EFFECT OF DIFFERENT FAT SOURCES IN PIG DIET ON FATTY ACID COMPOSITION OF MUSCLE TISSUE

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Abstract

The aim of the study was to evaluated the content of selected fatty acids in muscle tissue of pigs fed with feed mixtures with different sources of fat. Forty crossbred gilts were divided into four groups and fed with control diet (C) or diet containing sunflower (S), linseed (L) or CLA. The highest content ($P<0.001$) of linoleic acid was found in CLA and S group, the highest amount of alpha-linolenic acid was measured in L group. The content of arachidonic acid and EPA was also affected ($P<0.001$) by the type of feeding mixture. The content of monounsaturated fatty acids (MUFA) was also significantly different in control and experimental groups. Similarly, the polyunsaturated fatty acids proportion was affected ($P<0.01 – 0.001$) by the diet. The most favourable n-6/n-3 PUFA ratio was found in L group.

Key Words: Pig, CLA, fatty acids, muscle tissue

Lipids are important component of food. They have several functions in organism. Fat is added to the feed mixture as a source of energy. It is also source of fatty acids and can contribute to fatty acid composition in final product of animal production (Gläser et al., 1999). Oilseeds are the most important fat source in pig diet. Feed mixture based on cereals provides n-6 fatty acids and only small amount of n-3 polyunsaturated fatty acids. The components with higher proportion of n-3 fatty acids must be added to feed in order to meat fatty acid profile alternation.

Meat fatty acid composition can be changed via the diet, linoleic, α-linolenic and long-chain PUFA content responds quickly to feeding higher levels of α-linolenic acid (e.g. in rapeseed) in pigs (Wood and Enser, 1997).

Material and Methods

Crossbred gilts were divided into four groups (10 animals in each group) and fed with four feed mixtures-control (C), linseed diet (L) with 7 % of ground linseed, sunflower diet (S) with 5 % of sunflower seeds and mixture with 1 % of conjugated linoleic acid addition (CLA). Conjugated linoleic acid was supplemented in the form of the preparation LUTA-CLA (BASF, Germany). All mixtures had very similar content of crude protein and energy. Nutrient and chemical composition of feed mixtures is given in Table 1, fatty acid content in feed mixtures is documented in Table 2. The average live weight of gilts was 86,36 ± 11,66 kg at the start of the experiment, final live weight was 140,55 ± 11,43 kg. The samples for laboratory analysis were collected 24 hours after slaughter. Gas chromatograph Agilent Technologies HP 6890 was used for analysis of fatty acid composition in *M.longissimus dorsi.* The statistical evaluation was performed using the computer program QCExpert (TriloByte Statistical Software Ltd.)

Results and Discussion

The content of fatty acids was measured in the samples of *M. longissimus dorsi* of crossbred gilts from four groups (Table 3). The highest content ($P<0.001$) of essential linoleic acid was found in CLA (11.31 ± 1.00 g/100 g of total fatty acids) and S group (10.77 ± 1.11 g/100 g). The highest amount of alpha-linolenic (Graph 1) acid was in L group (1.12 ± 0.06 g/100 g). It corresponds with the highest amount of this fatty acid in feed mixture used for the L group. The content of arachidonic acid and EPA was also affected ($P<0.001$) by the type of feeding mixture. On the other hand, DHA content was not influenced ($P>0.05$). The amount of total saturated fatty acids (Graph 2) was the highest ($P<0.05 – 0.001$) in L group (41.44 ± 0.74 g/100 g) and also in C group (40.96 ± 1.26 g/100 g). The content of monounsaturated fatty acids was also significantly different in control and experimental groups. Similarly, the polyunsaturated fatty acids proportion was affected ($P<0.01 – 0.001$) by the diet . The content of total n-6 PUFA was the highest ($P<0.001$) in S and CLA group (13.70 ± 1.52 resp. 14.72 ± 1.09 g/100 g of total fatty acids), the highest content of n-3 PUFA was measured in L group (1.80 ±0.10 g/100 g of total fatty acids). Therefore, the most favourable n-6/n-3 PUFA ratio was found in L group (4.48).

Enser et al. (2000) compared two feed mixtures with different fatty acid proportion – diet with high content of linoleic acid (control) and diet with lowered linoleic acid content (linseed diet). Authors of the study found higher accumulation of alpha-linolenic acid in muscle and fat tissue of pigs fed linseed diet. Content of EPA was affected only in muscle tissue and content of DHA was influenced only in fat tissue. Guillevic et al. (2009) monitored the effect of the diet with linseed addition (high content of alpha-linolenic acid) and the diet with sunflower addition (high content of linoleic acid) on fatty

acid composition of muscle and fat tissue in barrows. The proportion of n-3 PUFA was higher in pigs fed with linseed diet, n-6 PUFA content was higher in sunflower group. Our results correspond with these findings.

In our experiment, the addition of CLA to pig diet had significant effect on fatty acid profile in muscle tissue. The content of saturated fatty acids and MUFA was lower ($P<0.05 – 0.001$) than in control group, content of PUFA was significantly higher ($P<0.001$) in CLA group. Weber et al. (2003) studied the effect of 0.6 % CLA in pig diet on fatty acid profile in muscle tissue. They found significantly higher proportion of saturated fatty acids and significantly lower amount of PUFA. On the other hand, the content of monounsaturated fatty acids was not affected by the diet.

Table 1. Chemical composition of feed mixtures

Analysed chemical composition (g/kg)	Diet			
	Control	Linseed	Sunflower	CLA
Dry matter	887.47	886.81	885.71	886.25
Crude protein	146.13	137.02	155.69	146.56
Fat	48.59	47.58	43.60	45.78
Fibre	37.33	45.97	45.24	37.00
Starch	438.90	442.77	421.50	434.26
Saccharose	21.77	19.04	20.22	19.56
Energy (MJ/kg)	13.36	13.10	13.04	13.22

Table 2. Fatty acid content (g/100 g of total fatty acids) in control and experimental feed mixtures

	Control	Linseed	Sunflower	CLA
Linoleic	32.89	33.33	54.74	32.65
Alpha-linolenic	7.61	29.25	8.55	6.74
Arachidonic	0.02	0.03	0.02	0.03
EPA	0.13	0.05	0.04	0.14
DHA	0.01	0.02	0.01	0.01
SFA	15.16	15.72	16.42	14.39
MUFA	43.80	21.11	19.48	36.68
PUFA	41.04	63.19	64.10	48.92
n-6 PUFA	33.05	33.61	54.93	32.83
n-3 PUFA	7.96	29.53	8.99	7.24
n-6/n-3	4.15	1.14	6.11	4.53

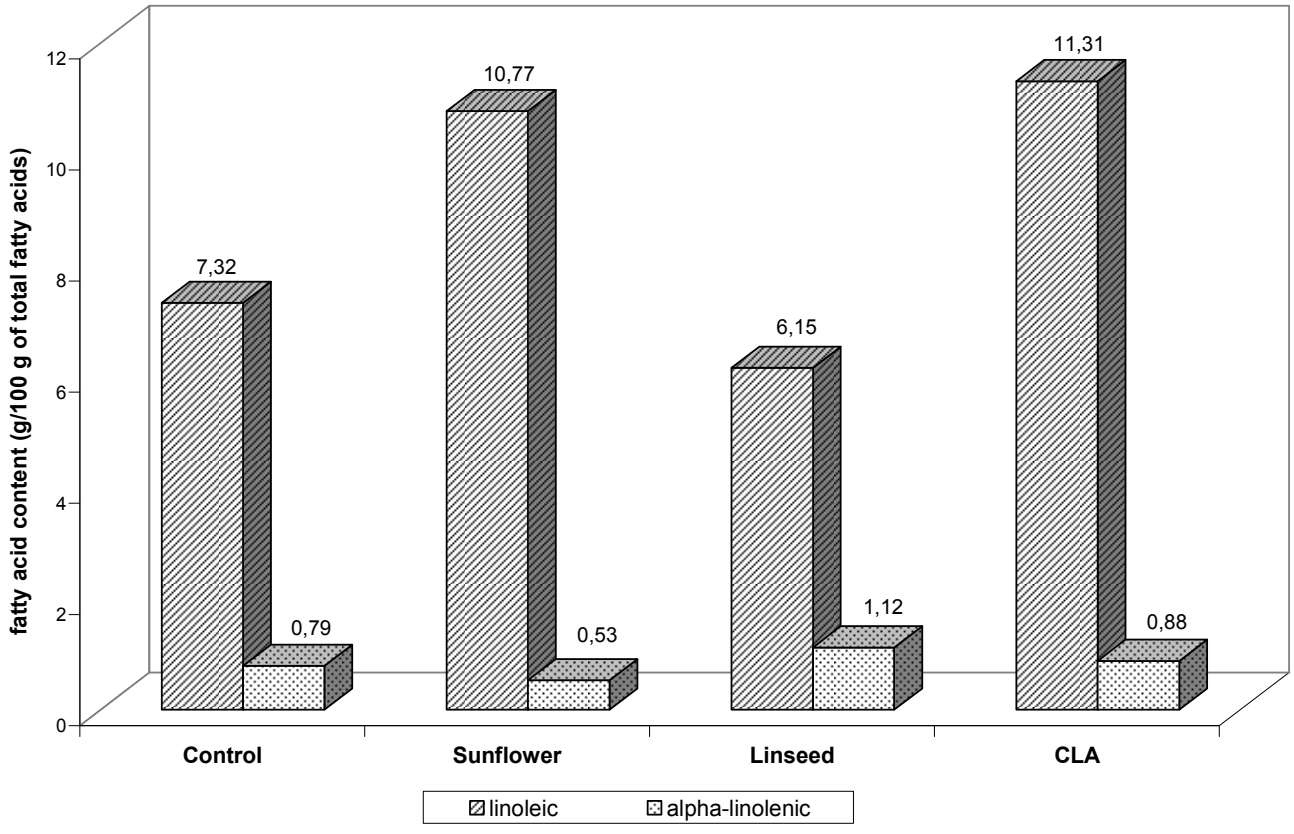
SFA—saturated fatty acids, MUFA—monounsaturated fatty acids, PUFA—polyunsaturated fatty acids

Table 3. Content of selected fatty acids in muscle tissue of fattening pigs (g/100 g of total fatty acids)

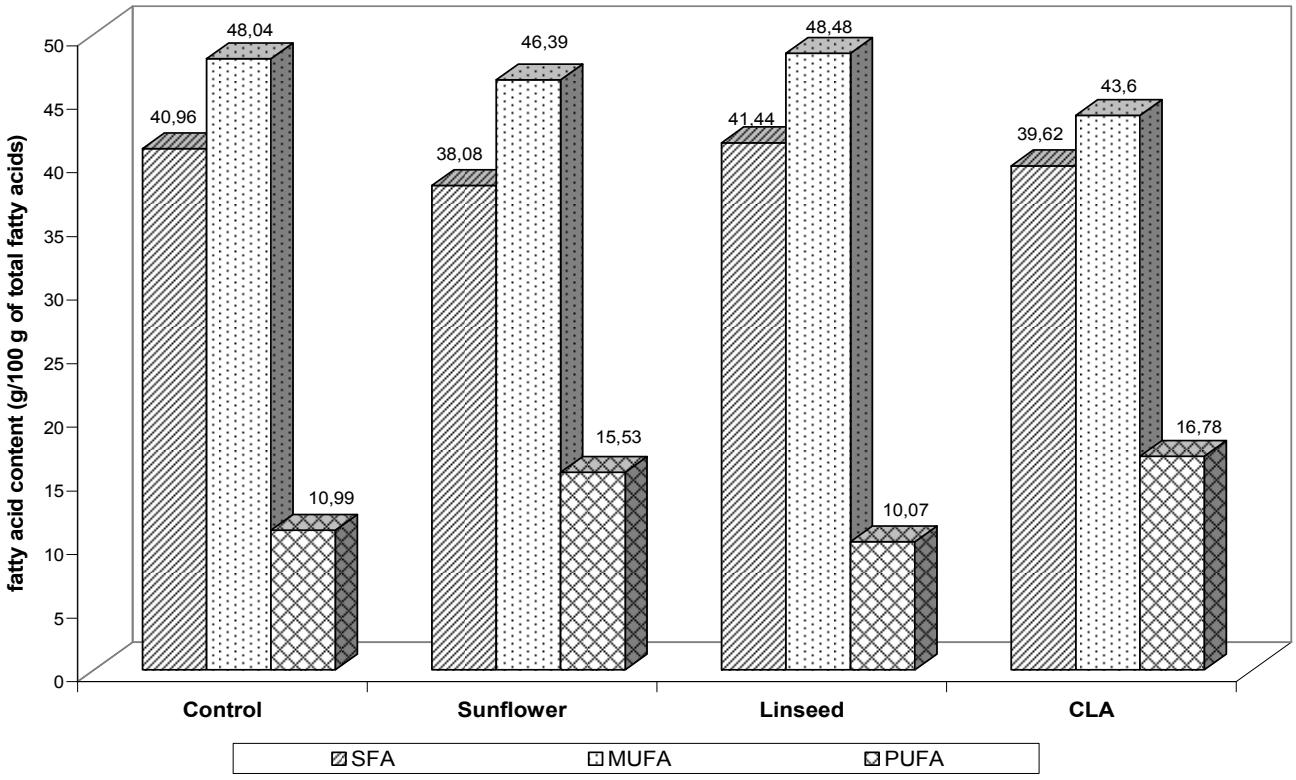
	Control (C)	Sunflower (S)	Linseed (L)	CLA
Linoleic C18:2-n6	7.32 ± 0.91 ^{ABD}	10.77 ± 1.11 ^{BD}	6.16 ± 0.54 ^{C}	11.31 ± 1.00 ^{AC}
Alpha-linolenic C18:3-n3	0.79 ± 0.11 ^{AB}	0.53 ± 0.03 ^{BC}	1.12 ± 0.06 ^{AC}	0.88 ± 0.07 ^{C}
Arachidonic C20:4-n6	1.41 ± 0.47 ^{AB}	2.02 ± 0.36 ^{BD}	1.21 ± 0.31 ^{CD}	2.41 ± 0.19 ^{AC}
EPA C20:5-n3	0.03 ± 0.01 ^{A}	0.06 ± 0.01 ^{AB}	0.04 ± 0.01	0.03 ± 0.01 ^{B}
DHA C22:6-n3	0.06 ± 0.01	0.06 ± 0.01	0.06 ± 0.01	0.07 ± 0.01
SFA	40.96 ± 1.26 ^{aA}	38.08 ± 0.87 ^{bAB}	41.44 ± 0.74 ^{cB}	39.62 ±0.78 ^{abc}
MUFA	48.04 ± 0.97 ^{Ac}	46.39 ± 0.89 ^{cB}	48.48 ± 0.80 ^{B}	43.60 ± 1.11 ^{AB}
PUFA	10.99 ±1.55 ^{AB}	15.53 ±1.61 ^{BD}	10.07 ± 1.00 ^{CD}	16.78 ±1.14 ^{AC}
n6 PUFA	9.49 ± 1.44 ^{AB}	13.70 ± 1.52 ^{BD}	8.07 ± 0.93 ^{CD}	14.72± 1.09 ^{AC}
n3 PUFA	1.37 ± 0.15 ^{AcB}	1.08 ± 0.11 ^{BCD}	1.80 ±0.10 ^{AdC}	1.58 ± 0.09 ^{cdD}
n6/n3 PUFA	6.97 ± 0.90 ^{ABD}	12.69 ± 0.79 ^{BCD}	4.48 ± 0.37 ^{ABC}	9.34 ± 0.65 ^{ACD}

SFA—saturated fatty acids, MUFA—monounsaturated fatty acids, PUFA—polyunsaturated fatty acids
a,b P<0.05 c,d P<0.01 A,B,C,D P<0.001

Graph 1. Content of linoleic and alpha-linolenic acid in muscle tissue of control and experimental pigs



Graph 2. Content of SFA, MUFA and PUFA in muscle tissue of control and experimental pigs



Conclusion

The results of the experiment confirm that there is possibility to alter the content of fatty acids in muscle tissue of fattening pigs via the diet. The fatty acid profile is changed according to their content in feed mixture.

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