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# Understanding dark cutters to reduce prevalence

| Project Title: | | Project Code: | BQU.03.13 |
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| Genetics and proteomics of dark cutting cattle in Alberta | | Completed: | *2016* |

Researchers:

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## *Background:*

Dark cutting is a stress-associated condition that is penalized within the Canadian grading system. Carcasses that “cut dark” are assigned a grade of Canada B4 and carcass values can be reduced by as much as 40%. The2010/11 Beef Quality Audit demonstrated a 52% increase in dark cutters compared to the 1998/99 audit from 0.84% to 1.28%, indicating the possible emergence of a trend that will need to be monitored.

Dark cutting carcasses are a very dark red to purple colour, contrary to the normal bright red colour of beef. This occurs when cattle are physically stressed prior to slaughter and therefore muscle glycogen (energy) is depleted from the muscles, resulting in an elevated muscle pH of over 5.8. Beef from dark cutters is visually unappealing to consumers, and the high pH stimulates the growth of spoilage bacteria, reducing shelf life.

## *Objectives:*

This project completed two main objectives:

1. Determine the relationships between sex, carcass and production phenotypes in a slaughter population to the occurrence of dark cutting in that population

2. Characterize the metabolic differences between normal and dark cutting rib eye muscles through proteomic (protein) analysis

## What they did:

Two separate pre-existing data sets were used to examine the influence of sex on dark cutting. The first data set examined 180 steers and heifers with live animal and carcass measurements from a single source. The second utilized information collected on 467 heifers over an eight-year period, which included the heifer information from the first data set. Weaning weight, live slaughter weight, dry matter intake, average daily gain, feed conversion ratio, residual feed intake, ultrasound and actual carcass measurements, animal age, and days to finishing and age at slaughter were recorded.

The proteomics study gathered 80 ribeye samples from AA and B4 carcasses from a commercial abattoir on two separate occasions. The carcasses came from 24 different groups of cattle that were the same gender, originated from the same feedlot, and were transported together. The commercial cattle were also grouped by rest time post-transport and pre-slaughter with cattle experiencing wait times of 4, 5, 6, 10 or 72 hours. The cattle that were rested for 72 hours received both feed and water, while the cattle with the shorter rest times were provided only water. The ribeye measurements included pH, shear force, colour, water holding capacity, nutrient analysis, myoglobin estimation, muscle fibre length, glucose metabolism, proteomic and genetic analysis.

## What they learned:

There was an increased frequency of dark cutting in heifers and bulls. Both carcass weight and live weight were related to the probability of a heifer having a dark cutting carcass, with lighter, slower growing animals more likely to cut dark. In steers, there were some instances of very large, heavily muscled steers also cutting dark. The relationship between carcass weight and dark cutting was stronger than that of live weight and dark cutting, which suggests that may be other factors involved. Generally, heifers weighing over 1200 lbs live, and with carcass weights over 715 lbs had substantially lower risk of dark cutting. The amount of marbling was not related to dark cutting, with the marbling in dark cutting carcasses being similar to that of carcasses grading AA. No single live animal or carcass phenotype was associated with dark cutting, as there was at least one dark cutting carcass spanning all the different heifer phenotypes.

This study found that animals held for a longer period of time prior to slaughter were more likely to be dark cutters. Previous research has shown varying results when comparing post-transport and pre-slaughter times. Some research has shown that longer rest times reduce the proportion of dark cutting carcasses, while other results support this study's findings. A large part of these contrasting results may be due to management during that rest period, including when feed and water is provided, and the quality of that feed. In this study, heifers and steers that were slaughtered the day of shipment were least prone to cut dark when held for 5-6 hours before slaughter compared to the other time periods.

In this study, a small number of carcasses had a normal pH, but still exhibited the dark cutting colour characteristics. The results from this project indicate that these atypical dark cutting carcasses have a slow rate of post mortem glucose metabolism, reduced activity of the enzymes that break down glucose and proteins, and produce tougher beef than typical dark cutting carcasses. Genetic analysis found 924 single nucleotide polymorphisms (SNPs) located near 19 candidate genes. These areas will have to be analyzed more completely to determine if there is a genetic component that accounts for a large degree of the variation in atypical dark cutting between animals.

## What it means:

Dark cutting is a multi-factorial condition caused by the interaction of a number of different management and animal factors. Even though a great deal of work has gone into attempting to prevent the dark cutting condition, it continues to occur and may even be rising. This research demonstrated that lighter, slower growing heifers are most likely to cut dark and that it may be possible to identify those animals at risk of dark cutting by measuring animal weight, average daily gain and feed intake. Differences exist in the enzymes that control the metabolism of glycogen between normal and dark cutting carcasses, this means there may be a fundamental metabolic or genetic difference in cattle that cut dark that will have to be investigated further.

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