Investigation of GxE Effects on Beef Quality Traits: Use of Genomics to Minimize the Impact of Mismanagement

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Dark cutting condition

Dark cutting condition

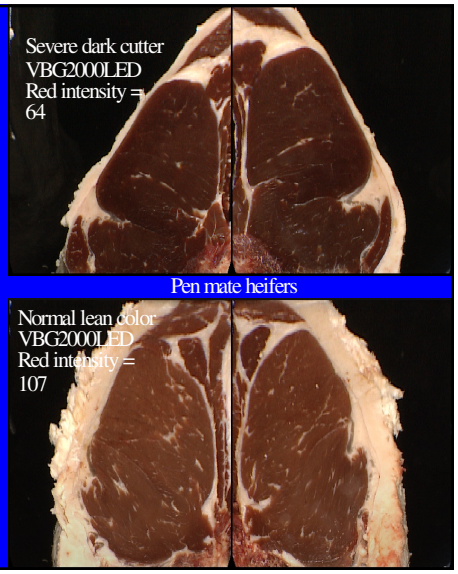
- Abnormally high ultimate pH
- Due to exhaustion of glycogen reserves before slaughter
- Long-term stress
- Gender is a huge environment. Bulls, cryptorchids, heifers
- Estrus --- MGA
- Seasonality
  - Cold stress
  - Heat stress
  - ß-agonist ?

Dark cutting condition

- We were all taught, and accepted, that dark cutting happened because somebody messed up.
  - The packing plant blames the feeder
  - The feeder blames the plant
  - And, everybody blames the trucker

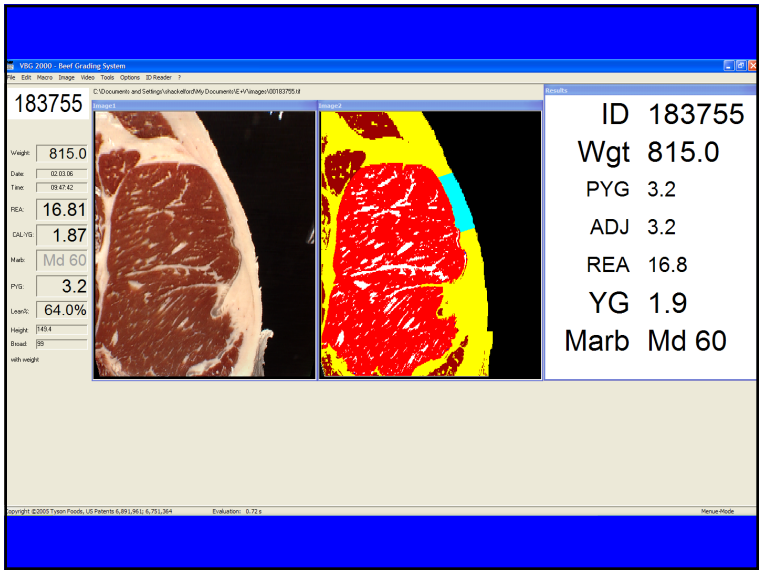
But, consider this.

- These are pen mate heifers. They, have lived the same life since they left their mother and traveled <10 miles to our feedlot.
- They, were harvested commercially within 2 minutes of each other.
- With the exception of permanent environment, the environment is the same.



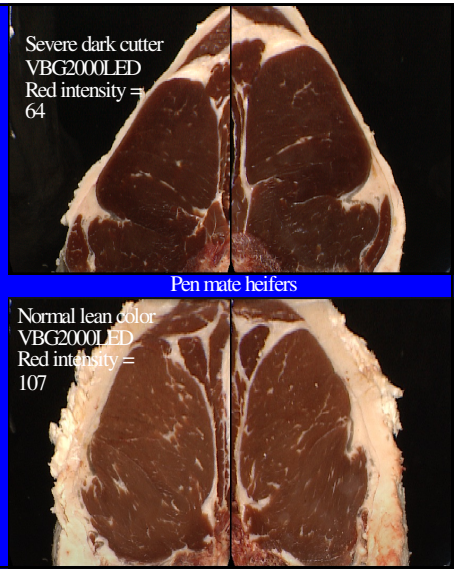
This, suggests that there is a genetic effect

VBG2000



Genomic control of dark cutting

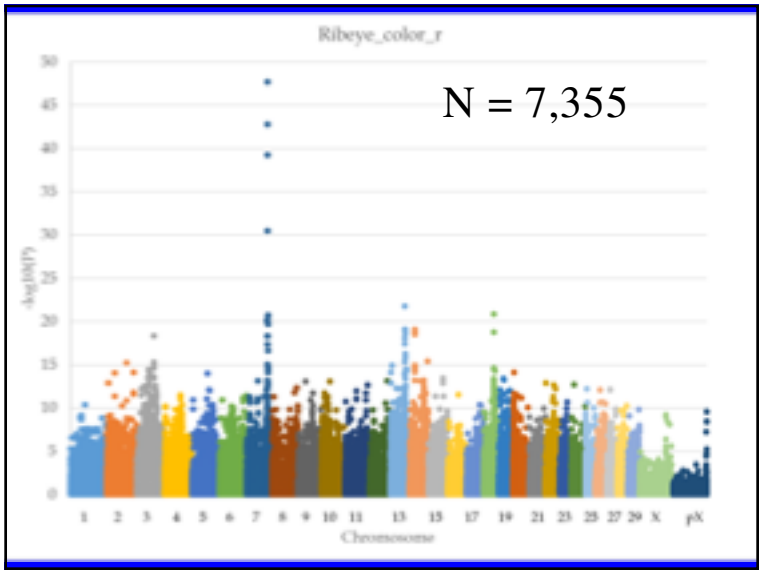
- N = 7,355
- 60+ harvest days over 10 years
- contemporary groups
  - Heifer
  - Steer
  - Late-castrate
- Instrument evolution
- Color as a continuous variable. NOT categorical



Not categorical because it isn't!

Imputation

- GPE, 18 beef breeds
- AI and multisire naturally-mated
- Every breed combination that you can imagine and many that you cannot.
- Smaller contribution from SFA and other projects (weight trait project)
- Imputed to F250

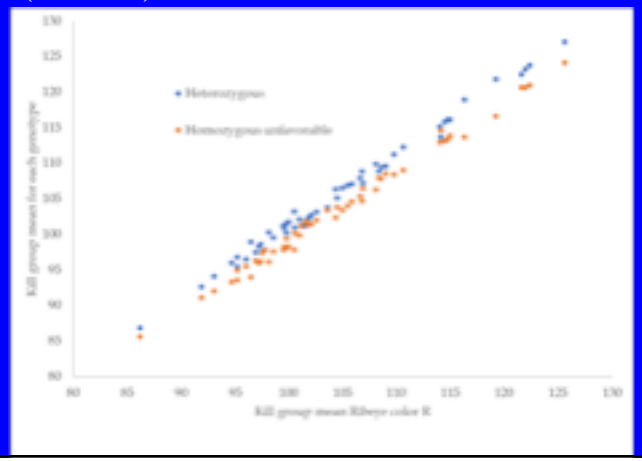


Chromosome 7 peak

- Functional mutation in a gene (ARRDC3) that regulates ß2 adrenergic agonist receptors
- This SNP is on many commercially-available SNP chips.
- Favorable allele is not fixed in any of the major beef breeds.
  - Highest frequency is ~ 0.7
  - For several breeds the frequency is less than 0.2

Ribeye_color_r

(0 to 255) lower value is darker..unfavorable



Genetic correlation

- What happens if we select to decrease susceptibility to dark cutting?
- We don't know!
  - We have the data to address this question. But, it has not happened yet. Probably, can best be addressed with industry data sets.

The blame game

- Turns out that maybe, the breeder is at fault.
- But, don't blame the breeder yet. Until I get this information published and the industry can start evaluating the impact of selection for decreased susceptibility to dark cutting, the only one to blame is me.

Dark cutting G × E

- Gary Bennett
  - Selecting Functional Alleles project
- Non-retained animals are fed for slaughter
  - And they have high density genotypes when they enter the feedlot at weaning!
- Blocked by Line (Angus and 3 composites), Pop (Control and select line), Sex (steers and heifers), and dark cutting genotype and assigned to
  - Natural (no life time implant)
  - Aggressive implant strategy
- Over the next 4 years, should be 1,500 to 2,000 head of excess steers and heifers in this study

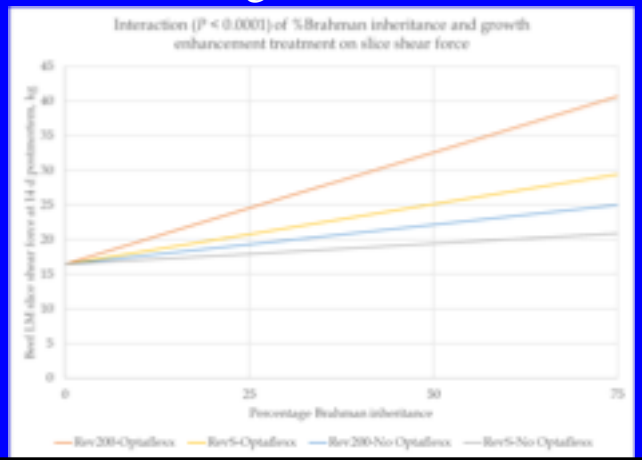
Dark cutting G × E

- Natural (no life time implant)
- Aggressive implant strategy
- Just harvested the first group

Interaction of growth strategy with genetics

- GPE – 18 beef breeds
- Most of the data is AI-sired calves but some naturally-mated
- Two implant regimes
  - Moderate
  - Aggressive
- With and without Optaflexx (ractopamine-HCL)
  - Same pen... Animal is the experimental unit

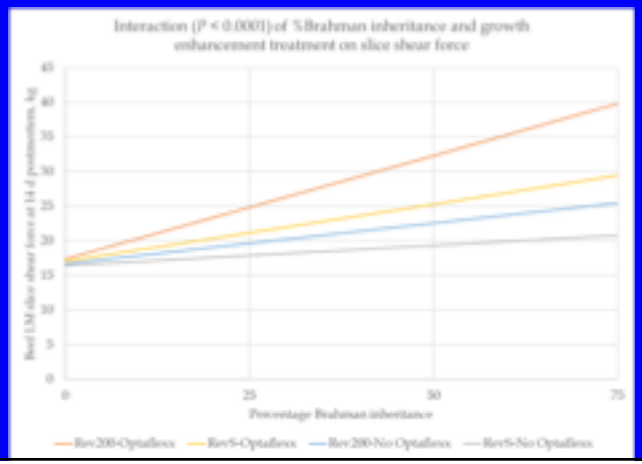
Interaction of growth strategy with genetics



That plot looks fake

- I questioned my analysis
- So, …

Individual regressions same result



The impact of growth strategies

- Depends on who you apply it too!

The impact of genetics

- Depends on how you manage it!
- But, does the improvement in tenderness justify the loss in production efficiency
  - Depends on who you ask.

Marbling score

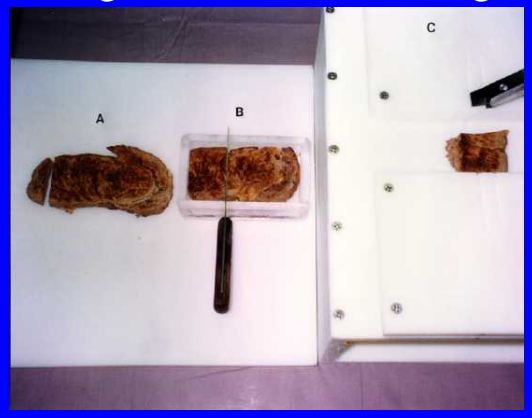
- Breed effects
- Small effect of treatment
- No logical interactions detected.

Prediction of beef tenderness

Belt grill

Cooked ribeye steak exiting belt grill

Obtaining 1 cm-thick, 5 cm-long slice

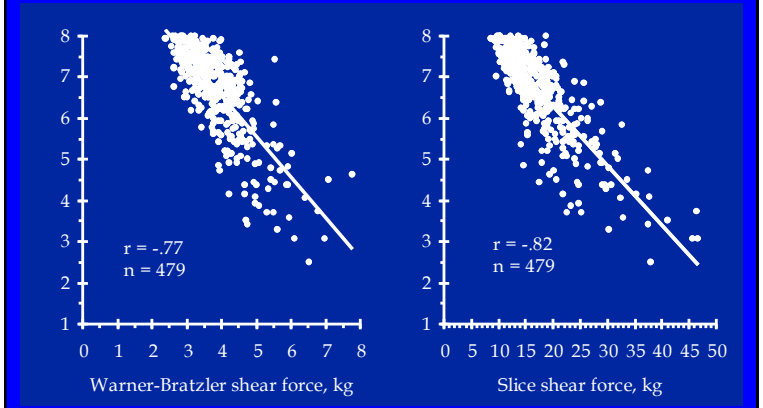


Muscle fiber orientation in slice box

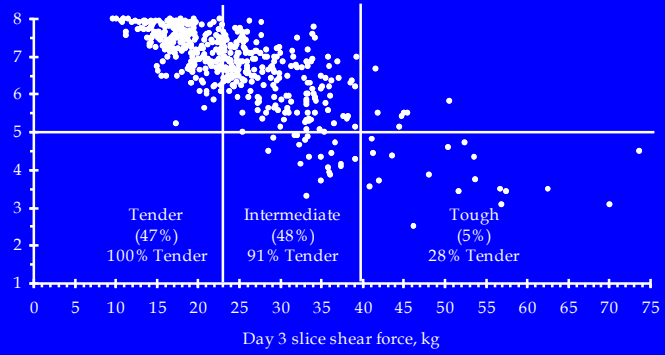
Universal testing machine

Slice shear force

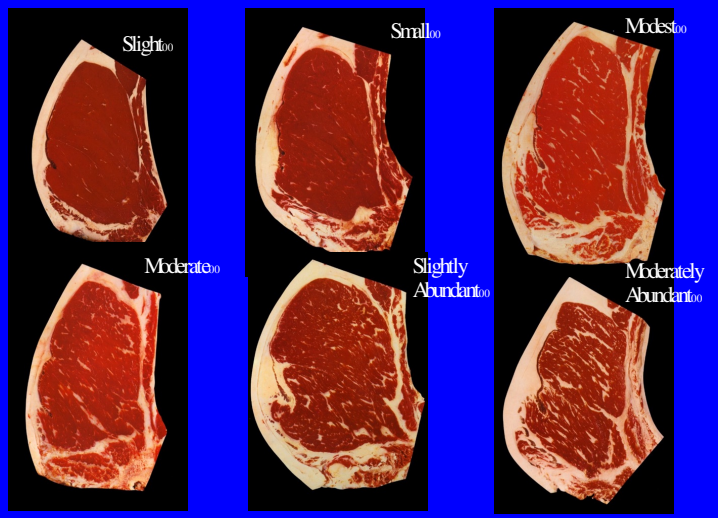
Correlation of WBSF and SSF with SPT



Overall success = 94.4%, n = 483



Point-of-purchase material



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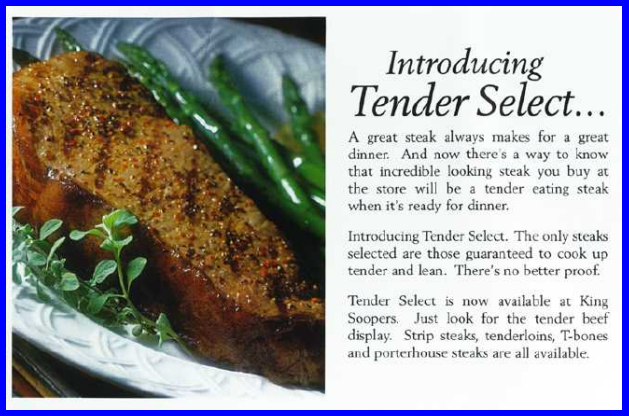
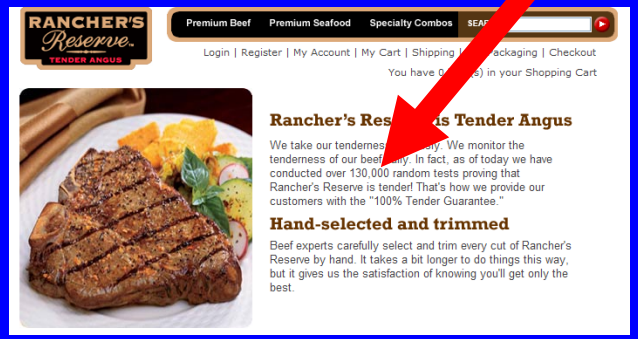


Use of slice shear force for routine tenderness measurement

- Warner-Bratzler shear force is laborious and requires a high degree of skill. Not conducive to high-throughput.
- Simplicity of SSF suggests greater chance of standardization across technicians and/or research institutions.

Cargill-Safeway Alliance



Use of slice shear force for routine tenderness measurement

- Now applicable to 22 beef muscles.
- Not all of the facts, that are true for WBSF, are true for SSF
  - That's a good thing
  - This is allowing us to simplify SSF