

## **Project Summary**

### **A Preliminary Study on Variation in Healthfulness of Beef from Different Breeds**

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### **Background**

The rationale underlying this objective is that the consumption of beef has decreased about 25% in the recent three decades and this decrease could be attributed, in part, to the consumers' concern about the healthfulness of beef. This project aims to find the genetic variations in concentrations of some compounds that contribute to the healthfulness of beef. Completion of this project would give information to animal breeders to select cattle that produce more healthful beef, which could lead to increased marketability and profitability to beef producers. The overall objective of this project was to determine the breed effects on the differences in concentrations of some human health-related components of beef, such as fatty acids, cholesterol, iron, vitamin E, creatine, and sphingolipids.

### **Methodology**

Steer progeny resulting from artificial insemination mating of Angus and MARC III (a composite population of 1/4 each Angus, Hereford, Red Poll, and Pinzgauer breeding) dams with Hereford, Angus, Brangus, Beefmaster, Bonsmara, and Romosinuano sires were used in the current study. Data were obtained from 253 steers (n= 23 per line) produced in 2001 (n=121) and 2002 (n=132) in cycle VIII of the Germplasm Evaluation Program at the U.S. Meat Animal Research Center. These sire and dam mating resulted in 11 different F1 breed crosses (Angus x MARCIII, Hereford x Angus, Hereford x MARCIII, Beefmaster x Angus, Beefmaster x MARCIII, Brangus x Angus, Brangus x MARCIII, Bonsmara x Angus, Bonsmara x MARCIII, Romosinuano x Angus, Romosinuano x MARCIII). The wholesale rib was collected, stored at 4C and transferred to the Meat Animal Research Center 36 hours after slaughter for further analysis.

Total lipids were extracted from about 2 grams of steak samples for HPLC analysis. Sphingolipids were analyzed by using a Beckman Coulter Nouveau HPLC system equipped with an evaporative laser light scattering detector. Sphingolipids were identified by comparing retention times with commercially available sphingolipid standards. Cholesterol and vitamin E were also analyzed, along with creatine and creatinine, which were assayed based on a water extraction. Non-heme iron was analyzed using a procedure modified from C.J. Rebouche et al. (2004). Total iron was analyzed using procedures modified from the AOAC International method 999.10. The fatty acids in the entire sample (phospholipids plus TAGs) were estimated on the basis of a weighted average of phospholipid and triacylglycerol fatty acid composition. In addition to fatty acid composition data, several indexes were evaluated. The atherogenic index as described by Ulbright and Southgate (1991) is calculated as  $= (12:0 + 4(14:0) + 16:0) / \Sigma\text{MUFA} + \Sigma\text{PUFA}$ . Indexes also were used to predict the activity of fatty acid desaturase and elongase systems. Examples of desaturase indexes would be 16:1/16:0 or 18:1/18:0. Likewise, elongase indexes would be represented by 18:0/16:0 or 16:0/14:0.

### **Findings**

#### **Sphingolipids**

Sphingomyelin (SM) was the only detectable sphingolipid in the beef samples. The effect of breed cross (F1 animals) was not significant for the two kinds of SMs detected or total SM, indicating similar concentration of SM in beef samples from different breed crosses. Researchers did not find any significant differences between sire or dam lines ( $P > 0.05$ ). However, greater within vs. between

breed variation was observed for SM concentrations indicating that background genetics does not impact SM levels.

#### Cholesterol

Because of the low concentration of individual cholesterol esters in beef, researchers were forced to saponify cholesterol esters down to free cholesterol. As a result, researchers were unable to identify individual cholesterol esters. Cholesterol was the only sterol detected in this study. The effect of breed line was not significant and no sire or dam line effects were detected indicating that background genetics does not impact cholesterol levels.

#### Vitamin E and Iron

Alpha-tocopherol concentration averaged 0.4 µg/g of tissue. This value is low and could have been caused by prolonged storage and multiple defrosting. The effect of breed cross had no significant effect on total iron or non-heme iron. In addition, no sire or dam line effects were detected. As with all traits measured in this study, the observed variation within a breed cross was greater than the variation observed between breed crosses.

#### Creatine/Creatinine

The effect of line cross had no significant effect on creatinine, phosphocreatine or total creatine concentrations. However, creatine concentration was affected by line cross. No sire or dam line effects were detected, with the exception that sire line tended to influence creatine concentration. These results indicate that genetic background of cattle may be able to influence the concentration of creatine and creatinine in beef.

#### Fatty Acid

The effect of line cross significantly changed the concentration of almost all fatty acids in both the triacylglyceride and phosphor-lipid fractions. In addition, sire or dam line effects were detected for almost all fatty acids. There were also significant differences in the level of saturation and chain length observed in the line crosses.

### **Implications**

For the majority of the compounds tested in this project, with the exception of a majority of the fatty acids, breed composition, sire line and dam line did not affect the concentration of these compounds in meat. These results indicate the possibility that the concentration of these compounds is not correlated with another trait, which producers have selected for. If this is the case, genetic selection for these compounds can be made independent of other traits. In contrast, a majority of the fatty acid concentrations differed between line crosses. Most likely this is the result of differences in triacylglyceride concentration between line crosses, as fatty acid composition differs dramatically between the phospholipid and triacylglyceride fractions. Thus, it is our contention that producers could select for healthier meat if they are presented with the proper tools to do so.

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