

Source: **UNIVERSITY OF NEVADA** submitted to 

FATTY ACID COMPOSITION OF CONVENTIONAL FED WAGYU CROSSBRED BEEF AND GRASS-FINISHED BEEF

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Project Director
[RINGKOB, T.](#)

Recipient Organization
[UNIVERSITY OF NEVADA](#)
(N/A)
RENO,NV 89557

Performing Department
Ag Nutrition and Vet Sciences

Non Technical Summary

A. Nevada ranchers and farmers are seeking information on how to produce a healthier beef product. B. The beef industry is asking for guidance in modifying and altering common feeding practices to produce a produce with a more desirable fatty acid profile. A. This project examines the contribution of the Japanese breed to produce meat with an increased amount of monounsaturated fatty acids. B. The purpose of this study is to alter the fatty acid profile by feeding increasing amounts of forage.

Animal Health Component (N/A)

Research Effort Categories

Basic	10%
Applied	70%
Developmental	20%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
308	3320	1010	100%

Knowledge Area
[308 - Improved Animal Products \(Before Harvest\);](#)

Subject Of Investigation
[3320 - Meat, beef cattle;](#)

Keywords

beef

wagyu

angus

omega-3 fatty acid

cla

Goals / Objectives

Grass-finished beef is becoming more and more popular with health conscious consumers because of the potential health benefits. Grass-finished beef has made inroads in market share due to its contribution to health aspects such as the increased production of conjugated linoleic acid (CLA) and omega-3 fatty acids. By measuring non-traditional parameters such as fatty acid profiles in meat, the beef industry may be better able to exploit genetic resources and nutritional management to more efficiently produce a healthier product and an improved image. Studies have shown that the manipulation of feed rations fed to conventionally-finished cattle can affect the levels of CLA and omega-3 fatty acids in these beef cattle. Different breed compositions are prone to express genetic potential in different ways which directly influence quality and yield grade: fat deposition in intramuscular (marbling); subcutaneous fat; or kidney, pelvic, and heart fat (KPH). It is the objective of this study to assess better ways to utilize genetic resources and nutrition to benefit producers and more importantly, the consumer. The objective is to compare meat traits and fatty acid profiles of Wagyu crossbred and Angus beef cattle fed conventional feedlot rations which means starting the cattle on high forage and increasing the amount of grain as the animal weight increases. The feeding phase will carry out practices commonly used on small farm and commercial feedlots. All the procedures are noninvasive except if a veterinarian is needed to treat a sick animal. By harvesting the animals at different stages during the feedlot phase, changes in the fatty acid profiles can be followed. Can conventionally finished beef be produced economically that is comparable or close to the levels of CLA and omega-3 fatty acids found in grass finished beef?

Project Methods

All cattle records will correspond with current ear tag numbers already in place. 1) Cattle. Three groups of cattle will be used in this study. Two groups (N= 24/group) of cattle will be fed a concentrate diet one of which will be a high concentrate (ca. 70% grain) diet and the other group fed a low concentrate (ca. 30%) diet, respectively. The third group (N=16) will be grass finished. Two local grass finished beef cooperatives located in Northern Nevada and California will supply the grass finished cattle, which are being finished on clover hay. The conventionally finished beef cattle will be acquired from Silver State Industries located in Carson City, NV. These particular cattle from Silver State Industries have extensive records documenting previous carcass characteristics from which to evaluate latest genetic selections. Cattle in the study will be compared to the performance of past progeny to evaluate effectiveness of genetic selections. Cattle in the study were specifically chosen from sires to enhance any shortcomings from past evaluations. 2) Ultrasounds and Weights. Cattle live weights will be collected bi-monthly (Sundays) and ultrasound screenings will be conducted the first Sunday of every month. Cattle will not be fed until after weighing sessions have occurred. Feed rations for the conventionally fed cattle will be calculated, adjusted, and administered following each weighing session. 3) Feed Ration. Feed rations will be balanced to maximize performance and feed intake will be recorded to track diet concentration and feed conversion. Alfalfa, cracked corn, barley, and grain screenings will be used to create the balanced feed rations. Cattle will be fed twice daily, early in the morning and later in the afternoon. 4) Harvest. Five cattle will be harvested under USDA inspection the Monday after ultrasounds have been performed to select for the right degree of finish. Live weights before slaughter, hot carcass weight and chilled carcass weight will be collected when collecting other carcass data. 5) Processing. Samples from each carcass will be taken prior to processing from the 13th rib. Steak samples will be weighed, photographed, vacuum packaged and frozen. Samples (100 gram) will also be collected from each side to be used in the fatty acid evaluations. Sides will be broken down into boneless wholesale cuts. These wholesale products will be weighed and vacuum packaged and then aged at approximately 36 degrees F until delivered to a white tablecloth restaurant operation. 6) Market. All of the conventionally fed cattle will delivered according to IMP standards as boneless wholesale products. All of the grass finished beef are to be returned to the cooperatives for their individual markets. These beef will be returned to the cooperatives as locker beef ready for the freezer already cut, wrapped, and frozen as retail cuts.

Progress 07/01/06 to 06/30/08

Outputs

OUTPUTS: Percent intramuscular fat and individual fatty acids were measured in the longissimus muscle from the 13th rib region. The steak and muscle samples were collected 2 days postmortem and vacuum packaged from 46 animals (34 sired by Wagyu and 12 by Angus). Fatty acid methyl esters (FAME) were synthesized by H₂SO₄ catalysis. The fatty acids are expressed as a percent of the total fatty acids measured. Percent intramuscular fat in the longissimus ranged from 2 to 18%. There was a curvilinear and significant

relationship between the percent intramuscular fat and n-3, n-6, n-6:3 ratio and polyunsaturated fatty acids (PUFA). A ten member taste panel detected flavor differences in the omega-3 fatty acid levels but not the CLA (conjugated linoleic acid). The panel also detected significant negative flavor differences with n-6:3 ratio and PUFA. The panel did not detect significant differences for off-flavor in the n-3, CLA and PUFA levels or n-6:3 ratio. There was a positive and significant relationship between percent intramuscular fat and initial and sustained tenderness as assessed by the taste panel. Two papers were included in the Proceedings of the Cattlemen's Update which was distributed to most Nevada ranchers. A poster was presented at the Main Station Field Laboratory field day. I gave an invited paper at the California Niche Meat Marketing Conference aimed at the smaller processors and locker plants. A poster was presented at the Reciprocal Meat Conference at the University of Florida and another will be presented this summer at the joint USA-Canada American Society of Animal Science meeting in Montreal, Canada. A poster and proceedings paper were presented at the ICOMST (International Congress of Meat Science & Technology) meeting in Cape Town, South Africa. Two papers are in review for the international journal, Meat Science. Personnel on the project were responsible for collecting and analyzing carcass data at URL:http://agri.state.nv.us/NJLS/2008_Beef_Carcass.pdf http://agri.state.nv.us/NJLS/2008_Lamb_Carcass.pdf http://agri.state.nv.us/NJLS/2008_Swine_Carcass.pdf http://agri.state.nv.us/NJLS/2008_GOAT_CARCASS.pdf. Applied information was presented and distributed mainly through the Proceedings of the Cattlemen's Update to Nevada ranchers. More basic information was presented at the ICOMST meetings which is a mix of researchers, industry and government policy makers. PARTICIPANTS: The primary personnel were from the Agricultural Experiment Stations of the University of Nevada, Reno and Washington State University, Pullman. A major hotel-casino cooperated by featuring beef from the project in their high-end restaurant. TARGET AUDIENCES: The target audiences were consumers, cattle industry, youth groups, and researchers in food science. It was accomplished in the following ways. Two papers were included in the Proceedings of the Cattlemen's Update which was distributed to most Nevada ranchers. A poster was presented at the Main Station Field Laboratory field day. I gave an invited paper at the California Niche Meat Marketing Conference aimed at the smaller processors and locker plants. A poster was presented at the Reciprocal Meat Conference at the University of Florida and another will be presented this summer at the joint USA-Canada American Society of Animal Science meeting in Montreal, Canada. A poster and proceedings paper were presented at the ICOMST (International Congress of Meat Science & Technology) meeting in Cape Town, South Africa. Two papers are in review for the international journal, Meat Science. Personnel on the project were responsible for collecting and analyzing carcass data at URL:http://agri.state.nv.us/NJLS/2008_Beef_Carcass.pdf http://agri.state.nv.us/NJLS/2008_Lamb_Carcass.pdf http://agri.state.nv.us/NJLS/2008_Swine_Carcass.pdf http://agri.state.nv.us/NJLS/2008_GOAT_CARCASS.pdf. Applied information was presented and distributed mainly through the Proceedings of the Cattlemen's Update to Nevada ranchers. More basic information was presented at the ICOMST meetings which is a mix of researchers, industry and government policy makers. PROJECT MODIFICATIONS: Nothing significant to report during this reporting period.

Impacts

Animal fat's image has suffered because of its dense caloric content contribution to the human diet. However, beef fat may impact the diet in a positive way depending on the composition of the lipids. Because beef also contributes certain monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids which may be beneficial to the human diet, there is a need to know how muscle composition affects the proportion of certain fatty acids such as omega-3 and CLA (conjugated linoleic acid). Percent intramuscular fat in the longissimus muscle ranged from 2 to 18%. Both panel sustained tenderness and flavor scores increased from 2 to 10% intramuscular fat in a curvilinear fashion. Omega-3, omega-6:3 ratios and PUFA decreased with increasing levels of intramuscular fat. CLA decreased with increasing percent intramuscular fat possibly due to the fact the animals were in a feedlot with no access to fresh green forage. Increasing levels of omega-3 and PUFA are associated with decreasing panel flavor scores. Omega-3 and PUFA are negatively associated with increasing intramuscular fat. However, increasing CLA and MUFA are positively associated with increasing intramuscular fat. No off-flavor problems were associated with omega-3 and CLA. The Wagyu steaks, roast and ground beef were featured at a major hotel-casino steakhouse. The promotion worked great and was well received by the restaurant management. Due to unsettling foreign trade issues, Kobe-style beef has made inroads into the high-end restaurant business in northern and especially southern Nevada.

Publications

- Casey, Susan, Butler, Bob, and Ringkob, Tom. 2006. Carcass value returns from cull cows for the Hispanic and other niche markets. Proc. Cattlemen's Update. pp. 99-101. Univ. of Nevada-Reno. http://www.cabnr.unr.edu/AB/Resources/Nevada_Cattlemen/Cattlemens_Updated_2006.pdf
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- Santistevan, Brian, Butler, Bob, and Ringkob, Tom. 2006. Nutritional attributes of grass-fed beef. Field Day Poster MSFL Univ. of Nevada-Reno.
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- Jiang, T., Busboom, J. R., Nelson, M. L., O'Fallon, J., Joos, D., and Ringkob, T. P., Effect of sampling fat location within beef steaks on fatty acid composition. 2008. AMSA 2008 RMC Abstracts: p. 51. <http://www.meatscience.org/Pubs/rmcarchv/2008/AMSA%202008%20RMC%20Abstracts.pdf>
- Casey, Susan C. 2009. Product Development and Marketing of Cull Cows. M.S. Thesis. University of Nevada, Reno.
- Jiang, T., Busboom, J. R., Nelson, M. L., O'Fallon, J., Ringkob, T. P., Joos, D., Rogers-Klette, K. R., and Piper, K. The influence of forage diets and aging on beef palatability. 2009. J. Anim. Sci. Vol. 87, E-Suppl. 1: abstract.
- Jiang, T., Busboom, J. R., Nelson, M. L., O'Fallon, J., Ringkob, T. P., and Joos, D. 2009. Effect of sampling fat location and cooking on fatty acid composition of beef steaks. Meat Science (in review).
- Jiang, T., Busboom, J. R., Nelson, M. L., O'Fallon, J., Ringkob, T. P., Joos, D., Rogers-Klette, K. R., and Piper, K. 2009. The influence of diet and aging on beef palatability. Meat Science (in review).

Progress 01/01/07 to 12/31/07

Outputs

OUTPUTS: Activities: The cattle groups, high concentrate (ca 70%), low concentrate (ca 30%) and grass finished, have been harvested. The genetic (Wagyu and Angus crosses) and nutritional regimes produced a wide range in intramuscular fat (IM) of 1-19%. Additional analysis, done on fatty acid profiles which were sampled from the loin eye (longissimus lumborum), has been completed on the high concentrate group and the grass finished group. Plotting and statistical analysis revealed a curvilinear relationship between IM and omega-3 as well as omega-6 fatty acids. There is a similar curvilinear between IM and poly unsaturated fatty acid (PUFA). That is that the high fatty acid (omega-3 & 6) and PUFA percent is associated with lowest IM% whereas high IM% are associated with much lower omega-3 & 6% and PUFA. Both the monounsaturated and saturated fatty acids increase with increasing IM%. Events: An invited presentation was made at the Niche Meat Marketing Conference in California. Questions during and after the presentation are a part of producers evaluating and contemplating changes toward a more sustainable agriculture. Services: I furnish expertise to the youth events (Nevada Junior Livestock Show) to make the events more educational which includes a carcass evaluation and collection of carcass data to be distributed to all participants. Products: The beef industry is realizing that they must retool to a more moderate size animal that is better able to utilize grass more extensively to produce a finished product. Dissemination: I have given 4 PowerPoint presentations to the Nevada and California Niche Meat Marketing conferences over the last 3 years. **PARTICIPANTS:** Individuals Tom Ringkob: Tom was the PI for the project. Brian Santistevan: Brian was the graduate student who collected the primary data and is using the study for his thesis to earn his MS degree. Dwight Joos: Dwight was responsible animal procurement and animal care. Bob Butler: Bob was responsible for carcass harvest under USDA inspection. Partner Organizations Washington State University: WSU is running the taste panels. Training or professional development: Numerous undergraduate students assisted with carcass data collection. **TARGET AUDIENCES:** Target Audiences: The primary target audiences are the small farmer/rancher and the backyard hobby producer. Efforts: My primary efforts include the Niche Meat Marketing conferences in Nevada and California. I have also spent considerable time with 4-H and FFA youth groups assisting with carcass evaluation and other educational events.

Impacts

Knowledge: The curvilinear relationship is quite interesting in that desirable high percent omega-3 and PUFA is associated with low IM which is a proxy for marbling. That is, low marbling scores produce lower grades and are avoided by the white tablecloth restaurants. **Actions:** However, conjugated linoleic acid (CLA%) and omega 6:3 ratio increases with increasing IM%. Wagyu with the propensity to marble may offer the potential to produce a high grading carcass with some desirable fatty acid characteristics. **Conditions:** Corn prices have increased from the \$2-3 range to \$5 / bushel due to the ethanol industry. This will force drastic changes in the beef industry. My interaction with the High Sierra Beef group and their forage-fed beef has led to some interesting discussions. There is a realization that the beef industry must change to a smaller animal that

finishes on grass. This is the model that was used in England for millennia. They used to be called "easy keepers" and got much too fat when the USA had a surplus of cheap corn.

Publications

- Ringkob, T. P and Grace Waymire. 2007. Opportunities in Pet Food. Proc. Niche Meat Conference, Univ of California-Davis.

Progress 01/01/06 to 12/31/06

Outputs

The cattle groups, high concentrate (ca 70%), low concentrate (ca 30%) and grass finished, have been harvested. Fatty acid profiles, measured on the loin eye (longissimus lumborum), have been completed on the high concentrate group and the grass finished group. Fatty acid profile results should be available soon on the low concentrate group. The Wagyu high concentrate group had only about 20% of the conjugated linoleic acid (CLA) content when compared to a preliminary group of forage finished beef (0.20% vs. 1.02%). However, the high concentrate Wagyu group had over 4 times the omega-3 fatty acid content of another cohort grain fed group (1.60% vs. 0.36%). The omega-6 fatty acids were the highest (4.27%) for the high concentrate Wagyu group which computed to a favorable omega 6:3 ratio of 2.61. The high concentrate Wagyu group had the highest amount of polyunsaturated fatty acids (5.9%) and therefore lowest (48.6%) saturated fatty acids.

Impacts

The genetic component may prove to be quite interesting as there is substantial variation in the CLA content (0 to 0.75%) in the Wagyu high concentrate group. A grass finished group was even higher at 1.02% CLA. There is considerable variation in both the omega-3 and the omega-6 fatty acid content so that there is a range in the omega-6:3 ratio from a very favorable 1.83 to a much less favorable 15.15. This is a preliminary analysis on part of the total group being studied.

Publications

- Ringkob, T. P. 2006. High Sierra forage fed beef. Proc. Niche Meat Conference, Univ of California-Davis.
- Casey, Susan, Bob Butler and Tom Ringkob. 2006. Carcass value returns from cull cows for the Hispanic and other niche markets. Proc. Cattlemen's Update. pp. 99-101. Univ. of Nevada-Reno.
- Brian Santistevan, Bob Butler and Tom Ringkob, 2006. Nutritional attributes of grass-fed beef. Field Day Poster MSFL Univ. of Nevada-Reno.