

Conjugated Linoleic Acid (CLA) in Diets of Beef Steers Results in Higher Red Color Scores and Lower Lipid Oxidation of Irradiated Ground Beef Patties

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Introduction

Feeding CLA 60 to market pigs resulted in decreased thiobarbituric acid (TBA) values (less oxidative rancidity) in fresh pork chops and increased Hunter a* values (redder colored patties) in fresh pork patties. Also, fresh pork patties from pigs supplemented with CLA had increased Hunter a* values and decreased TBA values in irradiated fresh pork patties when compared with control pork patties. These results prompted us to ask if we could improve the quality of irradiated beef patties containing CLA.

Our hypothesis was that feeding CLA 60 during the finishing phase to beef steers would result in increased levels of CLA 60 in the ground beef product, thus improving red color and decreasing oxidation after irradiation of ground beef patties.

The objectives of this study were to:

- 1) feed finishing beef steers two levels of dietary CLA 60,
- 2) formulate and irradiate lean (90/10) beef patties, and
- 3) determine color and lipid oxidation values of irradiated beef patties from CLA-supplemented steers.

Materials and Methods

Thirty continental-crossbred steers (360 kg) were randomly allotted to dietary groups by live weight and ultrasound 12th rib fat depth. Three diets of 0, 1 and 2.5% CLA were formulated with Ca⁺⁺ salts of CLA 60 to protect against rumen degradation. All steers averaged 130 d on feed.

Steers were harvested according to standard operating procedures. Individual beef inside round samples were collected and ground through a 1/2" plate and frozen. Then individual beef samples were pooled by pen, and reground and mixed. Each meat block was pattied, and patties were boxed and frozen according to pen and diet group.

One half of each batch of patties within a pen and diet group were subjected to electron beam irradiation. These beef patties were irradiated in a single layer on styrofoam trays with oxygen permeable PVC covering. The irradiation dose was set at 3 Kgy with a conveyor speed of 12.29 feet/min.

Three replications of each pen x diet group were evaluated for Hunter color and lipid oxidation. L*, a*, and b* values were obtained by using a Hunter Labscan system, and lipid oxidation was measured by using the thiobarbituric acid method.

Fat percentage was determined by difference using the Folch extraction method. Extracted lipids were methylated w/ sodium methoxide to obtain fatty acid methyl esters (FAMES). FAMES were analyzed for fatty acid and CLA profile by using gas chromatography and internal standards. Fatty acid peaks were compared with known retention times of the standards to determine quantity of fatty acids.

The statistical analysis was a completely randomized design with fixed effects of diet, pen, replication, and level of irradiation. The General Linear Model procedure of SAS (1990) was employed and statistical significance was set at $P < 0.05$.

Results and Discussion

Color of patties was improved significantly by feeding 2.5 percent CLA (Table 1). Hunter a* values (redder) were higher (> 0.05) for patties irradiated by 3 kilogray (Kgy) (Table 1). These results demonstrate that antemortem feeding of CLA to market steers would improve the color of ground beef patties.

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Table 1. Hunter color values for ground beef patties by irradiation and CLA levels.

Irradiation Level CLA (%)	0 KGy			3 KGy			SEM
	0	1.0	2.5	0	1.0	2.5	
L*	37.9 ^a	37.9 ^a	39.3 ^b	37.1 ^a	36.9 ^a	38.6 ^b	0.20
a*	14.0	14.9	15.0	7.13 ^a	6.88 ^a	9.57 ^b	0.40
b*	12.3 ^a	12.5 ^{ab}	12.9 ^b	10.4 ^a	10.3 ^a	11.4 ^b	0.12

Means within a row by irradiation dose with different letters are significant at P <0.05.

As observed in Figure 1, TBA values were lower (less oxidation products) in ground beef patties from beef steers fed CLA. This would suggest these patties would have a more desirable flavor and longer shelf life. Data in Table 2

show that the percentage of saturated fatty acids increased with the percentage (14:0, 16:0, and 18:0) of dietary CLA. Linolenic acid (18:3), however, increased as the dietary level of CLA increased.

Table 2. Percentage of fatty acids in ground beef patties by dietary CLA level.

Fatty Acid	Dietary (CLA %)			SEM = .219
	0	1.0	2.5	
14:0	2.8a	3.7b	3.5b	
16:0	24.9a	25.6b	25.9b	
18:0	14.6a	15.4b	17.2c	
16:1	3.4	3.2	2.7	
18:1	39.6a	35.6b	31.3c	
18:2	3.4	3.3	3.4	
18:3	5.8a	7.7b	9.4c	
20:4	0.7	0.6	0.5	

Means within a row with different letters are significant at P <0.05.

Three major isomers were observed to increase in ground beef patties with increasing level of percentage dietary CLA. These results suggest that consumption of ground beef patties with higher amounts of CLA isomers could be

more healthful. CLA in the diets of lab animals has been shown to prevent/reduce cancer, heart disease, and obesity, and enhance the immune system. Consequently, eating foods containing CLA may be more healthful.

Table 3. CLA Isomers (%) in Ground Beef Patties by Dietary CLA Level

CLA isomer	Dietary (CLA%)		
	0	1.0	2.5
<i>cis</i> 9, <i>trans</i> 11	0.49	0.65	0.78
<i>trans</i> 10, <i>cis</i> 11	0.00	0.17	0.34
<i>trans</i> 9, <i>trans</i> 11	0.005 ^a	0.55 ^b	1.06 ^c

SEM = .219

Means within a row with different letters are significant at P <0.05.

The conclusions drawn from this study of feeding dietary CLA to beef steers were:

- 1) The red color of irradiated ground beef as measured by Hunter a* values was improved.
- 2) TBA values for control and irradiated ground beef were decreased.
- 3) Saturated fatty acids were increased, and unsaturated fatty acids were decreased in lean ground beef.
- 4) The CLA isomer content of ground beef patties was increased over controls.

Implications

The inclusion of dietary CLA calcium salts to finishing beef cattle diets could prove useful in retaining a more desirable color. And decreasing lipid oxidation values could prove to give a more desirable ground beef flavor to irradiated ground beef patties.