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THE INCLUSION OF SUNFLOWER AND FLAX SEEDS IN THE DIET OF MANGALIŢA BREED

Bianca-Petruţa POPA (TIHINIUC-POPA)[1], Constantin NISTOR[1], Mălina-Andreea DĂNCIUG (ROTARU)[1], Elena-Oana ROŞCA (PARFENIE)[1], Benone PĂSĂRIN[1]

[1] „Ion Ionescu de la Brad " University of Life Sciences Iaşi, Aleea Mihail Sadoveanu no. 3, 700490, Iaşi, Romania

Abstract: The purpose of this study was to examine how sunflower and flax seeds in the diet of fattening Mangaliţa pigs affect the fatty acid content in their meat. Twenty Mangaliţa pigs were split into two groups: one group received a diet with 10% sunflower seeds (group S) and the other had a diet with 10% flax seeds (group F). The pigs were given feed and water freely. The fattening period lasted from when the pigs weighed 40 kg to when they reached 100 kg. The diet with added flax seeds significantly raised the levels of oleic acid, vaccenic acid and docosahexaenoic acid – DHA, compared to the diet with sunflower seeds. On the other hand, the total amount of saturated fatty acids and polyunsaturated fatty acids in the meat increased with the sunflower seeds diet, while the total amount of monounsaturated fatty acids decreased compared to the flax seeds diet. It can be concluded that there are no significant differences in the overall levels of fatty acids in the meat between the diets with sunflower of flax seeds, except for the differences in oleic acid, vaccenic acid and docosahexaenoic acid.

Introduction

▪Mangaliţa is a traditional pig breed that is known for being a fatty type of pig. The average total weight is made up of 30% - 35% meat and 65% - 70% fat (Egerszegi et al., 2003). The fat from Mangaliţa is softer and easier for humans t digest, containing more polyunsaturated fatty acids compared to fat from other pig breeds (Parunović et al., 2013).

▪Altogether, pork is great source of nutrients that are vital for human health (Cordis et al., 2015). Many factors such as genetics, breed, sex, energy intake, and the fatty acid makeup of the diet affect the fatty acid levels in the fat and muscle tissues of pigs (Parunović et al., 2013).

▪Overall, pork is a great source of nutrients that are vital for human health. Many factors such as genetics, breed, sex, energy intake and the fatty acid makeup of the diet affect the fatty acid levels in the fat and muscle tissues of pigs, the fatty acid content in food is very important for healthy eating. While saturated fatty acids are seen as a risk for heart diseases, polyunsaturated fatty acids are thought to help prevent such conditions.

▪The fatty acid levels in pork can be easily changed through the pig's diet. The pig feed often focuses on plant oils high in omega-3 fatty acids like soy, olive, linseed, sunflower, or rapeseed. Nutritionists suggest eating more polyunsaturated fatty acids (PUFA), especially n-3 PUFA, while reducing n-6 PUFA intake. An unbalanced intake of fatty acids, such as the ratio of PUFA to saturated fatty acids (SFA) or the n-6 to n-3 PUFA ratio, is a risk factor for cancer and heart diseases.

Material and method

The experimental subjects included 20 pigs of the Mangaliţa breed. The pigs were split into two groups: group S (n=10), which had a diet with 10% sunflower seeds added, and group F (n=10), which had a diet with 10% flax seeds added. The diet compositions are shown in the Table 1. The fatty acid makeup of the diets is displayed in Table 3. The pigs were raised in the same outdoor intensive conditions and were given a mix of feed and drinking water freely. The pen had a concrete floor, and straw was used for bedding.

Table 1. Composition of diets for fattening pigs

Ingredients	Diet S	Diet F
Corn	50	50
Barley	10	10
Wheat	10	10
Soybean meal	10	10
Sunflower seed	10	-
Flax seed	-	10
Granules 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 breakdown of diets for fattening pigs

Fatty acids profile (%)	Diet S	Diet F
PUFA	52.36	67.21
MUFA	31.85	17.76
SAFA	11.45	11.31
C16 (palmitic)	8.1	8.5
C18:0 (stearic)	2.3	2.3
C18:1 cis n9 (oleic)	31.6	19.1
C18:2n-6 (linoleic)	51.5	62.7
C18:3 n3 (alfa-linoleic)	0.7	4.4

The fattening period lasted from 30 kg to 100 kg of body weight. Then, pigs were killed at the slaughterhouse. The day after slaughter, samples of Musculus longissimus dorsi (MLD) were collected from the right side of the carcass to analyze the fatty acid profile. The fatty acid profile was examined using the FT IR (Fourier Transform InfraRed) method. FT IR is a type of infrared spectroscopy. An infrared spectrum provides a unique profile of a mixed sample with absorption peaks that correspond to the vibrations between the bonds of the atoms in the material.

The fatty acid profile parameters were analyzed statistically using analysis of variance (ANOVA) with the Statistical Analysis System (SAS 9.2, using the Enterprise Guide 5.1 application, 2012). The averages and standard error of the mean (SEM) were calculated. Tukey's test was used to compare the average values of the groups with different feed mixtures.

Conclusions

Based on the results, it can be said that adding flax seeds to the diet greatly increased the levels of oleic and vaccenic acids, along with DHA in the MLD of Mangaliţa. However, the overall amounts of SFA, PUFA and MUFA were not significantly affected by the different diets for fatteners.

Results and discussions

•The fatty acid profile results in Musculus longissimus dorsi (MLD) are shown in Table 3. The amounts of lauric acid, palmitic acid, and stearic acid were slightly higher in Group S compared with Group F. In contrast, myristic acid was found to be a little higher in Group F than in Group S. The total level of saturated fatty acids (SFA) was greater in Group S than in Group F. The differences were not statistically significant, so the SFA content was not affected by the diet.

•The diet with flax seeds significantly raised the amount of oleic acid and vaccenic acid in MLD compared to the diet that included sunflower seeds ($P<0.05$), which is reflected in the total level of monounsaturated fatty acids (MUFA) in MLD. However, the differences in MUFA levels between the groups were not statistically significant.

•Linoleic acid, CLA, EPA, DPA and DHA ($P<0.05$) were found in higher amounts in Group F than in Group S. However, the overall amount of polyunsaturated fatty acids (PUFA) was greater with the sunflower diet compared to the linseed diet, but the differences between the groups were not statistically significant. The level of n-6 PUFA was higher in Group S, while n-3 PUFA was lower in Group F.

Table 3. The impact of two diets on the fatty acid levels in the MLD

Fatty acids profile (%)	Group S (n=10) Mean	Group F (n=10) Mean	SEM	P-values
C12:0 (Lauric)	0.067	0.065	0.002	n.s.
C14:0 (Myristic)	1.27	1.28	0.006	n.s.
C16:0 (Palmitic)	24.37	24.31	0.039	n.s.
C18:0 (Stearic)	11.12	11.02	0.056	n.s.
C18:1 CIS-9 (Oleic)	42.26	43.81	0.355	*
C18:1 trans-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.
C20:5n-3 (DPA)	0.136	0.140	0.002	n.s.
C22:6n-3 (DHA)	0.039	0.043	0.001	*
Total SFA	36.71	36.42	0.213	n.s.
Total MUFA	50.61	50.88	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	16.64	0.424	n.s.
Ratio PUFA: SFA	0.336	0.322	0.007	n.s.

Group S: diet with 10% sunflower seeds, Group F: diet with 10% flax seeds.
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 said that the total amounts of SFA, PUFA and MUFA in MLD were not greatly affected by different diets for fattening pigs. However, the diet with added flax seeds significantly raised the levels of oleic and vaccenic acids as well as DHA in the MLD of Mangaliţa pigs. In the research by Cordis et al. (2015), lower amounts of total SFA, MUFA and PUFA in MLD from Mangaliţa were found compared to our findings. The pigs in that study were raised outdoors and only fed grass and grains without concentrates. According to Habeanu et al. (2014), Mangaliţa pigs fed a diet with added linseed showed higher SFA and PUFA levels in intramuscular fat of MLD, but lower MUFA levels compared to our study. However, the types of each fatty acid, such as myristic acid, palmitic acid, stearic acid, oleic acid, EPA, DPA and DHA were like our results. Petrović et al. (2014) compared the rustic pig breeds Moravka and Mangaliţa. The pigs were fed a diet that included 5% sunflower oil meal. They found a lower percentage of SFA and PUFA, but a higher percentage of MUFA in MLD compared to the Moravka breed. However, they recorded a higher proportion of SFA and MUFA, but a lower amount of PUFA than in our study. Research by Tomović et al. (2016) showed that the MLD of Mangaliţa had lower amounts of SFA and PUFA, but a higher proportion of MUFA compared to Large White pigs. These pigs were also fed with a diet with sunflower meal. The Mangaliţa pigs in our study had higher levels of SFA and PUFA, but a lower percentage of MUFA.

•In contrast, in this research was found a higher n-6/n-3 PUFA ratio, which can also be observed in the Figure 1.

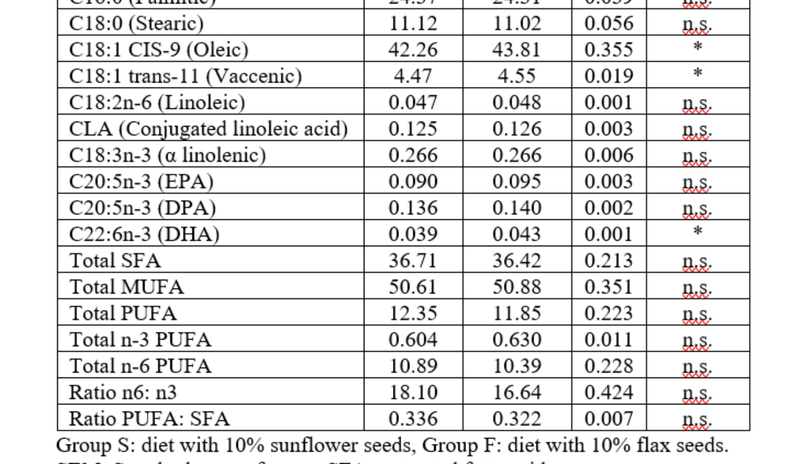

Figure 1. The impact of two diets on the fatty acid levels in the MLD