

EFFECTS OF CONJUGATED LINOLEIC ACID SUPPLEMENTATION ON PERFORMANCES, CARCASS QUALITY AND FATTY ACID COMPOSITION IN MEAT OF FINISHING PIGS

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Abstract

Conjugated linoleic acid (CLA) is a mixture of positional and geometric isomers of linoleic acid with conjugated double bonds. Conjugated linoleic acids have been reported to have a wide range of health beneficial effects, including anticarcinogenic, antiatherogenic, antidiabetic and immune stimulatory. The objective of this study was to elucidate the effects of CLA on performance, carcass quality and fatty acid composition of meat from finishing pigs. Forty eight crossbred finishing pigs [Duroc x (Landrace x Large White)] (24 gilts and 24 barrows), weighing 60 kg were used. The experimental design was a 3 x 2 factorial arrangement, with the level of CLA supplementation (0%, 0.5%, and 1.0% in diet) as the first factor and sex of pigs (gilts and barrows) as the second factor. Feed consumption was recorded weekly, while body weight was recorded fortnightly. Carcass composition was determined by slaughtering 24 pigs (12 gilts and 12 barrows). CLA supplementation did not affect ($P > 0.05$) average daily gain (ADG), average daily feed intake (ADFI) and Gain: Feed, however gilts showed higher ($P < 0.01$) ADG and Gain: Feed than those of barrows. There was no interaction between CLA and sex in ADG, ADFI and Gain: Feed. In addition, CLA supplementation did not affect ($P > 0.05$) backfat thickness (first rib, tenth rib, last rib and last lumbar), loin eye area and lean percentage. Firmness, marbling, color (L^* , a^* and b^* value) and chemical composition (protein, moisture and ash contents) of ham and loin were not influenced by CLA supplementation. However, CLA supplementation showed lower percentage of lipid in ham ($P < 0.05$) and in loin ($P < 0.01$) than that of the unsupplemented control. CLA supplementation showed higher total saturated fatty acid (SFA) percentage (especially C12:0, C14:0, C16:0 in ham and C12:0, C14:0, C16:0, C18:0 in loin) and SFA:UFA ratio. However, CLA supplementation showed lower unsaturated fatty acid (UFA) percentage especially mono-unsaturated fatty acid (MUFA) percentage (C18:1n9c in ham and C18:1n9c, C18:2n9c, C20:3n6 and C20:4n6 in loin). Poly-unsaturated fatty acid (PUFA) percentage in ham and loin were not influenced by CLA supplementation. However, barrows showed higher C18:2n6c, C18:3n3, C20:3n6, C20:4n6 and PUFA than those of gilts, whereas gilts showed higher C10:0 than that of barrows in loin. Accumulation of CLA (*cis* 9-*trans* 11 and *trans* 10-*cis* 12) in ham and loin was increased with supplemental CLA. There were no interactions between CLA and sex in all parameters. The present study clearly showed that CLA supplementation reduced fat content in meat, reduced UFA and MUFA but increased SFA and CLA in meat lipid.

Keywords: Conjugated linoleic acid, carcass quality, fatty acids, finishing pig

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Introduction

Conjugated linoleic acid (CLA), a group of positional and geometric isomers of linoleic acid, naturally occurs in animal products, predominantly in beef, meat of other ruminants and in dairy products (Chin *et al.*, 1992; Pariza *et al.*, 1983; Kritchevsky, 2000), but are present at lower amounts in pork and in meat from other non-ruminant species (Chin *et al.*, 1992; McDonald, 2000). CLA has been reported to have numerous beneficial effects, including reducing lipid uptake by adipocytes (Smith *et al.*, 1999), anticarcinogenic activity (Pariza *et al.*, 2001) and improving body composition (Evans *et al.*, 2002). The main component of CLA isomers found in foods of animal origin is *cis*9, *trans*11 isomers (Pariza *et al.*, 2001). CLA studies were performed using a mixture of various isomers, which contained *cis*9, *trans*11 and *trans*10, *cis*12 as the major components (O'Quinn *et al.*, 2000; Ostrowska *et al.*, 2003). Feeding CLA to pigs has been increased in the last decade as a result of its potential to increase rate of gain (Parish *et al.*, 1998), improve feed efficiency (Ostrowska *et al.*, 1999), reduce the body fat (Dugan *et al.*, 1997; Cook *et al.*, 1998; Thiel-Cooper *et al.*, 1998; Thiel-Cooper *et al.*, 2001), and increase protein accretion rate (Ostrowska *et al.*, 1999). The effective dose in the experimental feed in these trials was 0.5-1.5% CLA. Many studies have been carried out on the effects of dietary CLA supplementation on pig growth performances, carcass and meat quality (Dugan *et al.*, 1997; 1999; O'Quinn *et al.*, 2000; Wiegand *et al.*, 2002), lipid composition (O'Quinn *et al.*, 2000; Bee, 2001; Joo *et al.*, 2002) and adipocytes growth and differentiation (Mersmann, 2002; McNeel and Mersmann, 2003).

The purpose of this study is to determine the effects of CLA supplementation on performance, carcass quality and fatty acid composition in meat of finishing pigs.

Materials and Methods

Experimental Animals

Experiments were conducted in accordance

with the principles and guidelines approved by the Suranaree University of Technology Animal Care and Use committee which followed Guidelines for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (1st revised edition, 1999; Association Headquarters, 1111 North Dunlap Avenue, Savoy, IL 61874). Forty eight crossbred finishing pigs [Duroc × (Landrace × Large White) (24 gilts and 24 barrows)] averaging 60 kg live weight were used. Each group of 24 gilts and 24 barrows was randomly divided into 12 groups of 2 pigs. In each group and each sex, pigs were then randomly allocated to 4 pens of 2 pigs per each dietary treatment. Thus, there were 4 replicates of each treatment within each sex. The experimental design was a 3 × 2 factorial arrangement, with the level of CLA supplementation (0%, 0.5% and 1.0% in diet) as the first factor and sex of pigs (gilts and barrows) as the second factor.

Experimental Diet

Each group of gilts and barrows was further randomly fed an experimental diet, containing 0, 0.5 or 1.0% CLA. All experimental diets were isonitrogenous and isocaloric and formulated to meet the National Research Council (1998) requirements. The experimental diets were formulated to provide 3,295 kcal of ME/kg, 15.5% crude protein, 0.81% lysine, 0.51% methionine + cystine, 0.50% calcium and 0.67% available phosphorus. Commercial liquid CLA (BASF (Thai) Ltd., Bangkok, Thailand) containing 60% CLA (30% *cis*9, *trans*11; 30% *trans*10, *cis*12) was thoroughly premixed with silica (to be convenient to mix with other ingredients) to obtain a CLA concentration of 30% (15% *cis*9, *trans*11; 15% *trans*10, *cis*12). To equalize the concentration of total fat, the CLA source was substituted for palm oil. Silica was also added to the diets to maintain equivalent silica content in the diets. Experimental diets were fed to finishing pigs for 56 d. Chemical analyses of the diets were made for crude protein, crude fiber and ether extract (AOAC, 1998). Feed ingredients and chemical compositions of the experimental diets are presented in

Table 1. The fatty acid profiles of the diets, as analyzed by gas chromatography (GC), are given in Table 2. It is of interest to note that after inclusion of CLA, the level (g/100g of total fatty acids, Table 2) of both linoleic and linolenic acid decreased slightly.

Composition Measurement

Both semimembranosus and longissimus muscles from 4 pigs (4 gilts or 4 barrows) per treatment were collected at exsanguinations from the left side of the carcass (NPPC, 1999) for standard carcass measurements (loin eye area, lean meat percentage, back fat depth at the 10th

rib, midline fat depths at the first rib, last rib and last lumbar vertebra), whereas those from the right side of the carcass were collected, frozen in liquid nitrogen, and stored at -80°C until assayed for fatty acid composition.

Lipid and Fatty Acid Analysis

Fatty acid analysis was carried out as previously described (Raes *et al.*, 2000; 2001). In brief, lipids were extracted from fresh meat using chloroform/methanol [2:1, v/v, modified from Folch *et al.* (1957)]. Nonadecanoic acid (19:0) was added as an internal standard. The fatty acid methyl esters (FAME) were analyzed

Table 1. Ingredients, analyzed and calculated nutrient composition of basal diets (as-fed basis)

Feed ingredients	Control	0.5% CLA	1.0% CLA
Ingredients, %			
Rice polishing	66.80	66.80	66.80
Rice bran	11.30	11.30	11.30
Soy bean meal (44% CP)	15.20	15.20	15.20
Fish meal (58% CP)	3.00	3.00	3.00
Dicalcium phosphate (18% P)	1.20	1.20	1.20
Palm oil	2.00	2.00	2.00
CLA ¹	0.00	0.00	0.00
Premix ²	0.50	0.50	0.50
Total	100.00	100.00	100.00
Analyzed composition, unit			
Crude protein, %	15.78	15.71	15.76
Ether extract, %	3.22	3.21	3.21
Crude fiber, %	2.23	2.21	2.20
Calculated composition, unit			
Metabolizable energy, kcal/kg	3,295.00	3,295.00	3,295.00
Ca, %	0.50	0.50	0.50
Available P, %	0.67	0.67	0.67
Lysine, %	0.81	0.81	0.81
Methionine + Cystine, %	0.51	0.51	0.51

¹ Conjugated linoleic acid 30% containing 15% c9, t11; 15% t10, c12; 11% oleic acid; 3% palmitic acid; 2% stearic acid; 1% linoleic acid; 3% other isomers and 50% silica powder.

² Provided per kg of diet: vitamin A, 6,000 IU; vitamin D₃, 1,200 IU; vitamin E, 11 IU; vitamin K₃, 1 mg; vitamin B₁ 1 mg; vitamin B₂ 2.1 mg; vitamin B₆ 1.2 mg; vitamin B₁₂ 15 mg; pantothenic acid 7 mg; niacin 13.2 mg; choline 300 mg; Co 0.3 mg; Cu 100 mg; I 0.6 mg; Mn 35 mg; Zn 60 mg; Fe 60 mg; Se 0.15 mg.

by GC (model 6890, Hewlett Packard, USA) using a CP-Sil88 column (Chrompack, The Netherlands) for FAME (100 m × 0.25 mm). The GC conditions were as follows: injected temperature, 240°C; detector temperature, 260°C; carrier gas, He; split ratio, 1/30; temperature program, 70°C for 4 min, followed by an increase of 13°C/min to 175°C, then 4°C/min to 215°C. Peaks were identified by comparison of retention times with those of the corresponding standards (Supelco™ 37 component FAME Mix, Sigma-Aldrich Co., USA). Identification of the peak included fatty acids between 10:0 and 22:6; and CLA isomers, i.e. *cis*9, *trans*11; *trans*10, *cis*12.

Quality Measurements

Colormeter (Minolta CR-300, Minolta Camera Co. Ltd., Osaka, Japan) was used to measure color and reported as L*, a* and b* according to Hunter system. After 5°C at 48 h chilling, whole 10th – 11th rib of longissimus and semimembranosus muscles were taken and wrapped with polyvinylchloride sheet. Each sample of muscles was measured at 12 positions. Values were then averaged for each sample.

Firmness of semimembranosus and longissimus muscles was measured from samples taken after 5°C at 48 h chilling (each sample 1 cm width × 3 cm long × 1 cm thick) by Texture

Table 2. Fatty acid profiles of experimental diets

Fatty acids	Control	0.5% CLA	1.0% CLA
	-----% of total lipid-----		
Total lipid, % of diet	3.22	3.21	3.21
C 10:0	0.51	0.44	0.39
C 12:0	1.07	0.64	0.26
C 14:0	1.51	1.00	0.66
C 16:0	41.82	34.50	21.44
C 16:1	0.59	0.46	0.32
C 18:0	5.63	4.91	4.80
C 18:1n9c	39.92	32.73	31.09
C 18:2n6c	3.42	2.95	3.67
C 18:3n3	0.85	0.23	0.22
C 20:0	0.98	0.82	0.59
C 20:3n6	1.02	1.93	1.00
C 20:4n6	2.19	1.88	1.69
C 22:6n3	0.49	0.42	0.38
Total CLA	0.00	17.08	33.45
<i>cis</i> 9, <i>tran</i> 11	0.00	7.95	15.34
<i>tran</i> 10, <i>cis</i> 12	0.00	9.13	18.11
Saturated fatty acids	51.52	42.32	28.18
Unsaturated fatty acids	48.48	57.68	71.82
Mono-unsaturated fatty acids	42.72	35.08	33.11
Polyunsaturated fatty acids	5.77	22.60	38.71

Analyzer (TA – TX2, Stable Micro System, UK). Values were reported as force per distance (Lyon and Lyon, 1998).

Marbling of semimembranosus and longissimus muscles was evaluated from samples taken after 5°C at 48 h chilling after exsanguinations by a committee of five trained experts. Marbling scores were reported according to established guidelines (NPPC, 1999); 1 = devoid to practically devoid, 5 = moderately abundant or greater.

Chemical composition (%lipid, fat, water and ash) of semimembranosus and longissimus muscles was determined, after mincing samples, according to AOAC (1998) methods.

Statistical Analysis

Analyses were conducted using the general liner model (GLM) procedure of SAS (SAS Inst. Inc., Carry, NC). All data obtained were subjected to analysis of variance (Steel and Torrie, 1986) using Statistical Analysis System (SAS, 1996).

Results and Discussion

Growth, Carcass Composition and Quality

CLA supplementation had no effect on ADFI, ADG and feed efficiency ($p > 0.05$), however, gilts had higher ADG ($p < 0.001$) and feed efficiency ($p < 0.01$) than those of barrows (Table 3). No interaction ($P > 0.05$) between CLA supplementation and sex on growth was observed. Previous studies have reported that feed intake is decreased in pigs fed with CLA (Dugan *et al.*, 1997; Cook *et al.*, 1998). The lack of significant effects on feed intake in the present study may be due to a shorter duration of supplementing with CLA or supplementing at lower concentration than what have been previously reported. In fact, reported effects of CLA on growth of pigs are inconsistent (Dugan *et al.*, 1997; Cook *et al.*, 1998; O'Quin *et al.*, 1998). A linear increase in ADG as the level of CLA increased in the diet has been reported previously by Thiel- Cooper *et al.* (2001). In

Table 3. Effects of dietary treatment on growth and carcass composition

CLA	0%		0.5%		1.0%		SEM	Pr>F		
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow		CLA	Sex	CLA*Sex
ADFI ¹ , kg/d	2.24	1.89	2.09	2.09	2.31	1.99	0.041	0.742	0.053	0.390
ADG ² , g/d	769.00	586.00	740.00	634.00	793.00	568.00	25.00	0.961	0.001	0.297
Gain: Feed	0.34	0.31	0.35	0.30	0.34	0.28	0.098	0.600	0.006	0.648
Initial wt., kg	61.00	60.40	60.80	60.50	60.50	61.00	0.160	0.421	0.826	0.223
Final wt., kg	103.90	92.60	101.50	95.40	104.10	92.30	1.380	0.991	0.001	0.317
Back fat, cm										
1 st rib	3.31	2.80	3.43	3.43	3.68	3.30	0.30	0.559	0.425	0.828
10 th rib	2.54	2.54	2.41	2.54	2.54	2.54	0.30	0.985	0.908	0.985
Last rib	2.79	2.16	2.16	2.41	1.91	2.16	0.17	0.061	0.317	0.250
Last-lumbar	2.16	2.29	2.29	2.03	2.42	1.91	0.24	0.977	0.474	0.662
LEA ³ , cm ²	40.93	41.48	38.54	35.25	41.62	35.53	4.17	0.771	0.563	0.855
Lean, %	50.98	52.62	50.81	49.23	51.53	49.44	1.38	0.687	0.659	0.611

¹ ADFI: average daily feed intake, kg/d

² ADG; average daily gain, g/d

³ LEA: loin eye area, cm²

SEM = standard error of mean.

contrast, Dugan *et al.* (1997) found no significant differences in ADG of dietary CLA in pigs in agreement with lack of the effects on performance of feeding CLA reported in the present study and others (Dunshea *et al.*, 1998; Ramsay *et al.*, 2001; Tischendorf *et al.*, 2002a). The differences in response to CLA supplementation may be due to differences in the isomeric composition of CLA between trials (Pariza *et al.*, 2000), the concentration and duration of supplementing with CLA, or CLA $\times$ genetic population interactions.

Dietary CLA and sex did not affect ($p > 0.05$) backfat thickness (1st rib, 10th rib, last rib and last lumbar), loin eye area (longissimus muscle area) and lean meat percentage (Table 3). No interaction between dietary and sex CLA was found. Similar results were also reported (O'Quinn *et al.*, 2000; Eggert *et al.*, 2001; Joo *et al.*, 2002). CLA fed at 0, 1.0, 2.5, and 5.0% found that backfat thickness, loin eye area and lean meat percentage were unaffected by CLA (Joo

et al., 2002). However, it has been observed an increase in carcass lean by 2%, and a decrease in back fat thickness by 11% with addition of CLA at 2% (Tischendorf *et al.*, 2002a) which is in agreement with the findings of Ostrowska *et al.* (1999) and Dugan *et al.* (1997).

Subjective measures of both semimembranosus and longissimus muscle quality (firmness, marbling, and color) were not affected ($p > 0.05$) by CLA supplementation and sex. No interaction between CLA supplementation and sex was observed (Table 4). Several studies found no differences in marbling in the longissimus due to CLA supplementation. (Eggert *et al.*, 1998; O'Quinn *et al.*, 2000; Eggert *et al.*, 2001; and Joo *et al.*, 2002) However, Carrol *et al.*, (1999) and Wiegand *et al.* (2001) found increases in firmness, marbling and color in pork meat supplemented with CLA.

CLA and sex did not affect moisture, protein and ash contents of both semimembranosus and longissimus muscles, however, fat

Table 4. Effects of dietary treatment on meat quality

CLA	0%		0.5%		1.0%		SEM	Pr>F		
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow		CLA	Sex	CLA*Sex
Semimembranosus										
Firmness ¹ , g/cm	171.30	165.20	272.40	207.90	188.10	188.10	24.24	2.290	0.194	0.707
Marbling ²	2.64	2.38	3.20	3.13	3.55	2.76	0.26	0.258	0.206	0.630
Color ³										
L*	50.13	54.64	51.58	52.15	53.24	50.20	0.82	0.303	0.822	0.303
a*	8.68	10.04	10.53	8.81	10.00	11.64	0.87	0.501	0.681	0.378
b*	2.88	4.25	3.68	3.42	5.36	4.65	0.82	0.411	0.891	0.661
Longissimus										
Firmness ¹	148.70	198.40	167.60	198.70	151.00	106.20	45.00	0.415	0.384	0.367
Marbling ²	2.33	2.20	3.46	2.60	3.38	3.35	0.33	0.404	0.126	0.642
Color ³										
L*	51.90	54.07	55.76	54.52	53.24	53.21	1.95	0.707	0.898	0.826
a*	7.80	8.09	6.90	8.37	10.21	6.58	0.63	0.706	0.424	0.063
b*	1.37	4.44	2.14	4.26	3.87	2.28	1.02	0.979	0.346	0.303

¹ TA – TX2, Stable Micro System, UK.; expressed as g/cm.

² NPPC (1991) scoring system. 1 = devoid to practically devoid, 5 = moderately abundant or greater.

³ Minolta CR-300, Minolta Camera Co. Ltd., Osaka, Japan. L*: lightness (larger number indicates a lighter color); a*: redness (larger number indicates a more intense red color); b*: yellowness (larger number indicates more yellow color).

SEM = standard error of mean.

contents of these two muscles were reduced ($p < 0.05$) by CLA supplementation (Table 5). No interaction between dietary CLA and sex was determined (Table 5). A similar result was also reported (Ramsay *et al.*, (2001). Other studies have reported the reduction in subcutaneous fat content with CLA supplementation (Dugan *et al.*, 1997; Ostrowska *et al.*, 1999; Corino *et al.*, 2003).

Fatty Acid Composition

Dietary CLA increased C12:0 ($p < 0.05$), C14:0 ($p < 0.05$), C16:0 ($p = 0.001$), SFA ($p = 0.001$) and SFA:UFA ($p = 0.001$) but decreased C18:1n9c ($p < 0.05$), UFA ($p = 0.001$) and MUFA ($p < 0.05$) in semimembranosus muscle fat while sex had no effect on fatty acid composition in semimembranosus muscle fat. With longissimus muscle fat, CLA supplementation increased C12:0 ($p < 0.01$), C14:0 ($p = 0.001$), C16:0 ($p = 0.001$), C18:0 ($p < 0.05$), SFA ($p = 0.001$) and SFA:UFA ($p = 0.001$), but decreased C18:1n9c ($p = 0.001$), C18:2n6c ($p < 0.05$), C20:3n6 ($p < 0.05$), C20:4n6 ($p < 0.01$), UFA ($p = 0.001$) and MUFA ($p < 0.05$) in longissimus muscle fat.

Dietary CLA supplementation had a significant impact on the fatty acid profile of the lipids, resulting in an increase in myristic

(C14:0), palmitic (C16:0) and palmitoleic (C16:1) acids both in semimembranosus and longissimus muscles. The stearic acid (C18:0) content was higher ($p < 0.05$) in semimembranosus muscle of CLA-fed pigs than that in the unsupplemented control pigs.

The results of the present study are basically in agreement with the previous findings (O'Quinn *et al.*, 2000; Bee, 2001; Ramsay *et al.*, 2001; Demaree *et al.*, 2002; Weigand *et al.*, 2002; Ostrowska *et al.*, 2003) and confirm that the dietary CLA supplementation brings about an increase in SFA and also a reduction in MUFA in both semimembranosus and longissimus muscles. Ramsay *et al.* (2001) fed grower pigs CLA at levels ranging from 0% to 2% of the diet, and observed changes in the fatty acid composition of subcutaneous adipose tissue similar to those observed in the present study. The decrease in C 18:1n-9 became more pronounced with increasing concentration of CLA. Additionally, Wiegand *et al.* (2002) reported that increasing the portion of the finishing period during which CLA was fed further depressed adipose tissue C 18:1n-9 concentrations. These findings suggest that the effects of CLA on C 18:1n-9 are additive with increased level or time of supplementation. With regard to PUFA, this study has shown the same

Table 5. Effects of dietary treatment on chemical composition of meat

CLA	0%		0.5%		1.0%		SEM	Pr>F		
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow		CLA	Sex	CLA*Sex
Semimembranosus										
Moisture, %	71.47	70.78	71.19	71.98	71.50	71.79	0.48	0.487	0.810	0.771
Protein, %	22.79	22.77	23.19	21.95	23.02	22.74	0.43	0.875	0.336	0.598
Fat, %	4.49	4.69	3.67	3.23	3.94	2.92	0.29	0.046	0.261	0.389
Ash, %	0.96	1.20	1.22	1.10	1.30	1.19	0.12	0.630	0.990	0.508
Longissimus										
Moisture, %	71.35	71.19	70.83	70.84	71.05	70.64	0.29	0.532	0.599	0.878
Protein, %	23.92	23.34	23.49	22.56	23.69	23.50	0.49	0.636	0.353	0.869
Fat, %	5.39	5.71	4.64	4.62	4.00	3.80	0.19	0.002	0.881	0.626
Ash, %	1.12	1.41	0.98	1.34	1.24	1.37	0.19	0.845	0.259	0.900

SEM = standard error of mean.

pattern in intramuscular lipids as previously reported by Ostrowska *et al.* (2003) who found that dietary CLA administration tends to reduce C20:3, C20:4 and C22:6 fatty acids. Furthermore, Eggert *et al.* (2001) found that bellies from genetically lean pigs that had been fed with CLA had higher percentages of SFA and lower percentages of MUFA and PUFA than those from pigs not fed with CLA.

The effect of CLA on the lipid composition in pigs is broadly linked to a modification that these substances exert on desaturation mechanisms, i.e. a reduction in the D⁹ desaturase index and hence in the activity of Stearoyl CoA desaturase (SCD) (Lee *et al.*, 1998; Smith *et al.*, 2002), and eventually in a reduced

conversion of stearic into oleic by desaturation within adipose tissue. The same mechanisms could be responsible for modifying the relative proportions of the various polyunsaturated fatty acids. Smith *et al.* (1999) suggested that greater SCD activity may be associated with larger cell volumes in growing pigs. This hypothesis would explain the reduced adiposity often observed in pigs fed with CLA (Wiegand *et al.*, 2001; Tischendorf *et al.*, 2002b). However, neither Demaree *et al.* (2002) nor Smith *et al.* (2002) observed decreased adiposity in weanling pigs fed with CLA.

The effect of CLA on the lipid composition in pigs is broadly linked to a modification that these substances exert on desaturation

Table 6. Effects of dietary treatment on fatty acid profiles (% of total fatty acids) of semi-membranosus muscle

CLA	0%		0.5%		1.0%		SEM	Pr>F		
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow		CLA	Sex	CLA*Sex
C 10:0	0.12	0.10	0.10	0.09	0.10	0.09	0.008	0.376	0.329	0.911
C 12:0	0.09	0.09	0.11	0.12	0.12	0.14	0.007	0.041	0.492	0.798
C 14:0	1.25	1.27	1.61	1.76	1.95	1.91	0.116	0.017	0.767	0.843
C 16:0	24.00	23.61	27.31	28.57	28.34	27.81	0.396	0.001	0.812	0.281
C 16:1	3.14	3.40	3.53	3.93	3.90	3.71	0.322	0.504	0.716	0.725
C 18:0	11.52	10.19	12.96	13.37	13.01	12.41	0.640	0.092	0.519	0.650
C 18:1n9c	41.32	41.14	24.89	34.00	33.91	33.39	1.449	0.018	0.761	0.725
C 18:2n6c	14.87	16.17	15.06	13.88	13.67	14.88	1.170	0.733	0.755	0.713
C 18:3n3	0.74	0.88	0.87	0.68	1.06	0.86	0.134	0.602	0.611	0.609
C 20:0	0.15	0.14	0.16	0.15	0.14	0.12	0.011	0.379	0.320	0.957
C 20:3n6	0.53	0.55	0.56	0.50	0.52	0.55	0.023	0.892	0.906	0.447
C 20:4n6	1.70	1.74	1.20	1.29	0.89	1.36	0.287	0.361	0.568	0.845
C 22:6n3	0.57	0.73	0.56	0.59	0.61	0.78	0.107	0.747	0.382	0.886
<i>cis</i> 9, <i>tran</i> 11	0.00	0.00	0.77	0.85	1.23	1.44	0.073	0.001	0.307	0.618
<i>tran</i> 10, <i>cis</i> 12	0.00	0.00	0.34	0.25	0.57	0.58	0.021	0.001	0.332	0.235
SFA	37.12	35.40	42.24	44.05	43.64	42.45	0.792	0.001	0.703	0.308
UFA	62.88	64.60	57.76	55.95	56.36	57.55	0.792	0.001	0.702	0.308
SFA:UFA	0.59	0.55	0.73	0.79	0.78	0.74	0.023	0.001	0.810	0.279
MUFA	46.16	46.28	39.61	39.20	38.68	38.46	1.340	0.012	0.915	0.990
PUFA	16.72	18.32	18.15	16.75	17.67	19.09	1.382	0.872	0.746	0.704

SFA = saturated fatty acids; UFA = unsaturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids. SEM = standard error of mean.

mechanisms, i.e. a reduction in the D⁹ desaturase index and hence in the activity of Stearoyl CoA desaturase (SCD) (Lee *et al.*, 1998; Smith *et al.*, 2002), and eventually in a reduced conversion of stearic into oleic by desaturation within adipose tissue. The same mechanisms could be responsible for modifying the relative proportions of the various polyunsaturated fatty acids. Smith *et al.* (1999) suggested that greater SCD activity may be associated with larger cell volumes in growing pigs. This hypothesis would explain the reduced adiposity often observed in pigs fed with CLA (Tischendorf *et al.*, 2002b; Wiegand *et al.*, 2001). However, neither Demaree *et al.* (2002) nor Smith *et al.* (2002) observed decreased adiposity in weanling pigs fed with CLA.

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Table 7. Effects of dietary treatment on fatty acid profiles (% of total fatty acids) of longissimus muscle

CLA	0%		0.5%		1.0%		SEM	Pr>F		
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow		CLA	Sex	CLA*Sex
C 10:0	0.10	0.08	0.11	0.09	0.09	0.08	0.015	0.158	0.034	0.394
C 12:0	0.09	0.09	0.12	0.15	0.15	0.13	0.007	0.008	0.858	0.299
C 14:0	1.37	1.27	1.87	2.27	2.45	2.13	0.103	0.001	0.936	0.116
C 16:0	25.54	24.78	29.73	31.92	31.25	28.57	0.536	0.001	0.524	0.054
C 16:1	3.24	3.12	4.20	3.33	4.01	3.93	0.386	0.860	0.456	0.728
C 18:0	12.23	11.66	14.47	15.54	14.81	13.31	0.584	0.025	0.640	0.350
C 18:1n9c	42.45	40.71	36.63	31.70	32.61	33.76	0.834	0.001	0.104	0.107
C 18:2n6c	12.28	15.12	9.82	11.74	10.26	12.59	0.520	0.016	0.007	0.828
C 18:3n3	0.62	0.80	0.61	0.64	0.61	0.72	0.028	0.187	0.018	0.187
C 20:0	0.19	0.18	0.19	0.18	0.18	0.07	0.023	0.189	0.231	0.350
C 20:3n6	0.45	0.52	0.39	0.43	0.39	0.45	0.016	0.024	0.022	0.804
C 20:4n6	1.00	1.39	0.53	0.48	0.42	1.07	0.091	0.005	0.021	0.089
C 22:6n3	0.43	0.27	0.28	0.27	0.35	0.65	0.095	0.696	0.696	0.298
<i>cis</i> 9, <i>tran</i> 11	0.00	0.00	0.71	0.84	1.58	1.70	0.83	0.001	0.422	0.829
<i>tran</i> 10, <i>cis</i> 12	0.00	0.00	0.33	0.42	0.85	0.84	0.066	0.001	0.739	0.845
SFA	39.52	38.06	46.50	50.15	48.93	44.29	0.972	0.001	0.494	0.061
UFA	60.48	61.94	53.50	49.85	51.07	55.71	0.972	0.001	0.494	0.061
SFA:UFA	0.65	0.62	0.87	1.01	0.96	0.80	0.034	0.001	0.575	0.055
MUFA	46.96	45.21	41.36	35.52	37.04	38.76	1.327	0.011	0.408	0.338
PUFA	13.79	16.72	12.14	14.33	14.04	16.95	0.539	0.088	0.011	0.899

SFA = saturated fatty acids; UFA = unsaturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids. SEM = standard error of mean.

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