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Effect of conjugated linoleic acids in pig nutrition on quality of meat

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Abstract

Relationships among conjugated linoleic acid (CLA) in pig nutrition and carcass quality parameters (hot carcass weight, carcass yield and meatiness) and meat quality parameters (initial and pH value after 24, 48 and 72 h, temperature, drip loss, sensory color and marbling) were determined in pigs (crossbreeds Yorkshire x Landrace). Commercial CLA preparation containing 60% CLA isomers was included in the diet. No significant differences in performance parameters were found between pigs fed with CLA and control group during 60 days period. CLA supplementation in feed significantly increased SFA and decreased MUFA and PUFA fraction in pig muscles.

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Keywords: carcass quality; CLA; fatty acids; meat quality; pig

1. Introduction

The production of high quality pork has been a constant objective of the pig industry for many decades. The main goal is to obtain pigs with high lean percentage and good meat quality traits at the same time[1,2]. Fat and fatty acids (FAs), whether in adipose tissue or muscle, contribute importantly to various aspects of meat quality and are central

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to meat nutritional value[3]. Several attempts to modify the FA composition of pork have been made recently during the last years; one of them is the inclusion of conjugated linoleic acid (CLA) in feed for growing/finishing pigs for its distributive effect between fat and lean[4]. The CLAs are a mixture of positional and geometric isomers of linoleic acid (9c,12c C18:2), which were first identified in rumen fluid as an intermediate of the biohydrogenation process. In synthetic CLA preparations the 9c,11t and 10t,12c isomers are predominant (often in a 1:1 ratio). It appears that the 9c,11t isomer has positive effects on some types of cancer by inhibiting tumorogenesis, while the 10t,12c isomer could be responsible for changes in whole-body fat deposition[5]. The present study showed the effect of CLA and fatty acid composition in pig nutrition on quality of pork meat (performance, carcass and quality parameters).

2. Materials and methods

Pigs crossbreed of Yorkshire x Landrace, with initial body weight of 60 kg were used in present study. The pigs were divided into two experimental groups of 30 pigs in each and fed with standard mixture[6], from 60 to 110 kg (fattening period of 60 days). Only the experimental group received a commercially prepared conjugated linoleic acid 60% CLA (Lutalin, BASF, Germany), added at the recommended rate of 2.0% in their feed mixture. The mixtures were balanced and fully satisfied needs of the animals at this stage of fattening. After carcass refrigeration at 3°C for 24h, carcasses were weighed. Meatiness (in percentages) was determined according to regulation[7] on the basis of hot carcass weight and the sum of carcass fat thickness at two points (on the back and at the sacrum).Meat quality measurements were carried out 60 minutes, 24, 48 and 72 h after slaughter on muscle *Longissimus dorsi* (LD), *pars lumbalis*. Values of pH 60 minutes, 24, 48 and 72 h postmortem (pH_{60min}, pH_{24h}, pH_{48h}, pH_{72h}), and temperature 60 minutes postmortem (t_{60min}) were measured using a pH-meter Testo 205 (Germany) calibrated with pH 4.00 and 7.00 phosphate buffer. For determination of drip loss, sensory color and marbling of meat samples, 2.5 cm thick loin chops were taken 24 h after slaughter from LD, between the 3rd and 4th lumbar vertebrae. Meat samples were weighed and stored for 48 h at 4°C in a container[8]. Color and drip loss were analyzed in duplicate. An analytical panel of three members assessed sensory color and marbling of meat samples by using the scaling method[9]. After storage, meat samples were reweighed and drip loss (%) was calculated as the difference between sample weight before and after storage divided by the sample weight before storage. Total lipids for fatty acid determination were extracted from pig muscle tissue with hexane/isopropanol mixture by accelerated solvent extraction (ASE 200, Dionex, Germany). After evaporation of solvent until dryness under the stream of nitrogen total lipids were converted to fatty acid methyl esters (FAME) by trimethylsulfonium hydroxide. FAMEs were determined by using Shimadzu 2010 gas chromatograph equipped with flame ionization detector (FID) and cianopropyl HP-88 capillary column (100m x 0.25 mm x 0.20μm)[10]. Statistical analysis of the results was elaborated using software GrapfPad Prism version 5.00 for Windows, GraphPad Software, San Diego CA, USA, www.graphpad.com. Student t-test was used for testing the differences in the parameters between the control and experimental group.

3. Results and discussion

No significant differences in performance parameters of pigs which were fed with CLA and control group for a period of 60 days were found (average daily feed intake: C: 2.68 kg/day, E: 2.65 kg/day; average daily weight gain: C: 0.78 kg/day, E: 0.79 kg/day; feed to gain ratio: C: 3.44 kg/kg, E: 3.34 kg/kg). Animals fed with the CLA had similar final body weight than those fed with the control diet (C: 111.1 kg, E: 112.10 kg live weight). Dietary CLA did not affect the carcass weight and yield (Table 1). Additionally, although differences were not significant, meatiness was numerically higher in control group animal. The meat quality parameters such as pH value, temperatures, sensory color and marbling were not affected by dietary treatment.

The total SFA including C14:0 ($p < 0.01$), C16:0 ($p < 0.01$), C18:0 $p < 0.01$) were significantly higher in muscles from pigs fed dietary CLA than in control pigs (Table 2). However, the MUFA including C18:1 ($p < 0.01$) were reduced by CLA. A reduction of n-6 was caused by reduction of C18:2 n-6, C18:3 n-3, C20:2 n-6 and C20:3.

Table 1. Effect of diet on carcass characteristics and meat quality measurement from *Longissimus dorsi* muscle of swine.

	Groups	
	C ($\bar{X}$ ± SD)	E ($\bar{X}$ ± SD)
Live weight at slaughter(kg)	111.1±9.82	112.10±10.87
Hot carcass weight (kg)	81.29±3.18	81.80±3.10
Carcass yield (%)	85.22±5,69	86.08±7.09
Meatiness (%)	42.94±1.54	42.49±0.87
pH_{60min}	5.73±0.22	5.86±0.32
pH_{24h}	5.54±0.10	5.55±0.09
pH_{48h}	5.44±0.09	5.34±0.13
pH_{72h}	5.53±0.07	5.48±0.08
T_{60min}	37.68±1.79	38.53±1.19
Drip loss (%)	5.92±1.71	5.54±1.90
Sensory color score	2.29±0.49	2.51±0.38
Marbling	1.94±0.61	1.88±0.38

Table 2. Content of saturated (SFA), monounsaturated (MUFA), polyunsaturated (PUFA) fatty acids and CLAin musle (%).

Parameter	Group	
	C ($\bar{X}$ ± SD)	E ($\bar{X}$ ± SD)
C14:0	1.08^{A}±0.01	2.01^{A}±0.07
C15:0	0.04±0.008	0.05±0.01
C16:0	26.82^{A}±0.24	33.43^{A}±1.16
C17:0	0.33±0.05	0.32±0.03
C18:0	14.72^{A}±1.08	17.45^{A}±0.16
C20:0	0.24^{a}±0.03	0.20^{a}±0.01
C16:1	2.38^{A}±0.24	3.40^{A}±0.36
C18:1	43.26^{A}±1.70	33.95^{A}±0.59
C20:1	0.93±0.08	ND
C22:1+C20:4	0.33±0.04	0.36±0.01
C18:2 n-6	8.98±0.54	8.07±0.85
C18:3 n-3	0.30^{A}±0.02	0.24^{A}±0.02
C20:2 n-6	0.42±0.06	0.39±0.04
C20:3 n-6	0.11^{A}±0.01	$0,09^{A}$±0.01
C20:3 n-3	0.02^{A}±0.01	$0,08^{A}$±0.01
c9t11CLA	**ND**	2.37±0.01
t10c12CLA	**ND**	1.19±0.01
c9t11CLA+ t10c12CLA	**ND**	3.56±0.71

Legend: $^{A, B, C}$ same letters indicate significant difference of $p < 0.01$; ^{a} same letters indicate significant difference of $p < 0.05$; ND not detected.

In the first studies with pigs, dietary CLA increased lean tissue deposition and decreased fat deposition[11,12]. Comprehensive reviews on the effects of CLA on growth performance and carcass fat deposition in pigs have been published by Corino et al.[13] and Bee et al.[14]. In general, the response to CLA was not conclusive and inconsistency

could be attributed to the type of pig used in studies or to dietary factors like the source of CLA, the dietary fat content or the duration of feeding[15]. A higher dose of CLA was used in order to amplify the possible response to CLA in muscle content. Bee[16] documented that supplementing the basal diet of Swiss Large White pigs from 70 to 105 kg live weight with a CLA-enriched oil (2%) resulted in a measurable CLA content (14.9 mg/g fatty acids) in the adipose tissue compared with non detectable CLA levels in the groups with linoleic acid-enriched oil or lard supplements.

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References

1. Dokmanovic M, Baltic M, Duric J, Ivanovic J, Popovic LJ, Todorovic M, Markovic R, Pantic S. Correlations among Stress Parameters, Meat and Carcass Quality Parameters in Pigs. *Asian Austral J Anim Sci* 2015;**3**:435-41.
2. Baltic ZM, Markovic R, Djordjevic V. Nutrition and meat quality. *Tehn mesa* 2011;**52**:154-59.
3.Wood JD, Enser M, Fisher AV, Nute GR, Sheard PR, Richardson RI. Fat deposition, fatty acid composition and meat quality: A review. *Meat Sci* 2008;**78**:343–58.
4. Dugan MER, Aalhus JL, Schaefer AL, Kramer JK. The effect of conjugated linoleic acid on fat to lean repartitioning and feed conversion in pigs. *Can J Anim Sci* 1997;**77**:723–25.
5. Pariza MW, Park Y, Cook ME. Mechanisms of action of conjugated linoleic acid: Evidence and speculation. *Proc Soc Exper Biol Med* 2000;**223**: 8–13.
6. National Research Council, 1998. Nutrient requirements of swine. Subcommittee on swine nutrition, Committee on Animals Nutrition, National Research Council (10th Revised Ed.): National Academic Press.
7. Anon. Regulations on quality of slaughtered pigs and pork categorization (Sl. list SFRJ, 2/85, 12/85, 24/86). 1985.
8. Honikel KO. Reference methods for the assessment of physical characteristics of meat. *Meat Sci* 1998;**49**:447-57.
9. NPPC (National Pork Producers Council).. Pork composition and quality assessment procedures. E. Berg editor.Des Monica, Iowa, USA: National Pork Producers Council; 2000. p.1–38.
10. Trbovic D, Vranic D, Djinovic-Stojanovic J, Petronijevic R, Milijasevic M, Matekalo-Sverak V, Spiric A. Fatty acid profile of carp fish species from two aquaculture systems. V International Conference "Aquaculture & Fishery", Institute of Animal Science, Faculty of Agriculture, Belgrade-Zemun, Serbia, June 1.-3.2011. Conference Proceedings. 2011;80-84.
11. Dugan MR, Aalhus RJL, Jeremiah LE, Kramer JKG, Schaefer AL. Theeffects of feeding conjugated linoleic acid on subsequent pork quality. *Can J Anim Sci* 1999;**79**: 45-51.
12. Ostrowska E, Muralitharan M, Cross RF, Bauman DE,Dunshea FR. Dietary conjugated linoleic acids increase lean tissue and decrease fat deposition in growing pigs. *J Nutr* 1999;**129**:2037–42.
13. Corino C, Di Giancamillo A, Rossi R, Domeneghini C. Dietary conjugated linoleic acid affects morphofunctional and chemical aspects of subcutaneous adipose tissue in heavy pigs. *J Nutr* 2005;**135**:1444–50.
14. Bee G, Jacot S, Guex G, Biolley C. Effects of two supplementation levels of linseed combined with CLA or tallow on meat quality traits and fatty acid profile of adipose and different muscle tissues in slaughter pigs. *Anim* 2008;**2**:800–11.
15. Tous N, Lizardo R, Vilà B, Gispert M, Font-i-Furnols M, Esteve-Garcia E. Effect of a high dose of CLA in finishing pig diets on fat deposition and fatty acid composition in intramuscular fat and other fat depots. *Meat Sci* 2013;**93**:517-24.
16. Bee G. Dietary conjugated linoleic acids affect tissue lipid composition but not de novo lipogenesis in finishing pigs. *Anim Res* 2001;**50**:383–99.