EFFECTS OF DIETARY GROUND FLAXSEED ON COLOUR AND LIPID STABILITY IN BEEF *LONGISSIMUS DORSI*

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Introduction

Flaxseed (*Linum usitatissimum*) is high in omega-3 fatty acids, especially α-linolenic acid (C18:3n3). Many potential health benefits may be possible through the consumption of more omega-3 fatty acids (Alexander, 1998; Harbige, 1998). Flax-fed beef had increased polyunsaturation (Scollan *et al.*, 2001), decreased lipid stability (Wood *et al.*, 1999), and decreased colour stability (Hutchins *et al.*, 1967). Flax-fed beef without vitamin E in the diet had a ten-fold increase in C18:3n3 but decreased colour stability when compared to the control (LaBrune *et al.*, 2002). Drouillard *et al.* (2002) found that including vitamin E in the diet for flax-fed beef still resulted in increased C18:3n3 but the meat had similar colour stability to that of non-flax fed beef. The objectives of this study were to determine the effects of dietary flax on fatty-acid composition and lipid and myoglobin oxidation in beef *longissimus*.

Materials and Methods

Beef *longissimus dorsi* steaks (2.54 cm thick) from grain-fed Holstein steers fed 0% ground flaxseed (control, n=15) or 10% ground flaxseed dry matter basis with vitamin E (n=15) for 180 d were packaged in polyvinyl chloride film over wrap 11 d post-mortem. Steaks were displayed under continuous fluorescent lighting at 1°C for 5 d with instrumental CIE L*a*b* measurements taken daily. Trained visual panellists (n=6) evaluated muscle colour each day of display. Initial beef colour was evaluated using an eight-point scale, where 1=bleached red, 4=cherry red, and 8=very dark red. Muscle colour stability was measured using a five-point scale where 1=very bright cherry red, 2=bright cherry red, 3=slightly dark red to tannish red, 3.5=borderline acceptable, 4=moderately grayish tan to brown, and 5=tan, to brown to the nearest half-point. Metmyoglobin reducing activity (MRA) was determined on d 0 and 5 of display by reduction of nitric oxide metmyoglobin reduction using a modified procedure of Watts *et al.* (1966), where MRA = (observed decrease in metmyoglobin concentration / initial metmyoglobin concentration) × 100. 2-Thiobarbituric acid reactive substances (TBARS) were measured on d 0 and 5 of display as an indication of lipid oxidation by using a slightly modified method to that described by Witte *et al.* (1970). Fatty acid composition was determined from *longissimus dorsi* samples using gas chromatography (Sukhija and Palmquist, 1988). The PROC MIXED procedure of SAS® (SAS Institute, Inc., Cary, NC) was used to analyze the data.

Results and Discussion

Carcasses from both feeding regimens graded USDA Select, and those fed 0% flax had a yield grade of 2.9 and pH of 5.7 compared with 3.0 and 5.8, respectively, for the 10% flax group. Initial beef colour (cherry red) was the same ($P > 0.05$) for both 0 and 10% flax treatments. Visual colour during display remained the same ($P > 0.05$) for both treatments, but scores decreased throughout display (Table 1). There were no diet × day interactions for any additional colour traits including L*, a*, or b*, a*/b*, hue angle, and saturation index (data not shown). Metmyoglobin-reducing activity decreased ($P < 0.05$) throughout display as expected with d 0 having 90.7% metmyoglobin reduced and d 5 having 65.5% reduced but there were no differences ($P > 0.05$) between treatments.

Table 1: Means for visual colour scores[a] from 0 to 5 d of display of steaks from steers fed 0 and 10% flax.

	Time (days)						
	0	1	2	3	4	5	SE
Visual colour scores	2.5[b]	2.9[c]	3.0[c]	3.1[c]	3.4[d]	3.6[e]	0.12

[a]1=very bright cherry red, 2=bright cherry red, 3=slightly dark red to tannish red, 3.5=borderline acceptable, 4=moderately grayish tan to brown, and 5=tan to brown
[b-e]Means with different superscript letters are different ($P < 0.05$)

Fatty acid composition was affected by flax in the diet; steaks from cattle fed 10% flax had more ($P < 0.05$) omega-3 fatty acids (C18:3 *n*-3, C20:5 *n*-3, and C22:5 *n*-3; Figure 1) and fewer ($P < 0.05$) total *n*-6 to total *n*-3 fatty acids (Figure 2) than those steaks from cattle fed 0% flax. Regardless of differences in fatty acid composition, TBARS values were very low (less than 0.12 for both treatments throughout display), and although statistically different, of no practical importance.

Figure 1: Total n-3 fatty acids from cattle fed 0 or 10% flax

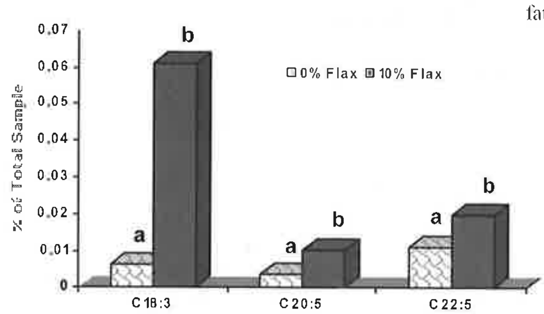
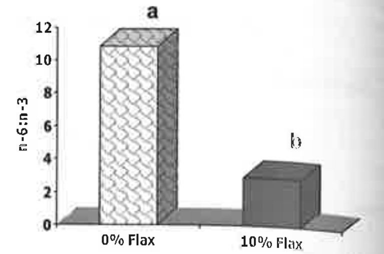


Figure 2: Comparison of total n-6 to n-3 fatty acids from cattle fed 0 or 10% flax



[ab]Means with different superscript letters differ $P < 0.05$

LaBrune *et al.* (2002) found that steaks from cattle fed flax without vitamin E had lower colour stability than steaks from control cattle. When vitamin E was included in the diet of cattle fed flax, colour stability was equal to that of steaks from control animals (Drouillard *et al.*, 2002). The current study confirms that vitamin E should be included in the diet of cattle fed flax and will not compromise the change in fatty acid composition occurring from including flax in the diet. In addition, it appears that the MRA of muscle does not decrease with the increase in fatty acid unsaturation as colour stability between the two groups was similar.

Conclusions

Including 10% flax and vitamin E in beef-cattle diets will increase the percent of unsaturated fatty acid and notably increase the omega-3 fatty acids. Including flax in the diet of cattle would have positive effects for the health profile of fatty acids without compromising colour or lipid stability.

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