

Report to the Ontario Forage Council

1. Project Title: Effects of Forage Species and Breed on Altering Fatty Acid and Iron Composition in Beef and Influencing Meat Quality with Forage Finishing

2. Name, address, phone and e-mail of Researcher:

Ira Mandell

Department of Animal & Poultry Science

University of Guelph, Guelph, Ontario N1G 2W1

(519-824-4120, Ext. 5-3337); (Fax: 519-767-0573);

[e-mail:IMANDELL@UOGUELPH.CA](mailto:IMANDELL@UOGUELPH.CA)

3. Executive Summary:

Two research studies were conducted to examine the effects of cattle breed and forage source on growth performance, carcass characteristics, eating quality, shelf life, and fatty acid and iron composition of forage finished beef relative to a grain finished product. Study 1 examined the use of conserved forages using alfalfa and grass silages fed at 3 forage to concentrate ratios (90% forage/10% concentrate, 50% forage/50% concentrate, and 13% forage/87% concentrate) to implanted British and Continental steers. The 2 species of forages were used due to differences in concentrations of the omega-3 fatty acid, linolenic acid. In addition, alfalfa silage was fed to nonimplanted cattle to emulate natural beef production using 2 forage to concentrate ratios (90% forage/10% concentrate and 13% forage/87% concentrate). Cattle were also limit fed a 90% forage/10% concentrate diet for 100 days and then either placed on a 13% forage/87% concentrate diet, or pastured for 60 days and then fed the 13% forage/87% concentrate until marketed for slaughter. Cattle were slaughtered based on attaining 10 mm backfat as determined using ultrasound. Extensive growth performance, carcass characteristics, and meat quality data have been collected to date. In the future, quantitative and qualitative determination of fatty acids and iron will be conducted along with taste panel determination of tenderness, juiciness, and flavor and in the future.

Study 2 examined the use of fresh pasture for forage finishing using alfalfa or grass pastures and comparing it to a drylot ration containing 85% concentrate/15% forage. Angus and Hereford steers were allocated to the 3 management regimens (alfalfa pasture, grass pasture, or drylot high

grain diet) starting May 1, 2007 with animals slaughtered after a constant time on feed. Half the animals were slaughtered on September 20, 2007 while the other half was slaughtered on September 27, 2007. Extensive growth performance, carcass characteristics, and meat quality data have been collected to date. In the future, quantitative and qualitative determination of fatty acids and iron will be conducted along with taste panel determination of tenderness, juiciness, and flavor.

Objectives: The objectives of the research project include examining the effects of cattle breed and forage source on growth performance, carcass characteristics, eating quality, shelf life, and fatty acid and iron composition of forage finished beef relative to a grain finished product.

Activities undertaken to achieve project objectives:

The research work with conserved forages was conducted at the Elora Beef Research Station. Weaned steer calves and heifers were classified as being either predominantly of British breeding (> 50% of Angus, Hereford, Salers breeds) or of Continental breeding (> 50% of Charolais, Simmental, Limousin, Gelbvieh, Piedmontese breeds). The calves were allocated to one of 10 management regimens with equal numbers of British and Continental bred calves for each management regimen with approximately 18 head per management treatment. The 10 management regimens in the trial are presented in the following table.

| Table 1. Management Regimens Used at Elora Beef | | | |
|--|---|---------------------------|------------------|
| Management Regimen | Forage/Concentrate Ratio | Forage Silage Used | Implant |
| 1 | 90%/10% | Alfalfa | Synovex-S |
| 2 | 90%/10% | Grass | Synovex-S |
| 3 | 50%/50% | Alfalfa | Synovex-S |
| 4 | 50%/50% | Grass | Synovex-S |
| 5 | 13%/87% | Alfalfa | Synovex-S |
| 6 | 13%/87% | Grass | Synovex-S |
| 7 | 90%/10% | Alfalfa | None |
| 8 | 13%/87% | Alfalfa | None |
| 9 | 90%/10%: Limit fed for first 100 days. Placed on pasture for 60 days and then finished using 13%/87% Forage/Concentrate diet | Alfalfa | Synovex |
| 10 | 90%/10%: Limit fed for first 100 days. Placed on 13%/87% Forage/Concentrate diet | Alfalfa | Synovex |

Cattle were weighed and ultrasounded on a 28 day basis. Feed intake data were collected on an individual animal basis. One management regimen was altered versus the original protocol. Management regimen 9 only had cattle on pasture for 60 days due to the lack of pasture from extremely dry summer conditions. While cattle were intended to be slaughtered at a targeted backfat endpoint of 10 mm as determined by ultrasound, cattle have been shipped for slaughter since September based on the greatest amount of backfat for individual cattle. These cattle will not have 10 mm backfat. This change in procedure was necessary to provide space for incoming "T" feedlot calves. The final slaughter of cattle for the trial will take place November 27, 2007.

The New Liskeard work examined the comparison of pasture versus grain-fed cattle. The trial utilized 80 steers with 40 from each of two breeds (Angus, Hereford). The cattle were purchased as yearlings and had been exposed to grain feeding. Within a breed, approximately 13 to 14 head of cattle were assigned to the following dietary treatments: 1) pasturing on alfalfa fields (rotational grazing), 2) pasturing on predominantly grass fields (rotational grazing), and 3) feeding of a 85% concentrate diet based on whole shelled corn. All pasture cattle received a Rumensin CRC bolus to prevent bloat while rumensin was fed to the drylot cattle. Herefords and Angus were selected for this study due to their ability to finish suitably on pasture. The cattle were slaughtered at Cargill Meat Solutions plant in Guelph with half of each breed per dietary treatment slaughtered on September 20, 2007 with the remaining cattle slaughtered on September 27, 2007. This design ensured similar times on feed and ages at slaughter. Use of a time constant endpoint enables comparison of experimental treatments for carcass composition, sensory attributes, and fatty acid composition at similar days on feed. Cattle were weighed every 28 days while individual feed intake data were collected for drylot fed cattle.

Detailed carcass data have been collected from both groups of cattle including hot carcass weight, backfat, longissimus muscle area, marbling, percentages of lean, fat, bone, and partitioning of fat (subcutaneous, intermuscular, body cavity). Meat quality data collected to date include pH, drip loss, and an objective measure of lean color using the CIE, L* a* b* scale. Longissimus and semitendinosus steaks have been saved for future analysis of intramuscular fat content, total and soluble collagen, qualitative and quantitative fatty acid analysis, quantitative concentrations of Vitamin E, and total heme iron and non-heme iron concentrations. Longissimus and semitendinosus steaks have also been aged for 7, 14, and 21 days for shear force evaluation as an instrumental measure of beef tenderness. Fourteen day aged steaks have been collected for taste panel evaluation of tenderness, juiciness, and flavour by a trained taste panel and a consumer panel. A 14 day aged steak was also placed in a foam tray, overwrapped with PVC film and allowed to chill for another 4 days to emulate retail display. Lean color and pH were measured on the 18 day

aged steak with the steak retained for future analysis of thiobarbituric acid to determine the presence of oxidation as a measure of treatment effects on shelf life.

Final outputs produced by the project

This project is not finished yet. Preliminary data for Elora are presented in Table 2. At the time of writing this report, there is still one more week before all cattle have been slaughtered from Elora. For pasture-fed cattle at New Liskeard, out of approximately 50 cattle fed on pasture, 5 carcasses were downgraded as B carcasses with 1 for yellow fat and 4 for dark cutters. There has been only limited meat quality evaluation of the samples obtained. Approximately 67% of the steaks from Elora have been processed for shear force evaluation. Work has yet to be started on fatty acid, vitamin E, iron, and taste panel evaluations. An M.Sc. student worked on the project for a year and then left the program to begin vet school at OVC at the University of Guelph. Further meat quality evaluation and chemical analyses will commence in the new year.

Table 2. Preliminary Results for Elora Trial

| Management Regimen^a | Forage to Concentrate Ratio | ADG, Kg/day | Days on Feed | Final Weight, kg | HCW, Kg^b | Backfat, mm | Rib eye area, sq cm | Quality Grade^c | Lean Yield^d | Marbling^e | Fat dissection, %^f |
|---------------------------------------|------------------------------------|--------------------|---------------------|-------------------------|----------------------------|--------------------|----------------------------|----------------------------------|-------------------------------|-----------------------------|--------------------------------------|
| 1 | 13/87 (grass) | 2.20 | 123.7 | 618.8 | 344.8 | 9.6 | 95.3 | 2 | 59.3 | 4.6 | 22.7 |
| 2 | 13/87 (alfalfa) | 2.25 | 129.8 | 626.8 | 364.3 | 10.5 | 95.4 | 2.2 | 59.1 | 4.9 | 23.3 |
| 3 | 50/50 (grass) | 1.65 | 183.3 | 633.4 | 367.0 | 8.4 | 99.7 | 2 | 60.7 | 4.8 | 22.1 |
| 4 | 50/50 (alfalfa) | 1.64 | 159.5 | 599.6 | 348.4 | 8.6 | 95.7 | 2.2 | 60.7 | 4.8 | 21.2 |
| 5 | 90/10 (grass) | 1.23 | 268.2 | 661.9 | 364.4 | 5.9 | 94.9 | 1.7 | 62.2 | 4.3 | 16.9 |
| 6 | 90/10 (alfalfa) | 1.10 | 267.5 | 634 | 337.6 | 6.4 | 87.6 | 1.8 | 62.1 | 4.4 | 18.0 |
| 7 | 13/87 (alfalfa) No implants | 1.12 | 241.5 | 597.8 | 323.5 | 7 | 86.6 | 1.8 | 61.3 | 4.7 | 22.6 |
| 8 | 90/10 (alfalfa) No implants | 1.91 | 119.9 | 575.7 | 332.1 | 9.5 | 86.0 | 2.2 | 58.0 | 4.9 | 24.3 |
| 9 | 90/10 (alfalfa) | 1.35 | 260.2 | 679.2 | 381.6 | 8.3 | 89.3 | 1.8 | 60.1 | 4.5 | 21.7 |
| 10 | 90/10 (alfalfa) | 1.54 | 216.3 | 669.6 | 386.7 | 9.2 | 91.9 | 2.2 | 59.8 | 4.8 | 23.5 |

^aManagement Regimen: Management Regimen 9 = 90%/10% diet limit fed for first 100 days. Placed on pasture for 60 days and then finished using 13%/87% Forage/Concentrate diet; Management Regimen 10 = 90%/10% diet limit fed for first 100 days. Placed on 13%/87% Forage/Concentrate diet until slaughter; ^bHCW = hot carcass weight in kg; ^cQuality grade coded with 0 for B1 or B4, 1 for A marbled carcasses, 2 for AA marbled carcasses, 3 for AAA marbled carcasses; ^dLean Yield = numerical saleable lean yield; ^emarbling = numerical marbling score with A = 4.0, AA = 4.5 or 5.0, AAA = 5.5 or 6.0; ^f Fat dissection,% = amount of fat in the rib based on dissection.

