes et al. 2004). The imbalance fatty acid intake such as ratio of PUFA: SFA or the ratio of n-6:n-3 PUFA, is a risk factor in cancer and coronary heart diseases. The recommended ratio of PUFA to SFA (P:S) should be increased to above 0,4 and ratio of n-6:n-3 PUFA less than 4 (Wood et al. 2003). According to Raes et al. (2004), several animal feeding goals have been carried out using different breeds aiming at bringing the PUFA/SFA ratio of meat closer to the recommended values more than 0.7 and for the n-6/n-3 ratio less than 5. Nowadays nutritionists have focussed on the type of PUFA and the balance in the diet between n-3 PUFA and n-6 PUFA (Wood et al. 2003).

The aim of study was evaluate the effect of diet with linseed addition and the diet with sunflower seed addition for pig fatteners in relation to fatty acid content in the pork from Mangalitsa breed.

MATERIAL AND METHODS

The experiment was carried out in the Experimental center of Animal at Slovak University of Agriculture in Nitra (SUA). The experimental material comprised of 18 pigs of Mangalitsa breed. The pigs were divided into two groups: group S (n=8), which received diet with 10 % of sunflower seed addition and group L (n=10), which received diet with 10 % of linseed addition. The composition of diets is presented in Table 1. The fatty acids composition of diets is shown in Table 3. The pigs were reared in the same outdoor intensive conditions and they received feed mixture and drinking water by *ad libitum* system.

The pen was consisted of concrete floor and the straw was used as bedding.

Table 1. Composition of diets for fatteners

Ingredients (%)	Diet S	Diet L
Corn	50	50
Barley	10	10
Wheat	10	10
Soybean meal	10	10
Sunflower seed	10	-
Linseed	-	10
Granuled alfalfa	7	7
Mineral and vitamin supplement[1]	3	3

[1]retihol 200 000 m.j., cholecalciferol 30 000 m.j., α-tocopherol 400 mg, riboflavin 80 mg, pyridoxine 30 mg, cyanocobalamin 1000 mcg, niacinamide 300 mg, folic acid 2 mg, pantothenic acid 300 mg, cholinchlorid 4000 mg, Cu 600 mg, Fe 3400 mg, Zn 1000 mg, Mn 1000 mg, I 30 mg, Se 8 mg.

Table 2. Fatty acids profile of diets for fatteners

Fatty acids profile (%)	Diet S	Diet L
PUFA	53,46	68,38
MUFA	32,95	18,54
SAFA	11,97	11,66
C:16 (palmitic)	8,3	8,7
C18:0 (stearic)	2,6	2,6
C18:1cis n9 (oleic)	32,6	18,3
C18:2n-6 (linoleic)	52,7	63,9
C18:3 n3 (alfa-linolenic)	0,8	4,5

Diet S: diet with 10 % of sunflower seed, Diet L: diet with 10 % of linseed

The fattening period lasted from 30 kg to 100 kg of body weight. Then pigs were slaughtered in the slaughterhouse of Experimental center of Animals. The day after the slaughter, the samples of *Musculus longissimus dorsi* (MLD) were taken from right half carcass for analyses of fatty acids profile. The fatty acids profile was analysed

by FT IR (Fourier Transform InfraRed) method. FT IR is method of infrared spectroscopy. An infrared spectrum represents a fingerprint of a homogenized sample with absorption peaks which correspond to the frequencies of vibrations between the bonds of the atoms making up the material.

The parameters of fatty acids profile were statistically analysed by the analyses of variance (ANOVA) using the Statistical Analysis System (SAS 9.2. using of application Enterprise guide 5.1, 2012). The means and standard error of mean (SEM) were calculated. Tukey's test was applied to compare the mean values of the groups with different feed mixture.

RESULTS AND DISCUSSION

The results of fatty acids profile in *Musculus longissimus dorsi* (MLD) are shown in Table 3. The percentage of lauric acid, palmitic acid and stearic acid were slightly increased in Group S compared to Group L. On the contrary, myristic acid was found negligible higher in Group L than in Group S. The total content of saturated fatty acids (SFA) was higher in Group S compared to Group L. Differences were not statistically significant, due to this fact the content of SFA was not influenced by the diet.

The diet with linseed significantly increased proportion of oleic acid and vaccenic acid in MLD compared to diet with addition of sunflower seed ($P < 0.05$), which is shown by total content of monounsaturated fatty acid (MUFA) in MLD. However differences of MUFA in MLD between groups were not statistically significant.

The linoleic acid, CLA, EPA, DPA as well as DHA ($P < 0.05$) were found higher in group L than in group S. However, the total percentage of polyunsaturated fatty acid (PUFA) was increased by the sunflower diet compared to linseed diet, but the differences between groups were not statistically significant. The content of n-6 PUFA was found higher in the group S, but n-3 PUFA was lower than in group L.

Table 3. The effect of two diets of fatty acids content of *m. longissimus dorsi*

Fatty acids profile (%)	Group S (n=8) Mean	Group L (n=10) Mean	SEM	P-values
C12:0 (Lauric)	0,068	0,066	0,002	n.s.
C14:0 (Myristic)	1,27	1,28	0,006	n.s.
C16:0 (Palmitic)	24,47	24,41	0,039	n.s.
C18:0 (Stearic)	11,24	11,12	0,056	n.s.
C18:1cis-9 (Oleic)	42,29	43,91	0,355	*
C18:1trans-11 (Vaccenic)	4,47	4,55	0,019	*
C18:2n-6 (Linoleic)	0,047	0,048	0,001	n.s.
CLA (Conjugated linoleic acid)	0,125	0,126	0,003	n.s.
C18:3n-3 (α linolenic)	0,266	0,266	0,006	n.s.
C20:5n-3 (EPA)	0,090	0,095	0,003	n.s.
C22:5n-3 (DPA)	0,137	0,141	0,002	n.s.
C22:6n-3 (DHA)	0,039	0,043	0,001	*
Total SFA	36,91	36,69	0,213	n.s.
Total MUFA	50,71	50,98	0,351	n.s.
Total PUFA	12,35	11,85	0,223	n.s.
Total n-3 PUFA	0,604	0,630	0,011	n.s.
Total n-6 PUFA	10,89	10,39	0,228	n.s.
Ratio n6 : n3	18,10	16,54	0,424	n.s.
Ratio PUFA : SFA	0,336	0,322	0,007	n.s.

Group A: diet with 10 % sunflower seeds Group B: diet with 10 % of linseed
SEM: Standard error of mean, SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty acids
n.s.: non-significant, *: $P < 0,05$

It can be concluded that total content of SFA, PUFA, MUFA in MLD were not significantly influenced by different diets for fatteners. While the diet with linseed addition significantly increased oleic and vaccenic acids as well as DHA in MLD of Mangalitsa. In the study of Cordis et al. (2015) was found lower percentages of total content of SFA, MUFA as well as PUFA in MLD from Mangalitsa compared to our results. The pigs were reared extensively and were fed only by grass and cereals without concentrates. According to Habeanu et al. (2014), the Mangalitsa breed fed by diet with linseed addition had higher content of SFA, PUFA in the intramuscular fat of MLD, but lower composition of MUFA compared to our study. However the profile of each fatty acid such as myristic acid, palmitic acid, stearic acid, oleic acid, EPA, DPA and DHA were similar with our results. Petrović et al. (2014) compared rustic pig breeds Moravka and Mangalitsa. The pigs received the diet with 5% sunflower oil meal addition. They determined decreased percentage of SFA as well as PUFA, but increased proportion of MUFA in MLD compared to Moravka. However, they achieved in their study higher proportion of SFA, MUFA, but lower content of PUFA than in our study. Research by Tomović et al. (2016) has shown that MLD of Mangalitsa had lower percentage of SFA and PUFA, but higher proportion of MUFA compared with Large White pigs. The pigs received diet with sunflower meal addition. The Mangalitsa breed from our study had higher content of SFA, PUFA, but lower percentage of MUFA.

In our study, the diet with linseed addition decreased the PUFA/SFA ratio and n-6/n-3 ratio compared to the diet with sunflower addition. However the PUFA/SFA ratio as well as n-6/n-3 ratio was not significantly influenced by diets. The PUFA/SFA ratio was less than 4,

how it is recommended according human nutritionist. However, n-6/n-3 ratio was higher than it is recommended. Similarly in the research of Parunović et al. (2012) and Parunović et al. (2013) was observed that Mangalitsa had in MLD PUFA/SFA ratio less than 4, but n-6/n-3 was higher than 30. The study of Kouba et al. (2003) showed that diet for pigs containing 6 % of linseed reduced the n-6/n-3 PUFA ratio in MLD to 3,9 compared to ratio 7,9 in control group of pigs. In contrary, in our study was observed more higher n-6:n-3 PUFA ratio.

CONCLUSION

From the results obtained it can be concluded, that the diet with linseed addition significantly increased oleic and vaccenic acids as well as DHA in MLD of Mangalitsa. However, the total content of SFA, PUFA as well as MUFA was not significantly influenced by different diet for fatteners.

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