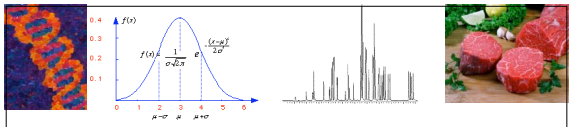


Beef Healthfulness Project

Pfizer Animal Health
Animal Genetics

National Beef Cattle Evaluation Consortium

Colorado State University-Cornell University-University of Georgia-Iowa State University

Go Cyclones!

Overview

- Human health
- Product labeling
- Healthfulness project
  - Overview
  - Genetic Correlations
  - Whole genome selection
  - Nutrient Composition Results
- Conclusions

Prostate Cancer Health Center

Fatty Fish May Cut Prostate Cancer Risk

Study Shows Eating Fish High in Omega-3s Reduces Risk of Aggressive Prostate Cancer

Eating Red and Processed Meat Associated With Increased Risk of Death

Libraries
Medical News

Keywords
RED AND PROCESSED M

Tuesday, March 24, 2009 **Print This Page**

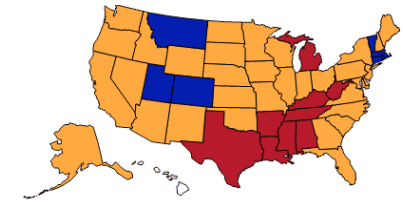
Chicken Consumption Reduces AMD Eye Disease

AUSTRALIA - New research shows that consumption of chicken reduces the likelihood of late age-related macular degeneration (AMD).

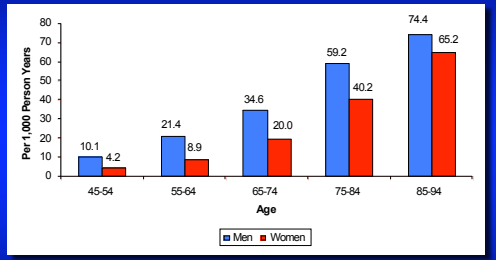
Obesity in U.S. in 2004

BMI ≥ 30, or ~ 30 lbs. overweight for 5'4" person

2004



American Heart Association
Learn and Live



Incidence of CVD* by age and sex. Framingham Heart Study, 1980-2003. Source:NHLBI. * Includes CHD, HF, stroke or intracerebral hemorrhage. Does not include hypertension alone.

5

American Heart Association
Learn and Live

Relative Priority of Consumption

Essential: High Priority → **Non-essential: Low Priority (avoid)**

Omega-3 PUFA
Some food sources are fatty fish and shellfish, flaxseed, walnuts, and canola oil.
- Eicosapentaenoic acid (EPA)-fish
- Docosahexaenoic acid (DHA)-fish
- α-Linolenic acid (ALA)-flax seed, walnuts
- Stearidonic acid (STD)-canola, fish
- Eicosatrienoic acid (ETE)-seafood
- Eicosatetraenoic acid (ETA)-seafood
- Docosapentaenoic acid (DPA)-seafood

Omega-6 PUFA
Some food sources are nuts, seeds and vegetable oils such as sunflower, safflower, corn and soybean oils.
- Linoleic acid-seeds
- Dihomo-gamma-linolenic acid-metabolic product
- Arachidonic acid-metabolic product

Mono-unsaturated FA
Some food sources are canola oil and olive oil.
- Oleic acid-olive, canola oil
- Palmitoleic acid-vegetable oil

Saturated FA
Some sources are animal-based foods such as cream, butter, cheese, and fatty meats.
- Lauric acid-coconut, palm oil
- Myristic acid-dairy fat
- Palmitic acid-meat
- Stearic acid-meat

Trans-Saturated FA
Some food sources are margarine, fried foods, baked goods and processed foods.
- Elaidic acid-preservative
- Partially hydrogenated plant and vegetable oils

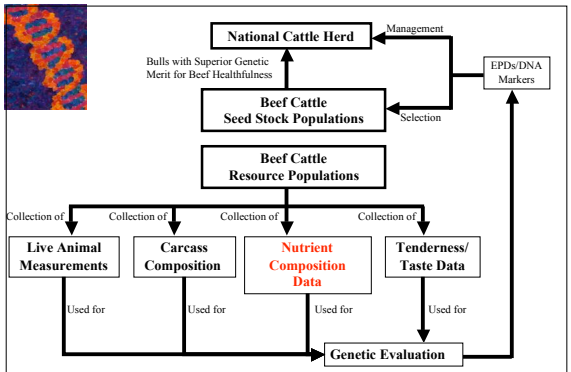
Most Beneficial
▲Cardioprotective
▲Does not promote obesity

Most Harmful Promotes: ▼Obesity ▼ Dyslipidemia ▼Atherosclerosis

Product Branding

Project Goals

- Develop the tools to allow breeders to select for -
  - More nutritious beef
  - Tastier beef
  - More efficient production



Phenotypes

- Growth
  - Birth, weaning, yearling, slaughter weights
- Carcass
  - Hot carcass weight, dressing %, ribeye area, back fat thickness, yield grade, quality grade, KPH
- Meat
  - Nutrient composition (extensive list), shear force, taste test panel, ether extract

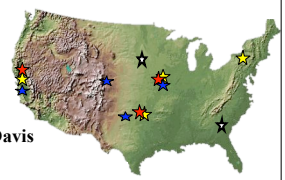
Nutrients

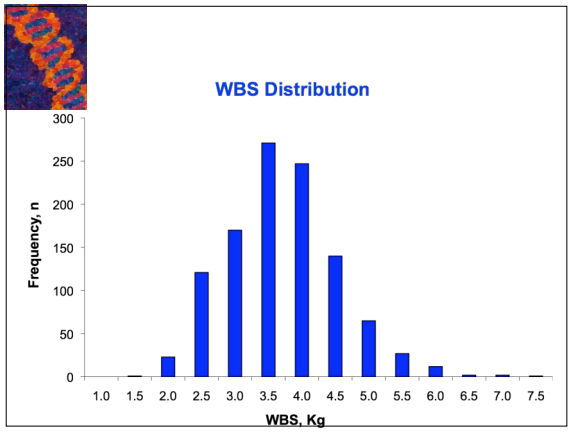
Go Cyclones!

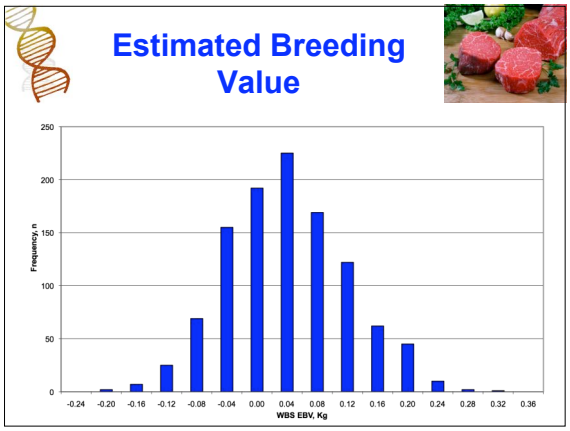
1) Fatty acids
   - Triacylgycerol, phospholipid, composite
2) Sphingolipids
3) Cholesterol
4) Minerals
   - Iron, sodium, magnesium, zinc, phosphorus, potassium, calcium
5) Creatine, creatinine
6) Vitamins
   - E, B_6, B_{12}
7) Carnitine

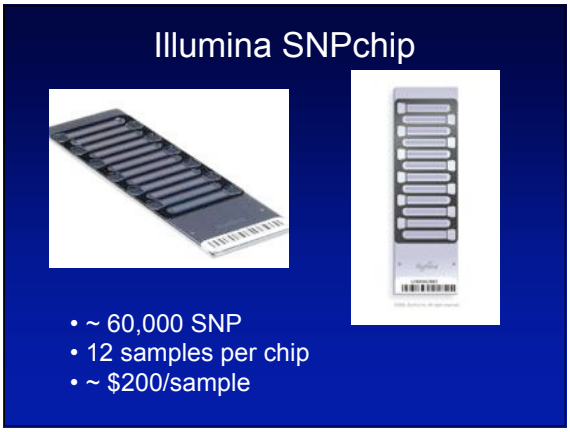
Project Partners

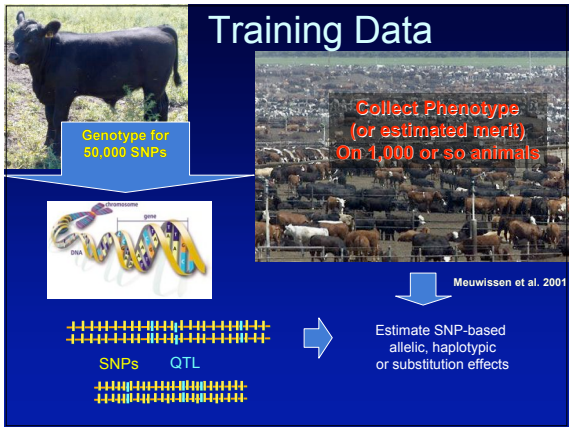
- Universities ☆
  - Iowa State University
  - Cornell University
  - Oklahoma State University
  - University of California – Davis
- Producers ★☆
  - Jack Cowley – California
  - DuckSmith Farms – Oklahoma
- Feedlots ★







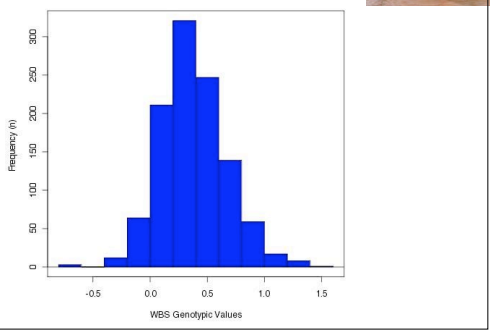




GenSel Output

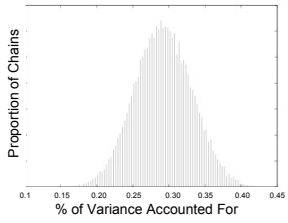
Marker	Effect	EffectVar	ModelFreq	GeneFreq	GenVar
1	6.64077525e-05	1.55730850e-05	0.0974	4.15896485e-03	3.65294218e-11
2	1.22905083e-04	1.50215337e-05	0.1002	8.54251325e-01	3.76149023e-09
3	1.88606122e-04	1.68765800e-05	0.1013	9.92606282e-01	5.22133392e-10
4	1.20531367e-04	1.49273828e-05	0.0972	8.92883599e-01	2.77895174e-09
5	-1.53294241e-05	1.31660790e-05	0.0945	6.69362426e-01	1.04014818e-10
6	-9.26569774e-05	1.35073096e-05	0.0966	1.94316044e-01	2.68818812e-09
7	2.40851259e-05	1.56056467e-05	0.0981	9.89371538e-01	1.21999398e-11
8	-1.61988093e-04	1.58290259e-05	0.0946	3.81608129e-01	1.23844739e-08
9	9.12404328e-04	2.14828597e-05	0.1143	4.09796655e-01	4.02693615e-07
10	-3.12177493e-04	1.46746033e-05	0.0997	4.05822515e-01	4.69986645e-08
11	4.45028600e-05	1.30605422e-05	0.0954	5.98706067e-01	9.51660639e-10
12	-1.17350792e-04	1.41250994e-05	0.0987	2.40757853e-01	5.03457498e-09
13	-3.46178203e-05	1.48911140e-05	0.0988	4.26524989e-02	9.78686368e-11
14	-1.50036547e-04	1.70521998e-05	0.1017	1.15526803e-02	5.14115139e-10
15	4.50238353e-04	1.61836160e-05	0.1013	8.01247656e-01	6.45645244e-08
16	-1.35994951e-05	1.39874737e-05	0.0981	2.04436198e-01	6.01600783e-11
17	-2.76162056e-04	1.56347814e-05	0.0990	1.10628463e-01	1.50074921e-08
18	-1.15274603e-03	2.45100091e-05	0.1235	6.71719134e-01	5.86044450e-07
19	-1.77638085e-05	1.50994520e-05	0.1002	4.62107221e-03	2.90290860e-12

Molecular Genetic Value



BayesC Summary of Shear Force

- Heritability = 0.20 ± 0.05
- 28.1% of the phenotypic variance
- 2160 Markers



SNP Plot::Upload files

This cgi tool plots genome/chromosomal locations of SNPs (as x axis), to present an overview how pre-g associated phenotype values (as y values).

1. Data within each file upload file suppose to come from one type of analysis which will be represent
2. When multiple files are uploaded, they suppose to come from the same TYPE of analysis such that

Upload file format

Multi-columns, delimited with spaces or tabs:

```
snp_id  value1 value2 value3  ...
```

With an optional header line*, as in:

```
numID   Growth pH    GFreq    ...
16028   32     5.6   5.1e+01  ...
16039   45     4.5   4.1e+02  ...
28931   121    5.1   2.1e+00  ...
21736   98     6.7   4.1e+01  ...
1141    35     5.7   2.1e+00  ...
6334    62     5.3   3.1e+01  ...
7973    77     6.9   1.1e+01  ...
..  .   ..     ...   .......  ...
```

a) Column 1 is marker ID (numerical)
b) Column 2 etc are phenotype values, but only one column will be used in the plot (must specify).
c) Header line:
1.Names for all fields must present, Or omitted all together
2.Each header name should not contain any space, Or they may be truncated

Upload your file(s):

1. Browse...
2. Browse...
3. Browse...
4. Browse...
5. Browse...
6. Browse...
7. Browse...
8. Browse...
9. Browse...
10. Browse...

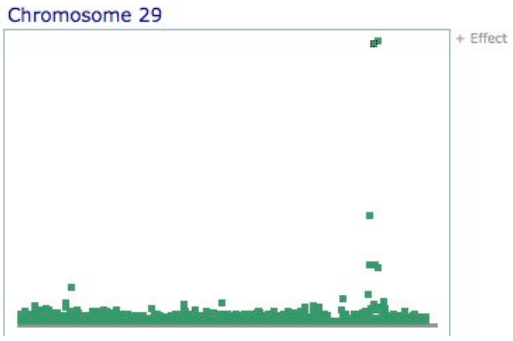
Use absolute values: Yes No

Which column to plot: None

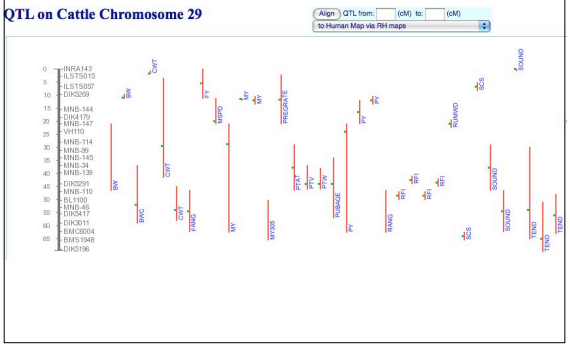
Upload files and plot | Reset

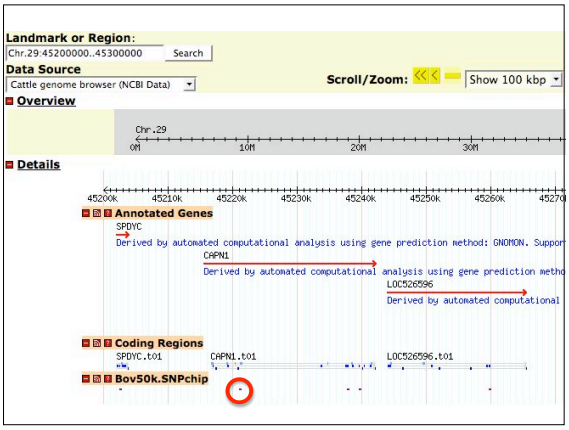
Note: The order number in which you upload files will correspond to plot color codes.

SNPlotZ Output



Animal QTL db

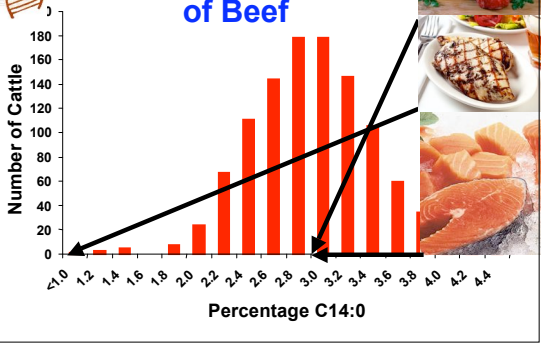




Project Goals

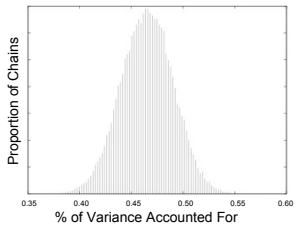
- **Can we explain variation in nutrient composition?**

Variation in C14:0 Concentration of Beef

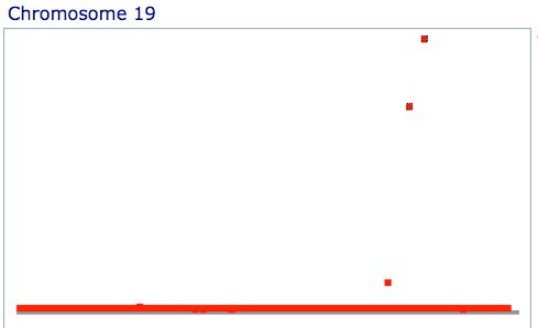


Myristic Acid (C14:0)

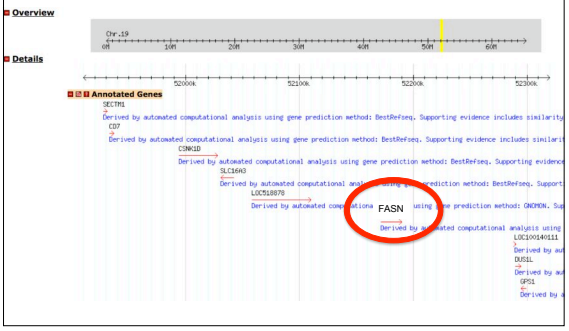
- Heritability = 0.63 ± 0.09
- 45.1% of the phenotypic variance
- 54 Markers



Fatty Acid C14:0



Fatty Acid Synthase



Fatty Acid Composition

Fatty Acid	wt%	Pedigree Heritability	Marker Heritability
14:0	2.81	0.63 ± 0.09	0.451
16:0	26.28	0.51 ± 0.08	0.430
16:1	3.35	0.60 ± 0.08	0.424
18:0	3.35	0.46 ± 0.07	0.394
18:1c9	41.05	0.47 ± 0.08	0.433
18:2	7.46	0.22 ± 0.06	0.262

Genetic Correlation Estimates

Fatty Acid	HCW	12 Fat	REA	MARB	W-B Shear
14:0	-0.23	0.27	-0.10	0.32	0.31
16:0	-0.24	0.17	-0.25	0.26	-0.04
18:0	0.00	-0.54	-0.50	-0.45	-0.07
18:1	-0.14	0.18	0.01	0.83	0.12
18:2	0.43	-0.17	0.24	-0.93	-0.04

Correlation between Fatty Acids and Meat Quality

Table 7. Pearson correlations between fatty acid composition and marbling score, Warner-Bratzler Shear force (WBSF), trained sensory traits, and thiobarbituric acid reactive substances (TBARS) of beef LM[1] (n = 1,715).

Fatty acid	Marbling score	WBSF	Initial juiciness	Sustained juiciness	Initial tenderness	Overall tenderness	Connective tissue	Beef flavor	Painty/ fishy flavor	Livery/ metallic flavor	TBARS
C14:0	**0.12**	**-0.06**	-0.02	-0.02	0.04	**0.07**	**0.07**	**0.06**	**-0.07**	-0.01	0.04
C16:0	**0.09**	-0.01	0.04	**0.05**	-0.01	0.00	-0.02	**0.07**	0.00	-0.03	0.04
C16:1	**0.15**	**-0.09**	**0.10**	**0.09**	**0.06**	**0.06**	0.04	**0.10**	-0.04	0.00	**-0.05**
C18:0	**-0.15**	**0.09**	**0.08**	**0.06**	**-0.09**	**-0.12**	**-0.17**	0.03	**0.16**	-0.02	**-0.06**
C18:1[2]	**0.10**	**-0.08**	**0.05**	**0.07**	**0.08**	**0.10**	**0.10**	0.04	**-0.11**	0.00	**0.09**
C18:2	**-0.41**	**0.15**	**-0.12**	**-0.15**	**-0.19**	**-0.21**	**-0.20**	**-0.08**	**0.12**	0.01	**-0.05**
C18:3[3]	0.04	0.03	**-0.11**	**-0.08**	**-0.06**	-0.02	-0.01	-0.01	**-0.10**	**-0.06**	**0.19**
C18:3[4]	0.02	-0.03	**-0.16**	**-0.15**	-0.01	0.03	**0.07**	-0.01	**-0.07**	**-0.05**	**0.18**
SFA	-0.02	0.01	0.03	0.02	**-0.05**	-0.04	**-0.07**	**0.06**	0.05	-0.03	0.01
MUFA	**0.16**	**-0.11**	**0.13**	**0.13**	**0.08**	**0.10**	**0.07**	**0.14**	-0.04	0.00	**-0.07**
PUFA	**-0.38**	**0.13**	**-0.18**	**-0.19**	**-0.18**	**-0.18**	**-0.15**	**-0.08**	-0.05	0.00	0.01
PUFA:SFA	**-0.34**	**0.11**	**-0.15**	**-0.16**	**-0.16**	**-0.15**	**-0.14**	**-0.07**	0.02	0.01	0.00
Σ n-3 fatty acids	**-0.07**	0.02	**-0.12**	**-0.11**	**-0.05**	-0.03	0.00	**-0.06**	**-0.07**	-0.03	**0.07**
Σ n-6 fatty acids	**-0.43**	**0.15**	**-0.15**	**-0.17**	**-0.19**	**-0.21**	**-0.20**	**-0.07**	**0.10**	0.02	-0.03
n-3:n-6 ratio	0.01	0.01	-0.03	-0.02	-0.03	-0.01	0.00	-0.03	-0.04	-0.01	**0.05**

[1]Significant correlations are shown in bold ($P < 0.05$).
[2]C18:1 = *cis*-9 C18:1 + *cis*-11 C18:1 + *cis*-12 C18:1 + *cis*-13 C18:1 + *trans*-6/9 C18:1 + *trans*-10/11 C18:1 + *trans*-12 C18:1 + *trans*-15 C18:1.
[3]n-3 fatty acids.
[4]n-6 fatty acids.

Mineral Composition

Mineral	ug/gram	Pedigree Heritability	Marker Heritability
Iron	14.4	0.54 ± 0.09	0.407
Zinc	38.9	0.09 ± 0.04	0.180
Magnesium	254.6	0.06 ± 0.04	0.157
Manganese	0.07	0.01 ± 0.03	0.218
Phosphorus	1965.9	0.03 ± 0.03	0.032
Sodium	489.4	0.18 ± 0.06	0.00056

Correlation between Minerals and Meat Quality

Table 6. Pearson correlations between mineral concentrations and marbling score, Warner-Bratzler Shear force (WBSF), trained sensory traits, and thiobarbituric acid reactive substances (TBARS) of beef LM[1] (n = 1,715).

Mineral	Marbling score	WBSF	Initial juiciness	Sustained juiciness	Initial tenderness	Overall tenderness	Connective tissue	Beef flavor	Painty/ fishy flavor	Livery/ metallic flavor	TBARS
Calcium	-0.01	**-0.06**	0.03	0.01	0.03	0.04	**0.07**	0.02	-0.04	**0.05**	**-0.08**
Copper	0.02	**0.06**	**0.14**	**0.11**	**0.06**	0.04	0.03	**0.13**	0.02	**0.09**	**0.22**
Iron	**0.06**	-0.03	**0.14**	**0.11**	**0.06**	0.04	0.03	**0.13**	0.02	**0.09**	**-0.23**
Magnesium	**-0.05**	**-0.07**	**0.13**	**0.06**	**0.06**	0.01	0.01	**0.11**	**0.09**	**0.09**	**-0.46**
Manganese	**0.13**	**-0.06**	**0.05**	0.04	**0.07**	**0.06**	0.04	**0.05**	0.04	0.01	**-0.16**
Phosphorus	**-0.06**	**-0.09**	**0.09**	0.02	**0.07**	0.03	0.05	**0.10**	0.04	**0.09**	**-0.40**
Potassium	-0.03	**-0.14**	**0.06**	-0.02	**0.10**	**0.05**	**0.06**	**0.14**	**0.06**	**0.07**	**-0.36**
Sodium	0.04	**-0.14**	**0.15**	**0.06**	**0.16**	**0.12**	**0.10**	**0.13**	**0.07**	**0.13**	**-0.32**
Zinc	-0.03	0.02	**0.08**	0.04	0.02	-0.01	-0.01	**0.07**	0.02	0.04	**-0.07**

[1]Significant correlations are shown in bold ($P < 0.05$).

Summary

- There is abundant phenotypic variation in nutrient composition
- Nutrient concentration is generally highly heritable
- Whole Genome Selection can account for much of the variation in nutrient content
- Nutrient content is in general lowly correlated with carcass and meat quality traits

Key personnel

- Iowa State University
  - James Reecy
  - Rohan Fernando
  - Dorian Garrick
  - Don Beitz
  - Richard Tait
  - Mary Sue Mayes
  - Kadir Kizilkaya
  - Jon Schoonmaker
  - Grace Duan
  - Matt O'Neil
  - Under graduate students
- Oklahoma State University
  - Raluca Mateescu
  - Deb Van Overbeke
  - Andrea Garmyn
- Univ. California - Davis
  - Alison Van Eenennaam
- Colorado State University
  - Dale Woerner
  - Meats judging team
- Producers
  - Jack Cowley
  - Don Smith
- **Pfizer Animal Genetics**