Quality Characteristics of Irradiated Chicken Breast Rolls from Broilers Fed Different Levels of Conjugated Linoleic Acid

A.S. Leaflet R1860

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Summary and Implications

Dietary CLA treatment reduced color a*- and b*-values of cooked chicken breast rolls. Sensory panels rated the color of cooked chicken rolls with CLA treatments darker than the control. The production of CO in cooked chicken rolls increased dramatically after irradiation and was correlated with the increased redness of cooked chicken rolls after irradiation. Irradiation greatly increased volatile production and induced a metallic off-flavor in chicken rolls. The hardness of chicken rolls increased and juiciness decreased as the dietary level of CLA increased, and consumer preferred the color of cooked chicken rolls after irradiation to the nonirradiated ones. Although dietary CLA was somewhat positive in reducing pinkness, but negatively influenced to the eating quality of irradiated cooked chicken rolls.

Introduction

Feeding conjugated linoleic acid (CLA) to animals could be a good method to obtain foods containing CLA for human consumption. However, CLA may affect the sensory characteristics of meat, milk or egg significantly. Irradiation has been shown to induce quality changes in meats. The most obvious quality changes in meat after irradiation are flavor and color. Irradiation induced the formation of a characteristic off-odor, and increased the redness of raw and cooked meat. The objective of this study was to determine the effect of irradiation and dietary CLA on the volatile, color, and sensory characteristics and the consumer acceptance of cooked chicken rolls.

Materials and Methods

One hundred twenty, 3-week-old broiler chickens were assigned to each of the three dietary treatments containing 0, 3.3% or 5% of commercial CLA source (60% CLA, composed of approximately 1/3 *cis*-9, *trans*-11, 1/3 *trans*-9, *trans*-11 and 1/3 *trans*-10 CLA isomers). After 5 weeks of feeding trial, chickens were slaughtered. Breast muscles were separated from the carcasses and used to make breast rolls and cooked in an 85°C smoke house. The rolls were sliced and individually packaged in vacuum bags, and irradiated by electron-beam at 0 or 2.5 kGy. The color, gas production, volatiles, TBARS, ans sensory characteristics of rolls were determined.

Results and Discussion

Color a*-value of rolls significantly increased after irradiation. When the effect of dietary CLA on the color of chicken rolls was compared, both a*- and b*-values decreased as the dietary CLA level increased, which made the appearance of chicken rolls from CLA diets dark or gray. Table 2 indicated that the production of CO in chicken rolls increased significantly after irradiation, but the amounts of gases reduced as the dietary CLA level increased. The decreased gas (CO) production as the dietary CLA level increased should be related to the decreased redness of chicken rolls as dietary CLA levels increased (Table 1).

Irradiation increased the TBARS values of rolls from chickens fed dietary CLA (Table 2). As dietary CLA level increased, the TBARS values of chicken rolls decreased. The decreased TBARS with the increase of dietary CLA should be caused by the reduced proportion of unsaturated fatty acid content in meat after dietary CLA treatments.

After irradiation, the total amount of volatiles in chicken rolls doubled compared with that before irradiation. Among the four sulfur compounds detected, dimethyl disulfide increased more than twenty-fold after irradiation, and methylthioethane and methanethiol were detected only in irradiated chicken rolls. The production of these volatiles should be related to the irradiation flavor detected by sensory panelists.

Sensory panelists also detected significant color differences in chicken rolls before and after irradiation (Table 3). Sensory panelists detected higher chickeny flavor in rolls from control diet, and the intensity of chickeny flavor decreased as the dietary CLA levels increased. Considering the decrease in the amounts of thiourea and propanal as the CLA level increased, these two volatile compounds could be closely related to the chickeny flavor in chicken rolls.

The texture of chicken rolls became harder and the juiciness decreased as the dietary CLA level increased. The changes in hardness and juiciness could be caused by the changes in fatty acid composition after feeding CLA. Dietary CLA reduced the proportion of unsaturated fatty acid, and thus, increased the melting point of lipids, which could make chicken rolls from high dietary CLA treatments taste drier than the control. The changes in texture of chicken rolls with dietary CLA treatments could also be caused by the difference in protein content, because CLA has been reported to increase protein content in muscle.

The intensity of off-flavor was higher in CLA treated chicken rolls both with or without irradiation (Table 2). However, irradiation reduced the acceptance of flavor significantly (Table 3). In general, consumers did not like the flavor induced by irradiation.

Conclusions

Dietary CLA had a negative effect on the quality of chicken rolls due to increased darkness in color, hardness in texture, reduced juiciness, and increased off-odor. Therefore, the levels of CLA supplementation used in this study (2% and 3%) should be avoided due to the decrease in quality though lower levels should be investigated for quality enhancement. Irradiation increased the redness of chicken rolls, and consumers preferred the color of irradiated chicken rolls. However, irradiation induced a metallic off-flavor in chicken rolls and had a significant negative effect on consumer acceptance. The color changes in chicken rolls could be related to the production of CO while off-flavor production might be related to the large increase in acetaldehyde after irradiation.

Table 1. **Color of chicken breast rolls after irradiation**

Dietary	Color L*		Color a*		CO		TBARS	
treatment	0 kGy	2.5 kGy	0 kGy	2.5 kGy	0 kGy	2.5 kGy	0 kGy	2.5 kGy
					--------- (ppm) -------		------TBARS -------	
0% CLA	82.8	82.8	9.1^{bx}	10.9^{ax}	657^{bx}	1106^{ax}	0.67^{x}	0.67^{x}
2% CLA	83.0	82.9	8.5^{bxy}	10.3^{axy}	568^{by}	960^{ay}	0.52^{by}	0.60^{ax}
3% CLA	82.3	83.2	8.2^{by}	9.6^{ay}	488^{bz}	904^{ay}	0.39^{bz}	0.49^{ay}

Table 2. **Sensory characteristics of chicken breast rolls by trained sensory panels**

		Dietary CLA (%)		
Descriptor	Irradiation	0%	2%	3%
Color	0 kGy	3.5^{y}	4.1^{y}	4.9
	2.5 kGy	5.6^{x}	6.6^{x}	6.6
Chicken aroma	0 kGy	8.0^{a}	6.0^{b}	5.9^{b}
	2.5 kGy	6.9	5.9	7.2
Off-flavor	0 kGy	3.9	4.1^{y}	4.9^{y}
	2.5 kGy	5.3^{b}	7.1^{bx}	9.3^{ax}
Hardness	0 kGy	4.5^{b}	6.1^{ab}	7.3^{a}
	2.5 kGy	5.2^{b}	6.2^{ab}	7.4^{a}
Juiciness	0 kGy	6.9^{a}	5.9^{ab}	4.7^{b}
	2.5 kGy	6.8^{a}	5.7^{ab}	4.7^{b}

[1]Color: 0 = white, 15 = dark; chicken aroma: 0 = weak 15 = strong; off-flavor: 0 = weak, 15 = strong; hardness: 0 = soft, 15 = hard; juiciness

Table 3. **Consumer acceptance of irradiated chicken breast rolls**

		Dietary CLA (%)		
Descriptor	Irradiation	0%	2%	3%
Flavor	0 kGy	5.7^{x}	5.9^{x}	5.7^{x}
	2.5 kGy	4.5^{y}	4.0^{y}	4.3^{y}
Color	0 kGy	5.3^{y}	5.2	5.4
	2.5 kGy	6.0^{x}	5.7	5.8
Overall	0 kGy	5.9^{x}	6.0^{x}	5.9^{x}
	2.5 kGy	4.8^{y}	4.4^{y}	4.8^{y}

[1]"Dislike extremely = 1" to "like extremely = 9"