THE INFLUENCE OF THE LINESEED SUPPLEMENTATION IN FEED ON FAT COMPOSITION IN PIGS

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Abstract

The aim of the study was to evaluate the effect of the linseed addition in fattening pigs on the backfat composition, respectively fatty acid profile. The test included 40 hybrid pigs of the $LW_S x(LW_D xL)$ genotype. Their average age from the birth was 69 days and average live weihgt 28.7 kg. During testing pigs were fed adlibitum by complete feed mixtures. Based on its composition, the animals were divided into two groups. The control group was without linseed, experimental group contained its addition of 15%. The test was finished at an average live weight of 110 kg. After slaughter, the representative samples of the back fat were taken from the right carcass halves (over the last thoracic vertebra), homogenized and subjected to chemical analysis.

The results show that linseed addition in the diet changes the fatty acids profile in the backfat in pigs. Also it was shown, the effect of this addition on the n-6 and n-3 PUFA profile in this tissue.

Key Words: Pig, linseed, backfat, fatty acid composition, PUFA

It has long been dominated by consumer the demand for pork lean meat. The trend is stimulated by the potential cardiovascular risk, which appears to be a function of the content and interactions between saturated and unsaturated fatty acids in animal fat.

Meat leanes is not the only factor of the pork meat quality. It should be remembered that fats are an essential component of food which cannot be replaced by other components. According to FAO recommends their energy share consumption for the day may be of about 20-30%. Decrease dietary fat below 20% have a negative impact on human health. Apart from the above mentioned, the fat (adipose and intramuscular) is the carrier desired sensory properties (Romans et al., 1995, Wood et al., 2008).

As a essential component of the fats are fatty acids. Their characteristics influence the saturated (SFA) and unsaturated (MUFA, PUFA) fatty acids (FA) share. With regard to the healthy diet requirements an emphasis on the greater representation of unsaturated fatty acids are required (Velíšek, Hajšlová, 2009).

Polyunsaturated FA of the n-3 (n-3 PUFA) are essential substances of which intake in the diet is essential for the humans from birth. n-3 PUFAs are important structural components of such as phospholipids in biological membranes, particularly in the brain, retina and spermatozoa.

Polyunsaturated FA positively influence the process of many diseases, such as coronary heart disease, no-hemorrhagic stroke, arterial hypertension, as well as some autoimmune diseases (Gannong, 1995).

The aim of pig breeders therefore is increasing the proportion of the n-3 and reducing the n-6 FA in pork meat. Their composition can be significantly affected by the composition of fats in feed mixtures for growing pigs. The aim of pig farmers is thus increasing the proportion of n-3 and reducing the n-6 FA in meat (Azain, 2004, Warnants et al., 1999).

The attitude of consumers to PUFA share in pig meat products is diametrically different from that of the producers of these ones. While PUFA in meat products for consumers are desirable, for producers not because it may change the structure of the product and reduce their durability (Warnants et al., 1999).

Kouba et al. (2003) reported that the implementation of linseed to the pig diet can increase the n-3 PUFA proportion without any negatively affecting of quality characteristics in slaughtered animals, as evidenced also Azain (2004).

The aim of the study was to objectively assess the impact of the linseed addition to diet on the chemical composition of backfat in pigs.

2. Material and Methods

Animals

The pig testing was carried out in the Testing Station of the Czech Univerzity of Life Science, Department of Animal Husbandry. The experiment involved a total of 40 hybrid pigs (sex balanced barrows/gilts) of the LW_S x (LW_D x L) genotype. The animals were of an average age 69 days from birth and the overall average live weight 28.7 kg. Pigs were penned in pairs according to the methodology for pigs testing in the Czech Republic (Smolák, Ivánek, 1992). After the test, all pigs were slaughtered on an average live weight 110 kg.

Nutrition, groups

Pigs were fed ad-libitum with complete feed mixtures (CFM) in the test. They contain three basic components (wheat, barley, soybean meal) and premix (vitamins,

minerals). CFMs were shuffled according to the methodology (Table 1) for each pen separately. The pigs were divided into two groups based on the composition of the CFMs. The control group was fed with CFMs without the addition of linseed, the experimental group with the addition of linseed. The CFMs transitions were carried out continuously during the test.

Fatty acids assessment

Representative samples of the backfat (*m. longissimus lumborum et thoracis - MLLT*) were taken from the right carcass halves at the last thoracic vertebra spot, homogenized and subjected to chemical analysis in the laboratory of the Department of Animal Husbandry, University of Life Sciences in Prague. Fatty acid methyl esters were determined following extraction of total lipids according to Folch et al. (1957). Methanolysis was performed by applying the catalytic effect of potassium hydroxide and extraction of acids in the form of methyl esters in heptane. The contents of isolated methyl esters were determined using a gas chromatograph (Master GC, Dani Instruments S.p.A., Cologno Monzese, Italy) equipped with a flame ionisation detector and a column with polyethylene glycol as the stationary phase (FameWax; 30 m×0.32 mm×0.25 μm). Helium was used as the carrier gas, with a flow rate 5 ml/min. The obtained records were analysed using Clarity 5.2 and quantified on the basis of known retention times from a standard Food Industry FAME Mix from the Restek Corporation (Bellefonte, PA, USA). The analysis carried out under the following temperature conditions - injector temperature 50 ° C (2 minutes) at 10 ° C / 1 minute up to 230 ° C (holding time 8 minutes), detector temperature 220 ° C. Records were analyzed using the program Clarity 5.2 and quantified on the basis of the retention times of known standards of the Food Industry FAME mix made by Restek.

Subsequently fatty acids were determined

- saturated (SFA), C10v0, C12v0, C14v0, C16v0, C17v0, C18v0, C20v0, C21v0,
- unsaturates (MUFA), C16v1, C17v1, C18v1, C20v1,
- polyunsaturated (PUFA), C18v2, C18v3, C18v39, C20v2, C20v3, C20v4, C20v5.

Statistical evaluation

The obtained results were interpreted with the use of a mathematical and statistical application SAS® Propriety Software Release 6.04 (2001) analysis of variance (ANOVA). Differences between the observed characteristics were tested using the GLM procedure.

Table 1. The CFMs compositions

Component (g/kg) CFM – type	Control group			Experimental group		
	A1	A2	CDP	A1	A2	CDP
Wheat	400.0	445.5	465.0	281.0	307.4	320.0
Barley	383.0	394.9	400.0	400.0	400.0	400.0
Soybean meal	182.0	124.6	100.0	137.0	111.1	100.0
Premix	35.0	35.0	35.0	32.0	31.5	30.0
Lineseed	-	-	-	150.0	150.0	150.0
Nutrient representation of the CFM						
Dry matter	881.5	880.1	879.6	883.3	880,6	879,6
MEp (MJ/kg)	12.71	12.67	12.65	12.86	12.82	12.81
Crude protein	182.75	162.07	154.08	183.22	159.78	151.65
Crude fiber	36.99	36.20	35.89	34.66	34.39	34,30
Lyzin	11.32	9.78	9.18	11.60	9.43	8,68
Threonin	6.88	6.00	5.66	7.04	5.93	5,54
Ca	14.11	13.99	13.95	14.09	12.62	12,09
P	1.20	1.13	1.10	1.13	1.07	1,05
Na	0.27	0.26	0.26	0.24	0.24	0.25
Retinol (mg/kg)	0.41	0.40	0.40	0.33	0.35	0.35
α-tocoferol (mg/kg)	17.53	18.29	18.58	13.37	15.37	16.06
Thiamin (mg/kg)	4.15	4.28	4.33	3.17	3.68	3.86
Ryboflavin (mg/kg)	1.68	1.57	1.54	1.43	1.40	1.39
Pantothenic acid	8.30	8.04	7.94	6.81	7.13	7.24
Cholin (mg/kg)	1197.9	1098.8	1060.4	1047.3	988.6	968.3

A1, A2 and CDP are types of mixed feeds, which were fed to pigs with average live weights of 28 to 35 kg, 35.1 to 60 kg and 60.1 to 110 kg, respectively.

Results and Discussion

Table 2. shows the differences in fat composition between control and experimental group. From this table it is evident that the addition of linseed significantly affects mainly linoleic acid, α-linolenic acid, eicosapentaenoic (EPA), oleic, palmitic, palmitoleic and stearic acida. The greatest influence of the nutrition on FA content in the backfat was observed for α-linolenic and eicosapentaenoic acids.

Similar changes in FA composition observed in their experiments also Bečková, Václavková (2010), Kouba et al. (2003) as well as Nuernberg et al. (2004). The diet with the addition of linseed diet compared without addition, these acids were increased almost ten times in the backfat. A similar results published D'Arragio et al. (2002), which states that the n-6: n-3 PUFA ratio in pig fat was improved mainly due to an increase of α-linolenic acid. Increasing the content of other long-chain FA due to nutrition in his experiment was not so pronounced. The lower content of palmitic, respectively stearic acid in the experimental group compared to control (by 3.88%) was also demonstrated, however, differences were insignificant. The addition of linseed occurred also in mono-FA reduction, particularly oleic acid (by 5.27%), which corresponds with Bečková, Václavková (2010). Significant reductions were also recorded in palmitoleic acid (by 1.54%) in favor of the experimental group.

As is evident from the Table 3, PUFA content of the experimental group was significantly increased, while the content of MUFA and SFA was reduced. The fact corresponds with the publication Owerholt-Specht et al. (1997), Romans et al. (1995) and Warnantse et al. (1999), which states that PUFA from the diet is more easily incorporated into fat pigs, while MUFA and SFA much less. Although there was an increase in total n-6 PUFA, the addition of the linseed in the diet can be evaluated as positive in this respect because n-6/n-3PUFA ratio recorded significantly lower values (Table 4). This ratio, with respect to human health, should achieve the values 4-5 and less. Also, the PUFA: SFA ratio was favorably modified by nutrition. Achieved PUFA: SFA ratio a swell as n-6/n-3 PUFA is consistent with the requirements and the recommendations by Gannong (1995), Romans et al. (1995), Warnants et al. (1999).

Table 2. FA share with respect to nutrition type in the backfat in pigs

FA	Control (n=24)		Experiment (n=16)		Significance
	x	s	x	S	
Capric	0,12	0,06	0,08	0,01	*
Lauric	0,11	0,05	0,08	0,01	*
Myristic	1,78	0,27	1,46	0,19	**
Palmitic	28,76	1,12	24,88	1,33	**
Palmitoleic	3,47	0,66	1,93	0,52	**
Margaric	0,35	0,09	0,28	0,07	*
Heptadecenic	0,36	0,14	0,21	0,04	**
Stearic	16,36	2,33	15,52	1,41	
Oleic	36,14	1,55	30,87	2,05	**
Linoleic	9,27	1,82	10,80	1,61	*
γ – Linolenic	0,01	0,01	0,00	0,00	**
α – Linolenic	1,04	0,27	10,55	1,40	**
Arachidic	0,22	0,09	0,28	0,06	*
Gadolejová	1,09	0,31	0,85	0,17	*
Eicosadienic	0,43	0,07	0,47	0,08	
Eicosatrienoic	0,06	0,02	0,04	0,01	*
Arachidonic	0,18	0,06	0,08	0,03	**
Eicosapentaenoic	0,14	0,06	1,38	0,19	**
Heneikosanic	0,00	0,00	0,12	0,04	**

Differences between the averages marked ** are statistically significant (P≤ 0,001).
Differences between the averages marked * are statistically significant (P≤ 0,05).

Table 3. FA- groups content with respect to nutrition type in the backfat in pigs

FA	Control (n=24)		Experiment (n=16)		Significance
	x	s	x	s	
SFA	47,76	2,51	42,77	1,81	**
MUFA	41,07	1,81	33,87	2,34	**
PUFA	11,13	2,12	23,33	3,11	**
n-6	9,46	1,88	10,88	1,63	*
n-3	1,17	0,32	11,92	1,53	**

Differences between the averages marked ** are statistically significant (P≤ 0,001).
Differences between the averages marked * are statistically significant (P≤ 0,05).

Table 4. FA- groups share with respect to nutrition type in the backfat in pigs

FA	Control (n=24)		Experiment (n=16)		Significance
	x	s	x	s	
n-6:n-3	8,34	1,54	0,91	0,07	**
MUFA:PUFA	3,83	0,82	1,49	0,29	**
PUFA:SFA	0,24	0,05	0,55	0,09	**
MUFA:SFA	0,86	0,07	0,79	0,06	*

Differences between the averages marked ** are statistically significant (P≤ 0,001).
Differences between the averages marked * are statistically significant (P≤ 0,05).

Conslussion

The experimental results showed that the addition of linseed in the diet of pigs positively influenced and changed the composition of fatty acids in the backfat in pigs. Statistically significant effect of the diet enriched with linseed seed with respect to the α-linolenic, linoleic and eicosapentaenoic acid contents in the backfat was demonstrated. Experimental results also showed a significant SFA reduction as well as significant n-3 PUFA increase proportion in the monitored tissue. It is therefore possible by help of the nutrition to reduce the SFA and MUFA concentration and to increase PUFA concentration in this tissue. This may be the ratio of PUFA: SFA positively influenced with regard to human health, as well as the n-6 and n-3 PUFA ratio.

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This study was supported by an S grant from the Ministry of Education, Youth and Sports of the Czech Republic and project no. MSM 604607901.