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Effect of Dietary Conjugated Linoleic Acid(CLA) on Fatty Acid Composition and Lipid Oxidation of Pork Loin

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SUMMARY

The effect of dietary conjugated linoleic acid (CLA) on fatty acid composition and lipid oxidation of pork was investigated. Pork loins from CLA-supplemented diet groups showed significantly ($p<0.05$) higher CLA content, compared to that of control group. The contents of arachidonic, linoleic, palmitic, and myristic acids were increased as well as CLA content by CLA-supplementation; however, the content of oleic acid was decreased. The content of CLA was not significantly ($p<0.05$) changed during chilled storage. TBARS of pork loin samples from CLA-supplemented groups (2.5% and 5%) was not significantly increased compared to that from control or 1% CLA-supplemented groups during storage. These results suggeste that dietary CLA revealed the inhibition of lipid oxidation with increasing the CLA content and changing the fatty acid composition.

INTRODUCTION

Conjugated linoleic acid(CLA) have been recognized as having anticarcinogenic and antioxidative properties in several animal models (Ha et al. 1987, 1990; Ip et al. 1991, 1994). CLA is produced in ruminants as a first intermediate in the biohydrogenation of dietary linoleic acid by the rumen bacteria *Butyrivibrio fibrisolvens* (Kepler et al. 1996). Consequently, foods derived from ruminant animals contain more CLA than the other foods from non-ruminant animals (Chin et al 1992). However, the CLA level of turkey lipid is similar to ruminant animals (Chin et al 1992) and intestinal bacteria of rats also have the ability to synthesize CLA from linoleic acid (Chin et al. 1994).

Much efforts have been contributed to increased CLA content in various foods. CLA contents in foods were effected by cooking, processing, and storage conditions (Ha et al. 1989; Shantha et al. 1992, 1994, 1995).

Given these positive biological functions of CLA, it is necessary not only to develop a techniques for the accumlation CLA in meat from non-ruminant animal but also to elucidate the role of CLA in muscle foods. Purpose of the present study is to produce value-added pork by feeding CLA as a diet additive and to investigate the effects of CLA on fatty acid composition and lipid oxidation during chilled storage (at 4℃) for 21 days.

MATERIALS AND METHODS

Each of twenty gilts (Landrace×Large White×Duroc) was randomly assigned to one of the following 4 diets for 4 weeks before slaughtering (slaughter weight was about 110 kg). Diets contained certain amount of CLA or corn oil by replacing their original lipids: Control, 5% corn oil; 1% CLA + 4% corn oil; 2.5% CLA + 2.5% corn oil; and 5% CLA. The CLA was chemically synthesized using corn oil by alkaline isomerization method and purified by the low-temperature precipitation method. The purified CLA was derivatized by 0.05N HCl in absolute methanol and analyzed by gas chromatography (GC). Pork loins were sampled at 24 hr postmortem. pH, TBARS, fatty acid composition and CLA concentration of the samples were measured at 2, 5, 8, 14, and 21 days of chilling storage at 4℃.

Lipids were extracted with a chloroform:methanol mixture as described by Folch et al. (1957). The extracts were concentrated using a rotorevaporator at 40℃ under nitrogen gas and stored at -40℃ for further analysis. Fatty acid methyl esters of samples were prepared by 0.05N HCl-catalyzed interesterification methanol and analyzed by gas chromatography (Shimadzu GC-14A, Japan) with a Silar capillary column (30 m×0.32 mm×0.25 μm). Thiobarbituric acid reactive substances (TBARS) was determined by a modified method of Witte et al. (1970). Analyses of all samples were conducted in triplicate. Data was analyzed by ANOVA with SAS (1996) at 5 % level of significance.

RESULTS AND DISCUSSION

Figure 1 shows the effect of dietary CLA supplementation on the accumulation of CLA in pork loin. The pork loin from CLA-supplemented diets showed significantly higher CLA content compared to that of control. Chin et al.

(1994) reported that intestinal bacteria of rats had the ability to synthesize CLA from linoleic acid; however, pigs subjected to the control diet did not have the ability to accumulate CLA in loin muscle. This result imply that dietary CLA is the only source to elevate CLA in pig muscle.

Table 1 shows the changes in TBARS during 21 days of storage at 4℃. The TBARS of the loins from control and 1% CLA groups were increased with increase in days of storage, whereas that of 2.5% and 5% CLA groups were not rapidly increased. There was a significantly difference in TBARS between control and CLA supplemented groups at storage 21 days. The contents of CLA were not significantly changed by chilled storage. It is assumed that lipid oxidation of pork loin might be affected, somehow, by the accumulated levels of CLA in meat. The changes in fatty acid composition by CLA accumulation in meat presented in Table 2. The contents of arachidonic, linoleic, palmitic, and myristic acids as well as CLA were increased by feeding CLA-supplemented diets; however, the content of oleic acid was decreased. This result might be due to, in part, inhibition of $\triangle^9$ desaturase acitivity by CLA (Lee, 1996).

It could be possible that the changes in fatty acid compositions were due to accumulation of CLA by dietary CLA supplementation and so lipid oxidation was inhibited. Further research, under strictly controlled conditions, is necessary to explain the relationship between CLA and lipid oxidation in muscle foods.

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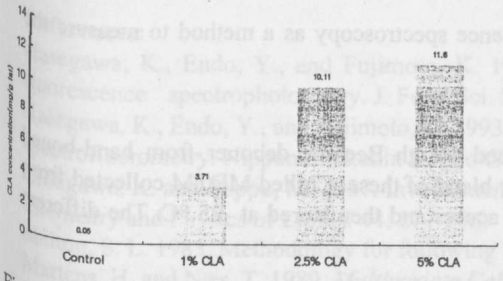

Figure 1. CLA content of pork loin fed various levels CLA. Control: 0% CLA + 5% corn oil, 1% CLA: 1%CLA + 4% corn oil, 2.5% CLA: 2.5% CLA + 2.5% corn oil, 5% CLA: 5% CLA + 0% corn oil.

Table 1. Effect of storage on TBARS of pork loins fed various levels of dietary CLA for 4 weeks.

Treatment[1]	Storage (days)				
	2	5	8	14	21
Control	$0.18^{Ba}(0.02^{TZ})$	$0.19^{Ba}(0.04)$	$0.22^{Ba}(0.02)$	$0.28^{Aa}(0.01)$	$0.30^{Aa}(0.04)$
1% CLA	$0.15^{Cb}(0.02)$	$0.16^{Cb}(0.02)$	$0.21^{Bab}(0.02)$	$0.24^{ABb}(0.02)$	$0.26^{Aa}(0.08)$
2.5% CLA	$0.14^{Bb}(0.02)$	$0.16^{ABb}(0.01)$	$0.18^{Abc}(0.04)$	$0.18^{Ac}(0.01)$	$0.20^{Ab}(0.02)$
5% CLA	$0.15^{Bb}(0.02)$	$0.15^{Bb}(0.05)$	$0.15^{Bc}(0.02)$	$0.18^{Ac}(0.01)$	$0.18^{Ab}(0.03)$

[1] Control: 0% CLA + 5% corn oil, 1% CLA: 1%CLA + 4% corn oil, 2.5% CLA: 2.5% CLA + 2.5% corn oil, 5% CLA: 5% CLA + 0% corn oil.

[2] A,B,C : Means with different superscript in the same row significantly different at P<0.05.

a,b,c,d : Means with different superscript in the same column significantly different at P<0.05.

Table 2. Effect of storage on fatty acid content of pork loin fed various levels of dietary CLA

Fatty acids	Treatment[1]			
	Control	1% CLA	2.5% CLA	5% CLA
	mg/g fat			
C10:0	3.51	4.13	2.73	2.80
C12:0	2.71	3.65	2.50	2.45
C14:0	31.82	36.03	33.74	33.01
C15:0	2.01	1.81	1.75	1.57
C16:0	315.99	340.31	316.55	320.50
C18:0	109.98	120.76	139.84	127.62
C18:1	386.58	339.70	333.83	379.59
C18:2	134.73	139.41	146.63	142.11
LN	6.65	6.15	6.85	4.51
C19:0	1.57	1.70	1.70	1.89
C20:4	2.44	2.69	3.01	3.12
DTR	0.27	0.28	0.19	0.37
DPE	0.30	0.37	0.42	0.35

[1] Control: 0% CLA + 5% corn oil, 1% CLA: 1% CLA + 4% corn oil, 2.5% CLA: 2.5% CLA + 2.5% corn oil, 5% CLA: 5% CLA + 0% corn oil.