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Fatty acid profiles, meat quality, and sensory attributes of organic versus conventional dairy beef steers

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ABSTRACT

Meat from Holstein and crossbred organic and conventional dairy steers were evaluated and compared for fatty acid profiles, meat quality, sensory attributes, and consumer acceptance. Bull calves (n = 49) were randomly assigned to 1 of 3 replicated groups: conventional (CONV), organic (ORG, pasture + concentrate), or grass-fed organic (GRS) and were born at the University of Minnesota West Central Research and Outreach Center (Morris, MN) between March and May 2011. The CONV steers (n = 16) were fed a diet that contained 80% concentrate and 20% forage, and ORG steers (n = 16) were fed a diet of organic corn, organic corn silage, and organic protein supplement. Furthermore, ORG steers consumed at least 30% of diet dry matter of high-quality organic pasture during the grazing season. The GRS steers (n = 17) consumed 100% forage from pasture during the grazing season and high-quality hay or hay silage during the nongrazing season. The ORG steers had fat that was greater in oleic acid (C18:1) than the GRS and CONV steers (47.1, 36.1, and 39.9%, respectively). The GRS steers (21.9%) were lower for monounsaturated fat than the ORG (42.1%) and CONV (40.4%) steers. Furthermore, the GRS steers tended to have greater n-3 fat and had lower n-6 fat than the ORG and CONV steers. Consequently, the GRS (1.4%) steers had a lower n-6-to-n-3 fat ratio than the ORG (12.9%) and CONV (10.0%) steers. The GRS (2.6 kg) steers had steaks that were not different for Warner-Bratzler shear force than ORG (2.3 kg) steaks; however, the GRS steaks tended to have greater shear force than the CONV (2.0 kg) steaks. The 3 steer group had steaks that were not different for color brightness (L*; 0 = black and 100 = white) and yellowness/blueness (b*; positive values = yellow and negative values = blue) values; however, the GRS (10.5) steaks had lower redness/greenness (a*; positive values = red and negative values = green) values than CONV (14.5) steaks. For sensory attributes (0- to 120-point scale), no differences were observed for ORG (71.3) and CONV (69.2) steers for overall consumer liking of the beef; however, the GRS (56.3) steers had the lowest overall liking among beef consumers. The ORG (73.3) steers had greater flavor liking than the GRS (56.8) and CONV (69.2) steers. Conversely, the GRS (6.3) steers had the highest scores for off-flavor (0- to 20-point scale) compared with the ORG (3.9) and CONV (4.1) steers. The results of the current study suggest that a potential market may exist for organic grass-fed dairy steers in the United States, but quality and consistency of the beef needs to be improved.
Key words: organic, dairy steer, grass-fed, n-3 fatty acid

INTRODUCTION

The organic beef industry is in the early stages of development in the United States; however, markets for organic meat have expanded rapidly over the past decade as consumers consider potential human health and environmental benefits (Dimitri and Oberholtzer, 2009). As consumers are demanding natural, local, organic, and grass-fed animal products, an opportunity exists for organic dairy producers to capitalize on the growing organic beef industry (Gillespie and Nehring, 2013).

The USDA National Organic Program (**NOP**) standards became effective in 2002 and address production, processing and labeling, certification, recordkeeping, and inputs allowed in organic farming and processing (USDA-NOP, 2012). Pasture and land for production of organic crops must not have had any prohibited substances, such as synthetic fertilizers or pesticides, applied to it 3 yr before the first use of the crop for organic purposes (USDA-NOP, 2012). All certified organic livestock must be fed organic feed from certified organic land, and all cattle over 6 mo of age are required to receive at least 30% of their DMI from pasture for at least 120 d during the grazing season each year.

Growth hormones and antibiotics are not allowed to be provided to livestock in organic production systems. However, it is forbidden to withhold medical treatment from a sick animal to keep its organic status (USDA-

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NOP, 2012). If beef is to be labeled and sold as organic, it must be harvested at a plant that is certified organic and federally or state inspected.

Most beef consumers in the United States prefer the taste of conventional grain-fed beef, and the United States cattle industry most commonly finishes animals on a corn-based ration (Daley et al., 2010). Conversely, in the European Union, beef consumers assert that meat from livestock managed under less intensive production systems has superior taste than meat from intensive production systems (Priolo et al., 2001). Currently, several consumers are evaluating their food-purchasing decisions and are considering pasture-fed beef as an alternative (Steinberg et al., 2009).

Saturated fat, *trans* fat, and cholesterol have become major health concerns for consumers (Daley et al., 2010). Conjugated linoleic acids are a group of FA that possess human health benefits (Razminowicz et al., 2006), and conjugated linoleic acids and n-3 FA are greater in cattle fed high-forage and pasture diets compared with cattle fed high-grain rations (Poulson et al., 2004; Daley et al., 2010). However, for consumer sensory evaluation, Steinberg et al. (2009) reported that United States beef consumers preferred grain-fed beef compared with grass-fed beef for flavor, juiciness, and tenderness.

Organic dairy bull calves may represent a potential resource for pasture-raised beef in the United States as an alternative to conventional feedlot-raised beef. The hypothesis of the current study was that meat from conventional dairy steers would have greater meat quality and greater consumer acceptance than meat from organic dairy steers; however, the meat from organic dairy steers would have greater levels of beneficial FA than meat from conventional dairy steers. Therefore, the objectives of this study were to compare conventional (**CONV**), organic (**ORG**), and organic grass-fed (**GRS**) dairy steers for FA profiles, Warner-Bratzler shear force (**WBSF**), objective color scores, and consumer acceptability. A companion paper (Bjorklund et al., 2014) reported results from the same steers for growth performance, carcass characteristics, and profitability.

MATERIALS AND METHODS

The study was conducted at the University of Minnesota West Central Research and Outreach Center (**WCROC**; Morris) and all animal care and management was approved by the University of Minnesota Institutional Animal Care and Use Committee recommendations (Animal Subjects Code no. 1104B98412). The University of Minnesota WCROC organic dairy has been certified organic since June 2010. A detailed description of the study and management of the organic dairy beef steers compared with conventional dairy beef steers is in Bjorklund et al. (2014).

Dairy bull calves (n = 49) were born at the University of Minnesota WCROC between March and May 2011. Breed groups of calves were Holsteins (**HO**; n = 9) selected for high production; Holsteins (n = 11) maintained at 1964 breed average level; crossbreds (n = 19) including combinations of HO, Montbéliarde, and Swedish Red; and crossbreds (n = 10) including combinations of HO, Jersey, Swedish Red (**HI**), and Normande (**LO**). Calves were assigned to 1 of 3 replicated groups (2 pens per group) at birth: **CONV** (n = 16), **ORG** (n = 16), or **GRS** (n = 17).

During the preweaning phase, all calves were fed 1.5% of birth weight of 13% TS organic unpasteurized whole milk once daily and weaned when the youngest calf in the group reached 90 d of age and consumption of starter averaged 0.91 kg starter/calf per day. The CONV calves were fed a conventional calf starter and ORG steers were fed an organic calf starter from 3 d of age. However, GRS steers were not provided calf starter, but were fed free-choice organic grass hay from 3 d of age. Postweaning, the CONV steers were moved to a cross-ventilated feedlot barn at the WCROC with 2.79 m^2/head of space and fed a diet of 67% concentrate and 33% roughage. Upon reaching a BW average of 204 kg, CONV steers were fed a diet of 80% concentrate and 20% forage. The TMR consisted of corn silage, dried distillers grains with solubles, dry corn, grass hay, soybean meal, and minerals.

The ORG and GRS steers were moved to permanent organic cool-season pasture postweaning and rotated to a new paddock every 3 d. For the ORG steers, at least 30% of DMI was from pasture during the grazing season. Furthermore, the ORG steers were supplemented with an organic TMR during the grazing and winter seasons containing organic corn, organic expelled soybean meal, organic corn silage, and organic-certified minerals. The GRS steers grazed pasture during the grazing season and were fed high-quality hay or hay silage during the nongrazing season, along with free-choice minerals during the grazing season.

Strip Loin Collection

Carcasses were selected randomly, within breed group, before carcass data collection and, subsequently, fabricated after chilling for 24 h according to North American Meat Processors guidelines (NAMP, 2002). One strip loin was removed from 8 carcasses from each treatment group, CONV (slaughter conducted on July 24, 2012), ORG (slaughter conducted on September 19, 2012), and GRS (slaughter conducted on November 13,