ANALYSIS OF POSSIBLE INFLUENCE OF CONJUGATED LINOLEIC ACID ON GROWTH CAPACITY AND LEAN MEAT CONTENT IN GILTS

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Abstract

The objective of this study was to evaluate the possibility of influencing growth capacity and lean meat content of gilts with conjugated linoleic acid. The experimental work was realized in operating conditions of a productive pig farm. During the experiments the gilts in the rearing were fed with a control feed mixture and an experimental feed supplemented with 2 % of conjugated linoleic acid for the time of 65 days. The aim of the evaluation was to test whether CLA influences the growth capacity and the lean meat content. The gilts in the experimental group, despite their lower initial weight 108.10 ± 6.56 kg versus 109.80 ± 9.67 kg, reached higher weight 148.05 ± 15.80 kg versus 135.75 ± 17.60 kg ($P \leq 0.05$) at the end of the test. The evaluation of mean achieved daily gain for the time from birth to the end of the test confirmed higher values for the gilts in the experimental group 586.05 ± 66.64 g/day against 539.00 ± 62.19 g/day for the gilts in the control group ($P \leq 0.05$). As for the lean meat content, no significant influence of CLA on its phenotypic manifestation was found.

Key Words: gilts, CLA, weight, growth capacity, lean meat content

One of the essential predispositions for reaching cost-effective life-long performance of sows is an appropriate preparation before their productive period. Improper rearing of gilts before their inclusion in the reproductive process does not assure subsequent achievement of maximum performance. Therefore, the aim of a breeder should be ensuring rearing of gilts leading to appropriate physical development and onset of sexual functions. Achievement of good results is influenced by a number of factors, such as quality genetic material, quality nutrition, housing conditions and health state of animals. Feed ration, or its composition, is one of very substantial exogenous factors. Besides the required energy, amino acids, vitamins and minerals, also fatty acids are essential components of nutrition. The fatty acids are major and nutritionally the most important components of lipids. Both in human sphere and in the nutrition of animals, conjugated linoleic acid (CLA) has recently been of a great interest. Stachowska (2008) reports that the interest in CLA increased with results published on anticancer and lipodystrophy effects, on effects on body composition changes, on diabetes, hypercholesterolemia and effects on immune system, growth capacity and reproduction. Conjugated linoleic acid represents a group of positional and geometric isomers of linoleic acid, whose most common sources are milk, dairy products and meat of ruminants. The isomers have double bonds in conjugated position, which means that they are not separated by a methylene group, unlike the other fatty acids with two or more double bonds (Steinhart *et al*., 2003). Thiel – Cooper *et al*. (2001) state that integration of conjugated linoleic acid into the feed ration of pigs ensures higher utilization of nutrients in feed. Martin *et al*. (2008) recorded no effect of different levels of CLA (0, 1 or 2 %) in gilts on higher feed intake, mean daily gain and conversion. Wiegand *et al*. (2001) observed an increase of growth rate and improvement of conversion of nutrients in pigs receiving 0.75 % CLA in feed. Václavková (2011) found the highest proportion of lean meat in gilts fed with addition of CLA. However, Oleszczuk *et al*. (2012) mention the difficulty of recommendation of conjugated linoleic acid supplements. The main reason is the inconclusiveness of the effect of CLA and ambiguous results. Also, the economic effect needs to be taken into account and whether the effectivity of synthetic isomers is equal to the natural ones.

Material and Methods

Analysis of possible influencing of selected productive parameters of gilts with conjugated linoleic acid was performed in operating conditions of a productive pig farm of agricultural company Bonagro, a.s., based in Šlapanice. Total number of 40 gilts of hybrid combination Czech Large White x Czech Landrace (CLW x CL) were included in the observation. Gilts were divided into two groups of the same number, i.e. 20 pcs in the control group and 20 pcs in the experimental group. The gilts were stabled in common operating conditions of the gilts rearing house, with each group, i.e. control and experimental, further divided into two group pens of 10 pieces. Feed and water intake was ad libitum, up to the weight of 65 kg the gilts were fed with complete feed mixture for rearing gilts PCH1, followed with complete feed mixture PCH2 until mating. Composition of the used feed mixtures is shown in Tab. 1.

The experimental work was started on the same day, when the mean weight reached 108.10 ± 6.56 kg in the experimental group and 109.80 ± 9.67 kg in the control group. From the onset of the experiment, the experimental group was given complete feed mixture PCH2 with the supplementation of 2 % of conjugated linoleic acid for the time of 65 days. The source of conjugated linoleic acid was preparation Lutalin (C 18:2 trans-10 cis-12) from BASF, Germany. At the beginning and the end of the experiment, the performance test were conducted in accordance with the methodology of CSN 466164 on Performance and progeny testing in pig. Life weight of animals was measured by weighing using digital scales. The performance parameters were measured using PIGLOG 105 appliance. The established

established data were processed and statistically analysed with the use of software Microsoft Excel 2010 and STATISTICA, version 10.0. Statistical conclusiveness of the differences between mean values of evaluated parameters was assessed as follows: *** $P \leq 0.001$, ** $P \leq 0.01$, * $P \leq 0.05$ and NS $P \geq 0.05$.

Results and Discussion

Growth capacity

Experiment was started when mean value of live weight reached 108.10 ± 6.56 kg in the gilts of the experimental group and 109.80 ± 9.67 kg in the gilts of the control group. The mean values found at the start of the experiment are presented in Tab. 2.

After termination of feeding the experimental group with the feed mixture enriched in 2 % of conjugated linoleic acid, the mean live weight was 148.05 ± 15.80 kg, resp. 135.75 ± 17.60 kg in the control group. The achieved mean values at the end of the experimental work are shown in Tab. 3.

Statistical evaluation of observed parameters revealed no significant difference between the monitored groups of gilts. The gilts in the experimental group, despite their lower initial weight 108.10 ± 6.56 kg vs. 109.80 ± 9.67 kg, reached higher weight at the end of the test (148.05 ± 15.80 kg vs. 135.75 ± 17.60 kg). The difference in achieved weight of gilts at the end of the test, which was 12.3 kg, was confirmed statistically significant ($P \leq 0.05$). The evaluation of achieved mean daily gain for the period from birth to the end of the test proved higher value in gilts from the experimental group (586.05 ± 66.64 g/day) against the value 539.00 ± 62.19 g/day in the control group. The difference of the achieved values between monitored groups was 47.05 g/day and was proved to be statistically significant ($P \leq 0.05$). Therefore, the results indicate a conclusive effect of supplementation with conjugated linoleic acid on the growth performance of gilts during the test, thus also on the growth performance during rearing.

Table 1. Composition and the nutrient content of control and experimental feed mixture for rearing gilts

Components proportion in %	**Control feed mixture**	**Experimental feed mixture with 2 % CLA**
Wheat	8.00	8.00
Corn	8.00	8.00
Spring barley	67.50	67.50
Extracted soybean meal	12.00	12.00
Rapeseed oil	2.00	0.00
Conjugated linoleic acid	0.00	2.00
SAUNGOLD TRAG	2.50	2.50
Nutrient content g/kg	**Control feed mixture**	**Experimental feed mixture with 2 % CLA**
N-substances	143.73	143.73
Roughage	44.49	44.49
Lysine	7.55	7.55
Methionine	2.41	2.41
Met+cys	4.79	4.79
Threonine	4.94	4.94
Tryptophan	1.66	1.66
Calcium	0.69	0.69
Total phosphorus	4.52	4.52
Digestible phosphorus	1.19	1.19
Sodium	1.64	1.64
ME (MJ/kg)	12.60	12.83

Table 2. Basic statistical characteristics of growth performance parametres in gilts at the start of the experiment

Parameter	Group		Conclusiveness
	Control	Experimental	
Live weight at the start of the test (kg)	109.80 ± 9.67	108.10 ± 6.56	NS
Mean daily gain from birth to the start of the test (g/day)	573.10 ± 47.10	595.20 ± 46.26	NS

NS = statistically non-significant ($P \geq 0.05$)

Table 3. Basic statistical characteristics of growth performance parametres in gilts at the end of the experiment

Parameter	Group		Conclusiveness
	Control	Experimental	
Live weight at the end of the test (kg)	135.75 ± 17.60	148.05 ± 15.80	*
Mean daily gain from birth to the end of the test (g/day)	539.00 ± 62.19	586.05 ± 66.64	*

* = statistically significant ($P \leq 0.05$)

West *et al*. (1998) described increased metabolic utilization of nutritions in the case, when conjugated linoleic acid is included in feed ration, which indicates, according to authors, that CLA can have a positive effect on productive parameters, especially on gain and conversion. Similar conclusion was published by Evans *et al*. (2002) who found in their work, that addition of conjugated linoleic acid on the level of 0.05 – 1.0 % increases the effectivity of nutrition. Also Thiel-Cooper *et al*. (2001) proved an increase of mean daily gain in case of supplementation of feed ration with CLA. Parrish *et al*. (1997) conducted an experiment aimed at assessment of the effect of several levels of conjugated linolieic acid preparations on growth capacity of gilts. Within the observation, they used following levels: 0.12 %, 0.25 %, 0.50 % and 1 %. Based on achieved results, the authors state that mean daily gain increased linearly with increasing level of fed CLA ($P \leq 0{,}01$). Weber *et al*. (2006) added 1 % of CLA into feed mixture of gilts for 8 weeks and they recorded a significant increase of mean daily gain only in the period between the 4th and 6th week ($P \leq 0.01$). In their study, Corino *et al*. (2008) supplemented CLA on the level of 0.75 %. Although the mean daily gain found in the control group was 588 g/day and 601 g/day in the experimental group, the difference between the values was not statistically conclusive. Similar results are presented by Václavková (2011) who fed 1 % of CLA to growing gilts. Comparing a control group and the group fed with the addition of CLA, a higher mean daily gain was found in the experimental group, however, the difference between the two groups was not statistically conclusive.

Contrary to previous conclusions, the vast majority of authors state, that supplementation of feed ration with conjugated linoleic acid has not a significant effect on growth capacity. Martin *et al*. (2008) observed an effect of various levels of conjugated linoleic acid on growth parameters in gilts. Hybrid gilts were fed with feed mixtures with three levels of CLA supplementation, particularly 0 %, 1 % and 2 %. Supplementation lasted for 53 days. However, the level of supplementation had no significant effect on mean daily gain or feed conversion. Also Ostrowska *et al*. (1999), who fed 0.125 %, 0.25 %, 0.50 %, 0.75 % and 1.0 % CLA to hybrid gilts (LW x L) proved no effect of any of the CLA addition levels on growth capacity of gilts. Gatlin *et al*. (2002) state that mean daily gain was not influenced by 1 % addition of CLA fed for 47 days. On the basis of an evaluation of 0.5 % addition of CLA, O´Quinn *et al*. (2000) report decreased mean daily gain as compared to a control group.

Lean meat content

Achieved mean values of the lean meat content in gilts at the start and the end of experiment are presented in Tab. 4. At the start of the test, the gilts in the control group reached the value of 60.01 ± 3.26 % and the gilts in the experimental group 60.85 ± 2.99 %. The difference between the achieved mean values of the lean meat content were without significance. Nor the lean meat content at the end of the test assessed by ultrasound measuring was statistically significantly different. The mean value measured in the gilts of the control group was 58.74 ± 3.68 %. The gilts of the experimental group achieved the value of 58.40 ± 3.86 % after termination of feeding the mixture with 2 % of CLA.

Results found by our observation do not correspond to conclusions of authors Park and Pariza (2007), who attribute also an ability to support the formation of muscle mass to conjugated linoleic acid, in addition to reduction of the body fat. According to Ostrowska *et al*. (1999) the effects of conjugated linoleic acid on the skeletal muscles are less understood, yet the results show that CLA can increase the deposition of proteins in muscles and the lean meat content in proportion to fat accumulation. They prove their statements with a performed study in which hybrid gilts were fed with 0.125, 0.25, 0.50, 0.75 or 1 % of conjugated linoleic acid. Based on achieved results they claim that formation and deposition of muscle tissue was increased after eight-week supplementation, to the detriment of fat deposition. Their statements are proved by conclusions of Weber *et al*. (2006), who confirmed in their study, that eight-week supplementation with 1 % of CLA led to an increase of the lean meat content in gilts ($P \leq 0.05$). Tous *et al*. (2013) gave gilts a higher dose of conjugated linoleic acid for the purpose of possible effect enhancement, particularly 4 % of CLA for 54 days. After evaluation of their results the authors state that the higher dose of CLA significantly increased the lean meat content. Results confirming the effect of conjugated linoleic acid supplementation to gilts on muscle tissue formation were published also by Dugan *et al*. (2001) whose conclusions speak of the lean meat content increase by 2.7 %.

Table 4. Basic statistical characteristics of lean meat content in gilts at the start and the end of the experiment

Parameter	Group		Conclusiveness
	Control	Experimental	
Lean meat content at the strat of the test (%)	60.01 ± 3.26	60.85 ± 2.99	NS
Lean meat content at the end of the test (%)	58.74 ± 3.68	58.40 ± 3.86	NS

NS = statistically non-significant ($P > 0.05$)

Conclusion

The aim of the realized experiment was to analyze the possibility of influencing the growth capacity and the lean meat content in gilts during rearing by the means of supplementing the feed mixture with conjugated linoleic acid in the operating conditions of a productive farm. In the experiments, the gilts during rearing were fed with control feed mixture and an experimental mixture supplemented with 2 % of conjugated linoleic acid for 65 days. On the basis of the achieved results it can be concluded that the 2 % supplementation of CLA significantly increased mean daily gain from birth to the end of the individual performance test ($P \leq 0.05$), therefore the gilts of the experimental group reached significantly higher weight at the end of the experiment ($P \leq 0.05$). The lean meat content was not affected.

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