Quality of Holstein Beef

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Introduction

The dairy cattle industry makes a significant contribution to the domestic supply of beef in the U.S. Dairy cows account for 22% of all cows (LMIC, 2007), but due to few lactations per cow and therefore high cowherd turnover, they are 50% of total cow slaughter (LMIC, 2007). Since the Holstein breed accounts for 93% of dairy cows (NAHMS, 2002) this breed is the principal contributor to dairy beef supplied. All weaned heifer calves are utilized as herd replacements. Consequently, Holstein females only contribute to the U.S. beef supply via the culled cow harvest. Bull calves are either utilized as feeder calves for beef production, accounting for 75-80% of the bull calf crop, or for special-fed veal production. Beef derived from finished Holstein cattle is almost completely from steers. Based on information from NAHMS (2002) for calving interval and calf death loss, and assumptions for gender distribution, steer placement into feedlots and steer mortality, Schaefer (2005) estimated that Holstein steers account for approximately 8% of U.S. annual fed steer and heifer harvest. This estimate exceeds the Holstein hide color frequency of 5.7% (McKenna et al., 2002) in the 2000 National Beef Quality Audit.

Prices for Holstein steers are typically discounted relative to beef breed steers and heifers at comparable live weights (Buhr et al., 1996). Burdine et al. (2005) addressed perceptions of poor quality ascribed to Holstein steers. Specifically, they addressed the allegation that the Holstein beef market is driven by the ground beef market. From their econometric analysis, they concluded that finished Holstein steer price was influenced by the Choice cutout price, value of hide and offal, and price premium for Prime. These same factors are influential in the traditional beef sector. Finished Holstein price was not related to the price of 85% trim and its responsiveness to a Prime premium indicated that buyers recognize that Holstein steers can contribute to the supply of USDA Prime beef. Buege (1988) considered this pricing differential in terms of the following factors: dressing percentage, sub-primal yield and value, hide value, value of trimmings, drip loss, fresh meat color stability and consumer acceptability. Yield differences between Holsteins and traditional beef breeds exist (Schaefer, 2005; Rust and Abney, 2005). This review focuses on Holstein meat quality traits.

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Fresh Meat Color

Lean color is an important meat package selection criterion by consumers (Killinger et al., 2004). Bright, cherry-red is usually preferred but dark red is preferred by a subset of U.S. consumers. Lean maturity score has been assessed in two large-scale surveys of U.S. fed-beef carcasses. McKenna et al. (2002) found no difference between native and dairy carcasses in lean maturity score. Page et al. (2001) made the same observation, but found dairy ribeye lean to be less white, less red and less yellow than native beef carcasses. Chromameter measurements of Muir et al. (2000) indicated similar color differences between Holstein and Hereford steers at 27 mo of age. Comparing German Angus and Holstein Friesian breeds, Wegner et al. (2000) reported no breed difference in whiteness (L*) for bulls at 12-24 mo of age. Faustman and Cassens (1991) compared Holstein and crossbred beef muscles at 48 hr postmortem and found more rapid metmyoglobin accumulation and lipid oxidation by the Holstein longissimus and gluteus medius. Subsequently, Arnold et al. (1993) fed three dietary concentrations of vitamin E to Holstein and beef crossbred (Angus, Hereford, Charolais) steer calves from 200 kg to harvest. There was no difference between breed groups in terms of metmyoglobin accumulation during simulated retail display of the same two muscles, yet lipid oxidation tended to be greater in longissimus samples from Holstein versus crossbred steers. This report also provided convincing evidence for the responsiveness of fresh meat color in Holstein beef to vitamin E supplementation.

Drip Loss

Drip loss is sarcoplasmic fluid that exudes from fresh meat during package storage or retail display. It is unsightly to meat product managers and consumers, and constitutes a reduction in saleable weight. Page et al. (2001) accessed carcasses at the time of USDA grading (d1 or d2) and meas-

ured higher electrical impedance in the loin of dairy-type versus beef-breed carcasses, suggesting the presence of less extracellular water. However, Mitsumoto et al. (1995) found that longissimus on d7 postmortem displayed greater drip loss and more histological evidence of fiber disruption if it was derived from Holstein steers. Supplemental vitamin E caused a reduction in drip loss and was associated with less muscle fiber disruption in both Holstein and beef-breed meat. Inconsistent effects of vitamin E on drip loss by longissimus, semitendinosus and psoas muscles have been noted (den Hertog-Meischke et al., 1997; Mitsumoto et al., 1998).

Tenderness

Rust and Abney (2005) reviewed 11 studies involving Holstein and beef steers with regard to tenderness and eight of these studies reported Holstein beef to be equally or more tender. Muscle fiber number was unchanged postnatally and the actual and temporal distributions of muscle fiber types were similar for Holstein and Angus breeds (Wegner et al., 2000). Muir et al. (2000) found Hereford and Friesian steers to not differ in Psoas major total and soluble collagen content or in μ– or m–calpain or calpastatin activities. Tenderness reduction was noted in Holstein steers that received three successive anabolic implants (Scheffler et al., 2003).

Aroma

Diet affects the fatty acid profile of beef. Meat from cattle finished on cereal grain diets is enriched in *n*-6 fatty acids, while meat from cattle finished on forage diets is enriched in *n*-3 fatty acids. Elmore et al. (2004) finished Holstein and Angus steers on grass silage or barley-based diets in a factorial arrangement of treatments. Breed did not affect fatty acid profile, though the ratio of polyunsaturated to saturated fatty acids was elevated in Holstein longissimus. Of 68 volatile compounds quantified from cooked beef, diet affected 22 volatiles while breed affected four volatiles. Holstein beef had elevated concentrations of 1- and 2-phytene from chlorophyll oxidation, lower acetone, and higher S-methyl thioacetate in headspace gas.

Summary

There are some minor differences in bloomed color and fresh meat color stability due to Holstein breeding, but this limitation can be corrected by dietary vitamin E supplementation. Holstein beef is mainly not different from beef-breed meat in tenderness. Vitamin E effects on drip loss are not uniformly explained by invoking benefits in membrane integrity. Diet has more effect on fatty acid profile and profile of cooked beef volatile compounds than breed.

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