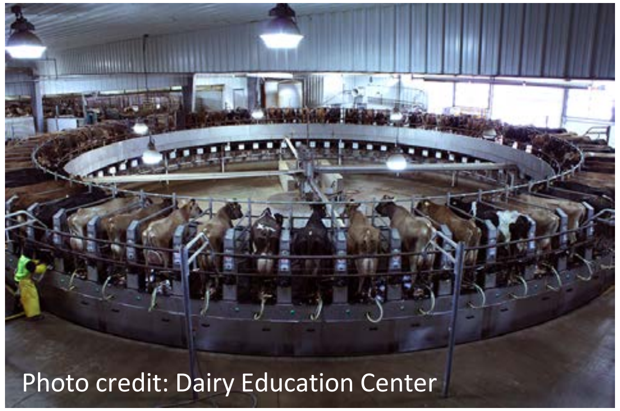
Effect of a bovine non-specific immune stimulant on health and performance of Jersey calves during the pre-weaning period.

Luciano Caixeta, Bobwealth Omontese, Angel Garcia Munoz

University of Minnesota

Health and performance of calves influence adult life production

↑ ADG + ↓ Diseases = More milk

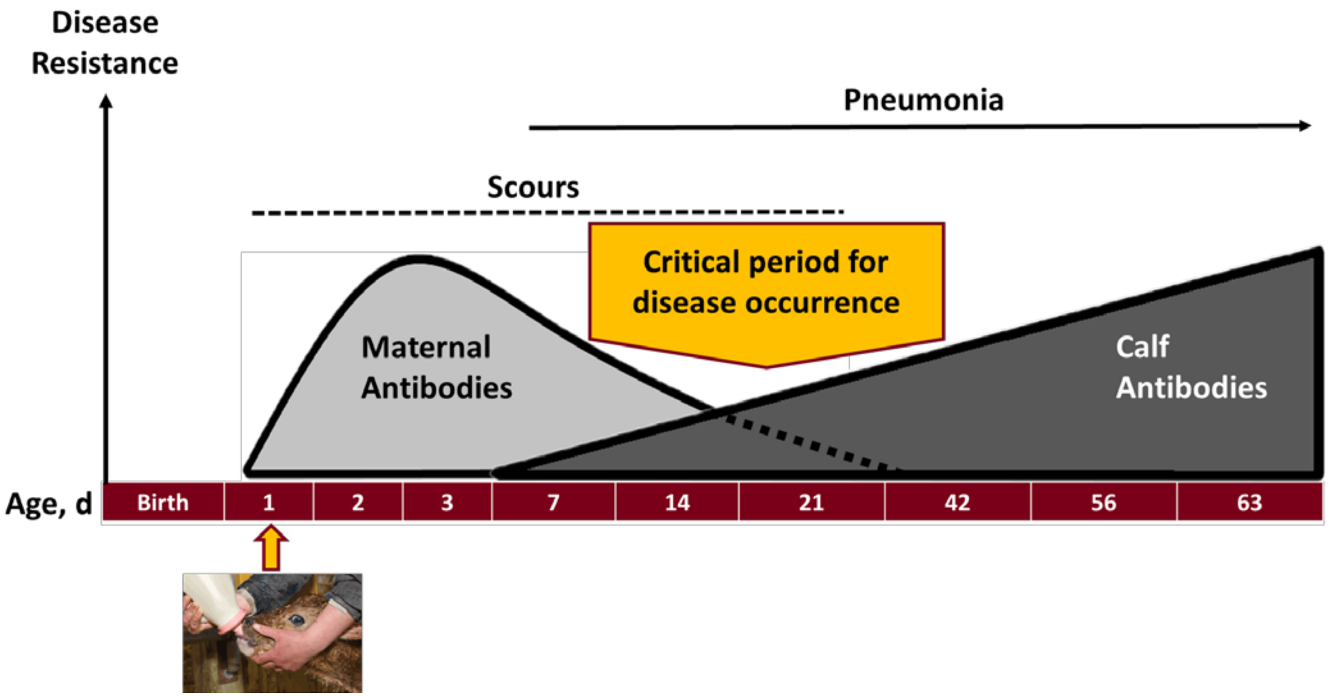


To have healthier calves we need:

- To have proper colostrum management
- To provide clean, dry and comfortable housing
- To have adequate ventilation and air quality

Good colostrum management and hygiene are key

- Dairy calves depend on the immune protection acquired from ingestion of colostrum immediately after birth to fight infections
- Proper hygiene decreases chances of pneumonia and scours during the pre-weaning period



Pneumonia and scours are the two most important diseases affecting young calves

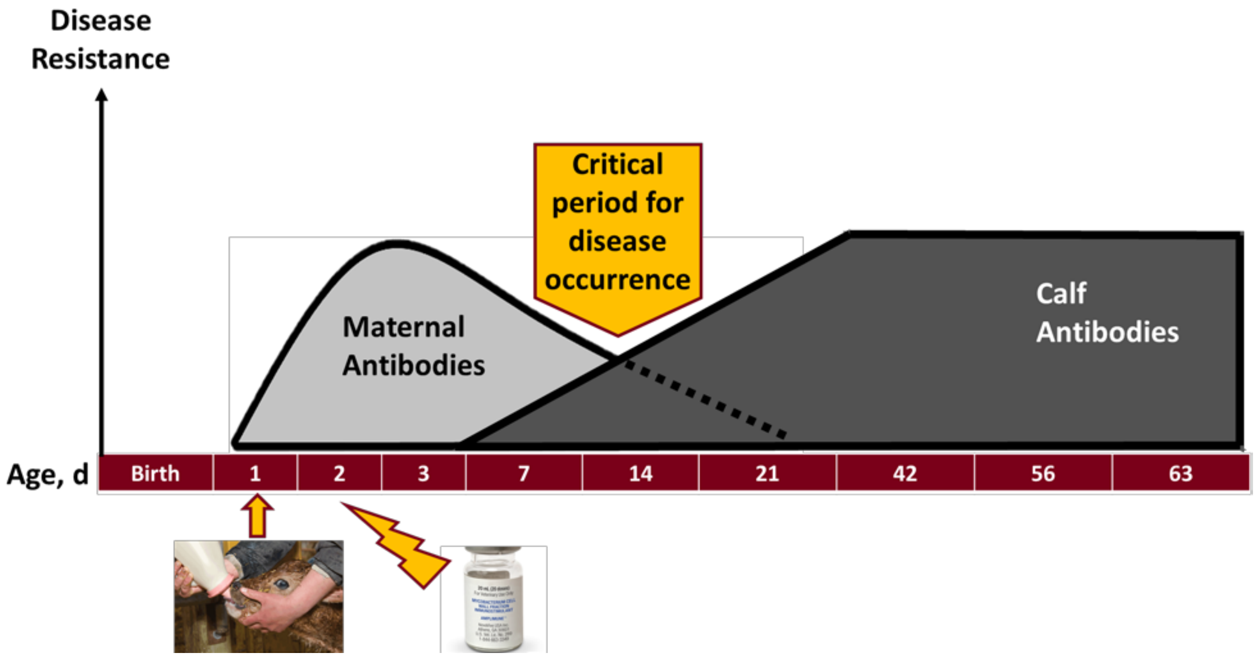
- Pneumonia affects 20% to 30% of pre-weaned calves
- Scours affects 50% to 60% of pre-weaned calves
- Both disease can have lifelong effect on animal's performance
- Preventing diseases is much better and cheaper than treating diseases

"There is no magic bullet to overcome a poor colostrum program and/or bad housing/hygiene. Our overall focus should be on management."

Dr. Geof Smith

Improving calf health and performance without the use of antibiotics

Our hypothesis: Non-specific immune stimulant drugs can induce an early activation of the immune system of the newborn dairy calves decreasing the period of high susceptibility to infectious diseases (i.e. pneumonia and scours).



Our goal: decrease the length of period critical for disease occurrence

Immune stimulant that will be tested

Amplimune™

- **The active ingredient is a mycobacterium cell wall fraction (MCWF) of *Mycobacterium phlei*, a non-pathogenic, soil-borne bacterium**
- **It is a non-specific immune response modifier that enhances the immune system of neonatal calves**
- **Initiates and modulates an appropriate immune response**
- **Amplimune™ is licensed by USDA and CFIA as an immunotherapeutic for the treatment of *Escherichia coli*K99+ scours in newborn calves**

Study design

- This will be a randomized clinical trial
- 2 different commercial dairy farms in Minnesota
- Treatment groups
  - Treatment: 1 mL of immune stimulant subcutaneous
    - n = 400 calves
  - Control: 1 mL of sterile saline subcutaneous
    - n = 400 calves

At…

BIRTH

- All calves will receive 4L of good quality pasteurized colostrum within 6 hours of birth.

- Birth weight will be measured using a digital scale

At…

BIRTH | 2d

- Calves will be randomly allocated to the control (1mL saline) or treatment (1mL immune stimulant) groups

- Blood sample will be collected for measurement of serum total solids to assess passive transfer.

At…

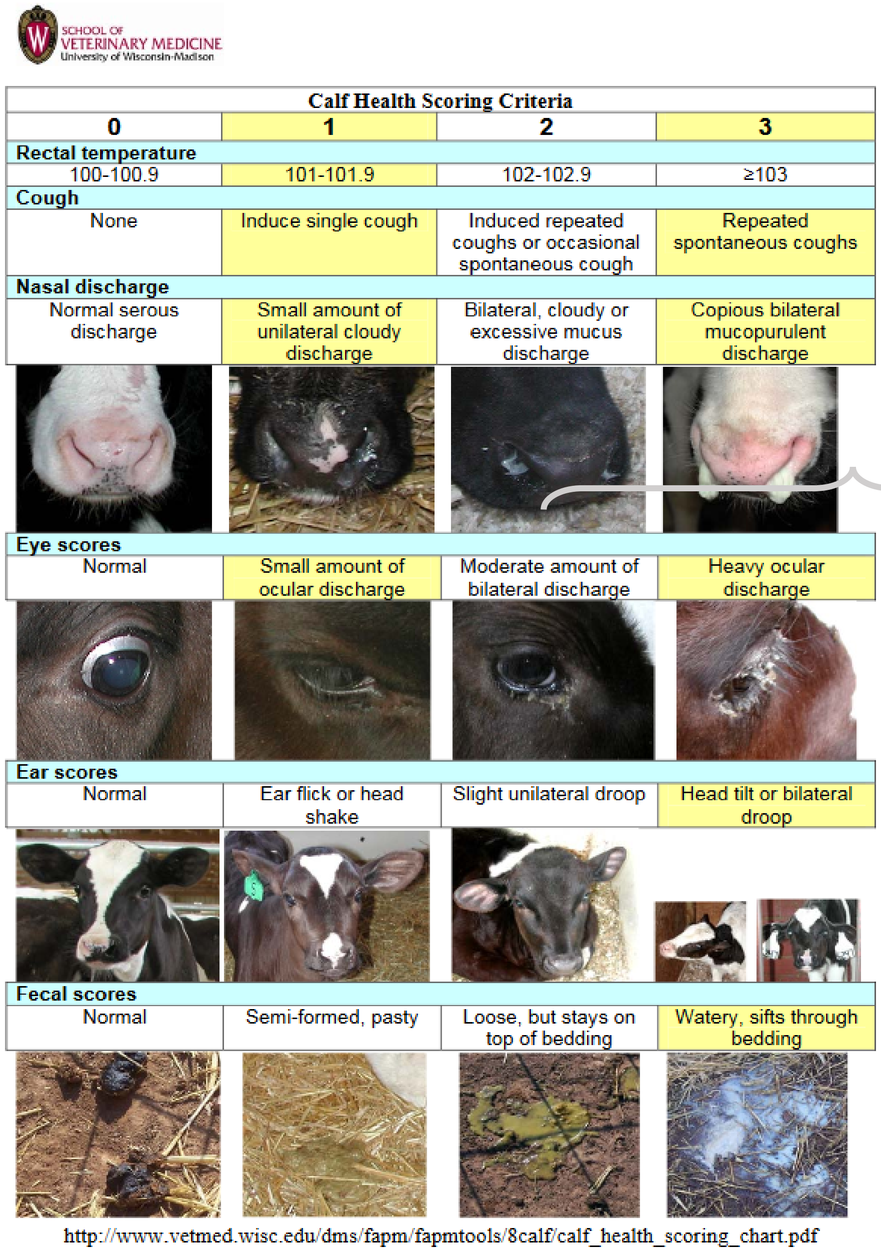
BIRTH	2d	3d	7d	10d

Treatment & Total Solids

- Plasma samples will be collected on days 3, 7, and 10 of life to measure:
  - White blood cell count (# of immune cells released)
  - Neutrophil function (activation of immune cells)

University of Minnesota

At…


SCHOOL OF VETERINARY MEDICINE
University of Wisconsin-Madison

Calf Health Scoring Criteria			
0	1	2	3
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
Fecal scores			
Normal	Semi-formed, pasty	Loose, but stays on top of bedding	Watery, sifts through bedding

http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf

10d

Weeks 2 & 3

- Calf health will be evaluated on a weekly basis using the calf health scoring criteria from University of Wisconsin.
- Factors: Body temperature, nasal discharge, eye score, and fecal scores.

At...

- Weaning weight will be measured using a digital scale
- Farm treatment records will be recovered from on-farm software

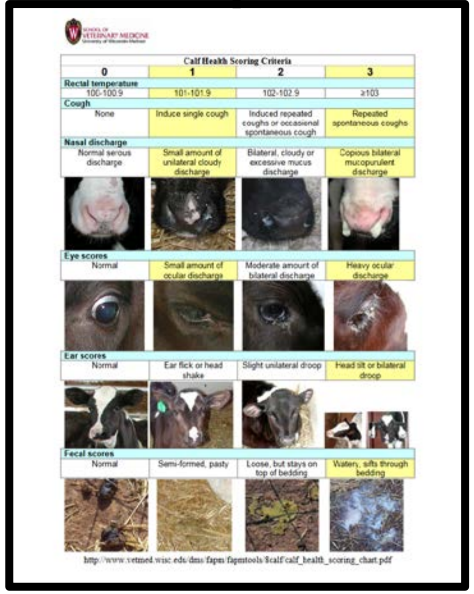
Weaning

Study design

White blood cell count
& Neutrophil function

BIRTH | 2d | 3d | 7d | 10d | Weeks 2 & 3 | Weaning

Treatment &
Total Solids



Calf Health Scoring Criteria

	0	1	2	3
Rectal temperature	100-100.9	101-101.9	102-102.9	≥103
Cough	None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
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Ear scores	Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
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http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf

Expected results

We anticipate that the administration of the immune stimulant will decrease the incidence of pneumonia and diarrhea in Jersey calves during the pre-weaning period. Additionally, we expect that calves in the treated group will have fewer sick days than their control counterparts. Consequently, treated calves are expected to have a better average daily gain and lower number of antimicrobial treatment during the weaning period.

Thank you for your support!

Any questions contact Dr. Caixeta
e-mail address: lcaixeta@umn.edu

COLLEGE OF VETERINARY MEDICINE

UNIVERSITY OF MINNESOTA

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dairyKNOW

Genomic improvement of colostrum quality and Jersey heifer calf survival

Principal Investigator: Dr. Rebecca Cockrum

Co-investigators: Dr. Katharine Knowlton and Dr. Kristy Daniels

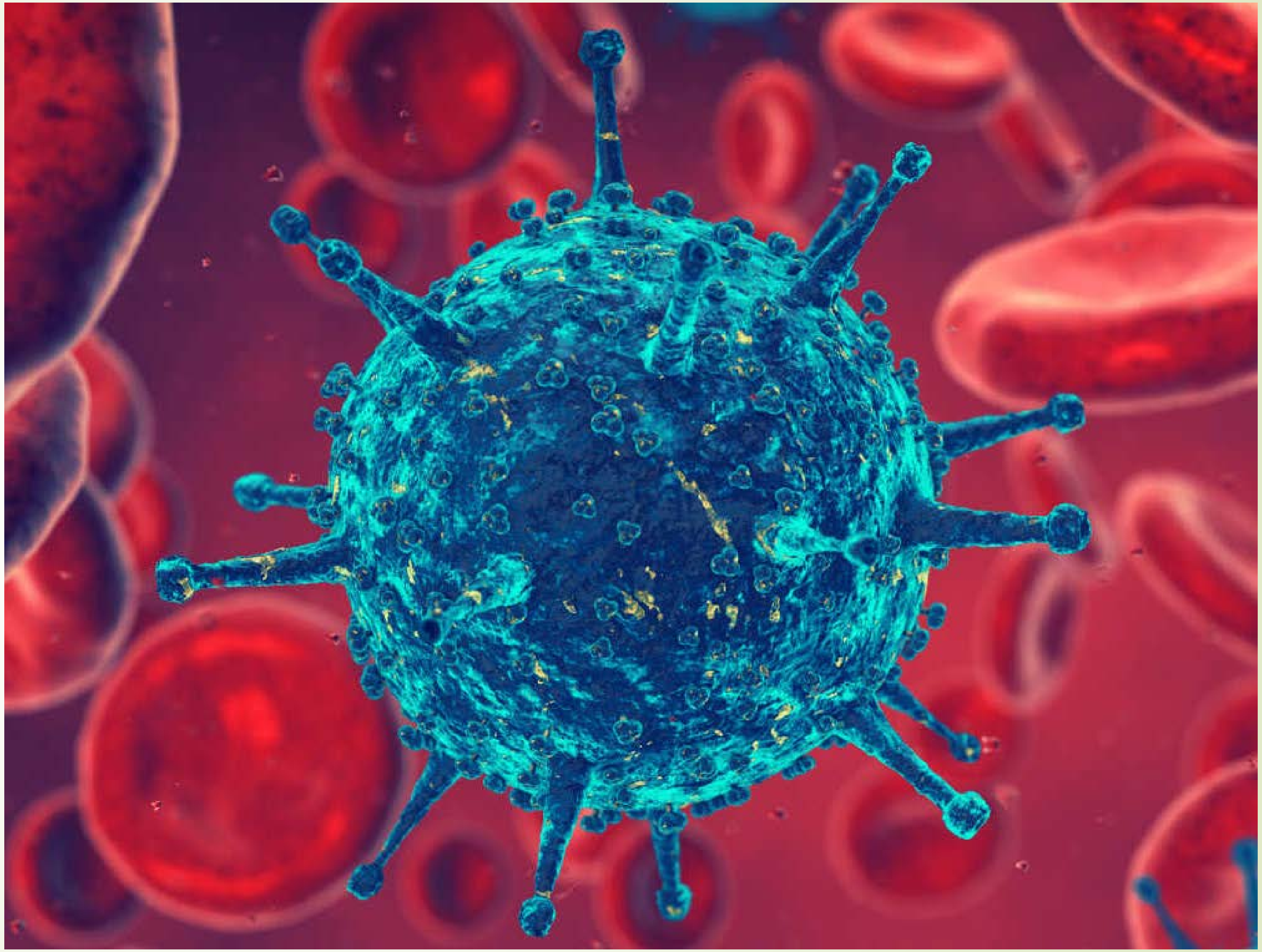
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
DAIRY SCIENCE
VIRGINIA TECH

Introduction

- Colostrum is the first milk produced by the dam late in pregnancy or a few days after birth
- It contains a wide range of components that play a role in the calf's health and survival.

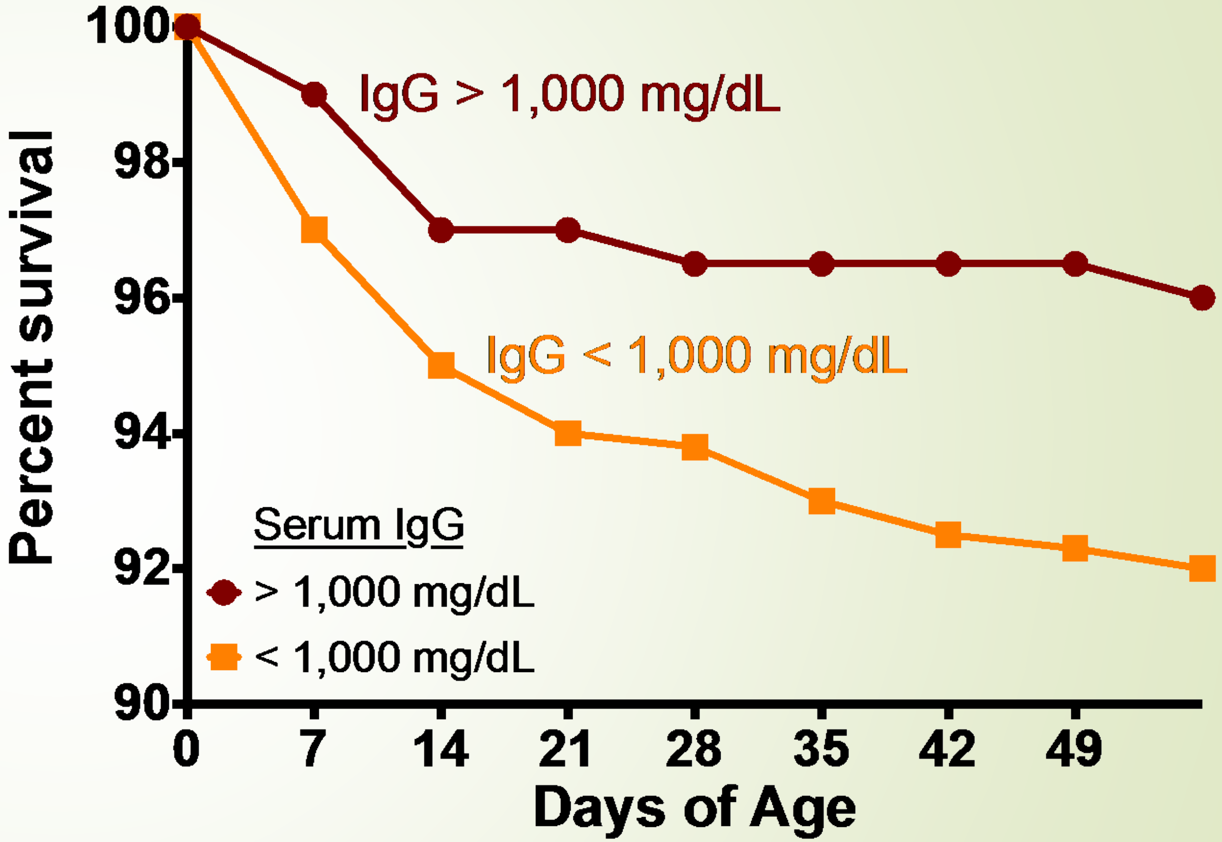
Introduction

- From the many components found in colostrum antibodies have been the most heavily studied.
- Antibodies act as the first protective barrier to the calf in its initial days of life.
- Antibody levels in colostrum can be inherited by progeny.



Introduction

- Even after calves receive these antibodies through dam’s colostrum there is still high incidence of calf death.
- There's only a 4% difference in survivability between calves that receive the adequate amount of antibodies an those that do not.
- Thus, obviously, other components in colostrum contribute to calf survivability and may also be heritable.



(Sellers, 2001)

Economic impact

- Calf deaths account for > $100 million in losses every year. *This doesn't include morbidity!*
  - $ for prevention & treatment of diseases
  - increased feed costs
  - losses in lifetime profitability
- Many deaths due to scours and respiratory diseases.
  - B/c calves did not receive high quality colostrum in the first hours of life!
  - But what constitutes high quality colostrum?

Importance to Producers

- What if one could identify and choose bulls that produce daughters that generate high quality colostrum?

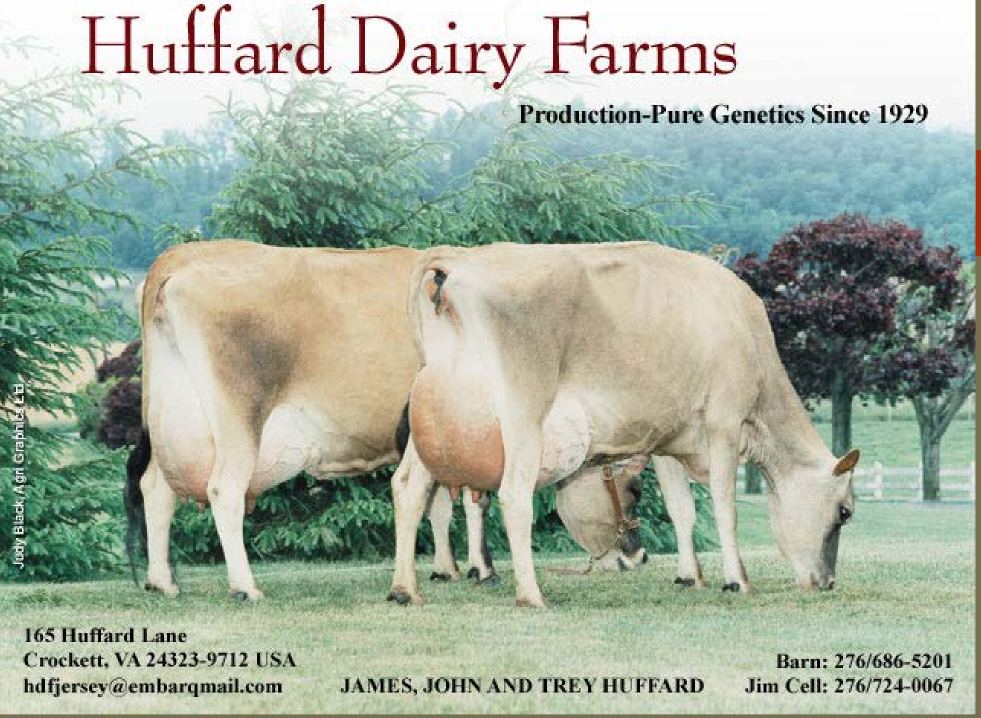
I. Impacts:
   - Improve calf survivability
   - Improve profitability of Jersey producers
     I. If death loss was decreased from 8% to 4 % on a farm that produces 500 calves, min savings of $42,000/year.
   - Increase number of “no problem” cows on the farm

Study: Hypothesis

- Genetically selecting for optimal colostrum quality will reduce incidence of pre-weaned calf deaths and increase survivability

Objectives

- Determine genetic relationships between colostrum composition and calf health
- Demonstrate how much genetic improvement of colostrum quality can be made over time
- Identify influential Jersey bulls that produce daughters with high quality colostrum that produce healthy calves



Experimental Methods

Objective 1. Determine genetic relationships between colostrum composition and calf health

- Data will be collected from registered Jerseys from regional participating farms. A total of 730 and their offspring.
  1. Kentland Dairy Complex (n=30)
  2. Waverly Farms Jersey (n=200)
  3. Huffard Dairy Farms (n=500)

Experimental Methods

- Colostrum will be analyzed for:
  1. Colostrum quality via Brix refractometer
  2. Colostrum volume
  3. Composition
     1. True protein, fats, solids non-fat, urea, lactose, SCC, acetone and BHB
     2. Immunoglobulins
     3. Growth factors
- Calves' blood will be collected to confirm passive transfer of immunity.
- Health and growth records through 56 days of age

Experimental Methods

Objectives 2 and 3:

- Demonstrate how much genetic improvement of colostrum quality can be made over time
- Identify influential bulls that produce daughters with high quality colostrum that produce healthy calves

The graduate student will spend a summer at AGIL to incorporate our data with national database and develop prediction model for optimal colostrum production.

Experimental Methods

- Plan-Objectives 2 and 3:

1. Determine heritability of colostrum quality
2. Determine genetic correlations between colostrum quality and calf health and performance traits
3. Develop genomic breeding value for optimal colostrum production
4. Identify influential Jersey bulls that both produce daughters with high quality colostrum and produce healthy calves

Summary

- Components in colostrum play an important role in calf health and survival.
- Antibodies are necessary for immune protection for the calf but even when calves get necessary antibodies there is still too much calf death.
- If we genetically select for other components in colostrum to improve the quality we likely can:
  - I. Improve profitability of Jersey producers - store increased amounts of high quality colostrum
  - II. Improve calf health
  - III. Increase number of “no problem” cows on the farm
- Our study will provide a genetic selection tool for to select for optimal colostrum quality and allow for selection of influential sires.

Developing Calf Starters for Efficient Growth of Jersey Heifers

Dr. Maurice L. Eastridge, Professor

Department of Animal Sciences

CFAES

USJersey

The Ohio State University
College of Food, Agricultural, and Environmental Sciences

INTRODUCTION

- Jersey calves consuming high levels of starch in grain may have more advanced rumen development and higher rates of gain at the time of and during weaning.
- Jersey milk is higher in lauric and myristic fatty acids than Holstein milk which may be important for gut development and health. Providing these fatty acids in the grain may be advantageous in sustaining gains during the weaning phase.
- High rates of gain are needed for achieving calving at 20 to 22 months of age.

BENCHMARKS

Age	Weight
Birth	60 lb

1.2 lb ADG

Age	Weight
Weaning (5 to 7 wks)	120 lb

1.5 to 1.2 lb ADG[1]

Age	Weight
Breeding (11 to 13 mo)	550 lb

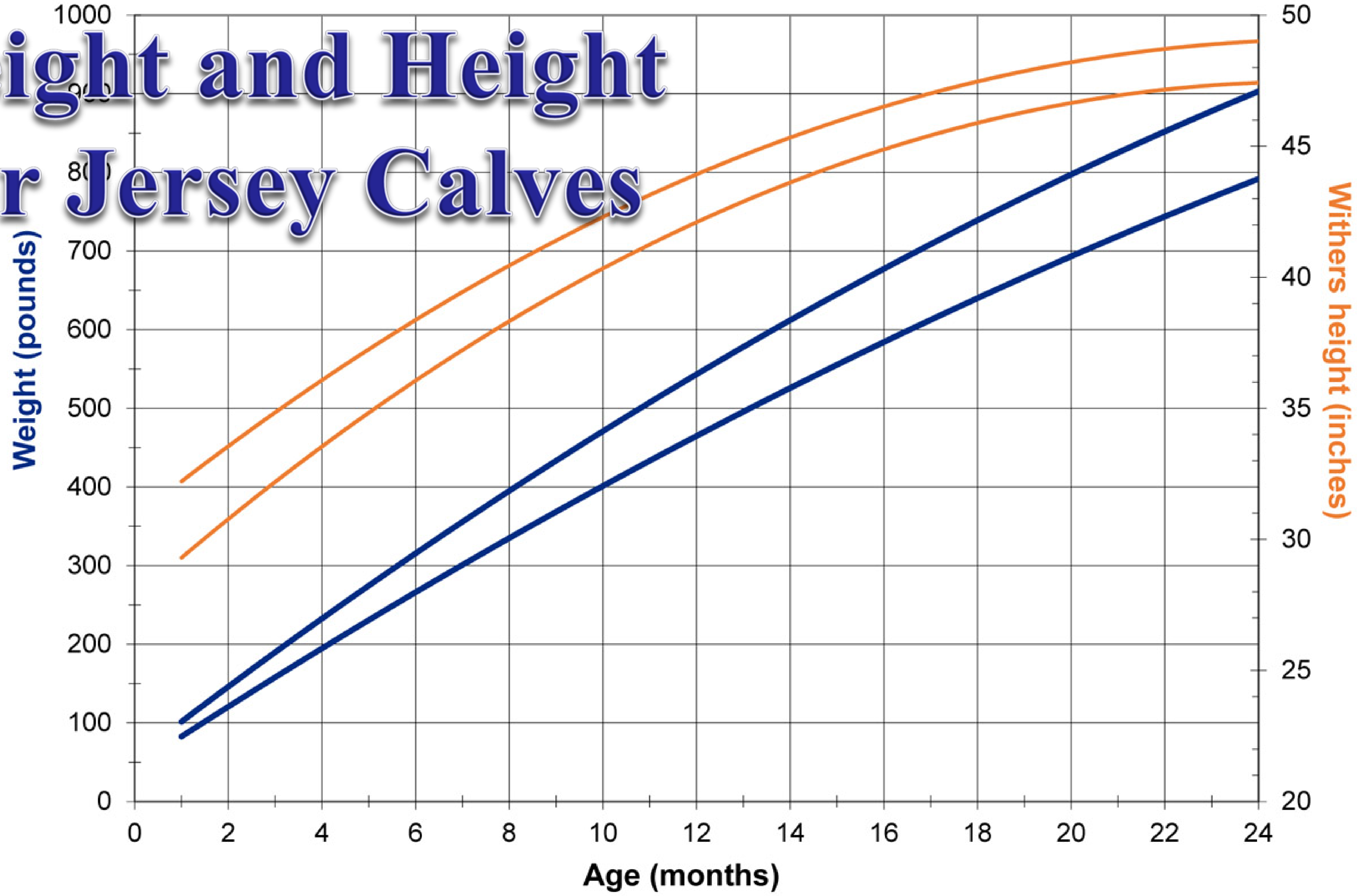
1.5 lb ADG[2]

Age	Weight
Calving (20 to 22 mo)	950 lb[2]

[1]*Average daily gain needed will depend on goal for age at first calving.*

[2]*Includes weight of fetus and reproductive tract.*

Weight and Height for Jersey Calves



Source: Penn State University, https://extension.psu.edu/growth-charts-for-dairy-heifers#section-6

OBJECTIVES

1) Determine the pre-weaning, weaning, and post-weaning growth and physiological measures of Jersey calves as affected by level of starch and fat intakes from calf starter.
2) Evaluate the NRC requirements for Jersey calves fed diets with varying carbohydrate and fat concentrations in diets.

HYPOTHESES

1) Calves with the higher starch and fat concentrations in the starter will have higher growth pre-weaning and this advantage will be sustained during the weaning phase, and
2) Calves fed the higher starch and fat concentrations will have fewer days with fecal scores >2.

Calf Starter Treatments

Heifer calves will be fed one of 3 calf starters:

1) 35% starch and 2% fat (typical formulation),
2) 20% starch and 2% fat, or
3) 35% starch and 4% fat.

Materials and Methods

- 36 Jersey heifer calves will be blocked by date of birth and body weight and then randomly assigned within a block to one of the 3 calf starters.
- Starch will be provided primarily by corn and oats.
- The fat supplement will be a blend to especially provide for targeted concentrations of lauric, myristic, and linolenic fatty acids.

Materials and Methods *(continued)*

- At birth calves will receive 4 L (1gal) of colostrum within the first 6 hr of birth and then will be fed 4.5 L/day (1.2 gal/day) of a commercial milk replacer designed for Jersey calves (e.g. Cow's Match - Jersey Blend, 28% protein, 25% fat; Purina Animal Nutrition, Gray Summit, MO).
- Calves will be housed outdoors in hutches with free choice water and calf starter.
- At 49 days of age, the milk feeding will be reduced to half per day for one week. At 56 days of age, milk feeding will cease as long as the calves are eating at least 2 lb/day of starter for 3 consecutive days.
- One week after weaning, calves will be moved to group housing with 4 to 6 calves per pen and monitored for 4 weeks.

Materials and Methods *(continued)*

- Blood samples will be taken within 48 hour of feeding colostrum for measurement of serum protein.
- Body weight and height will be taken at birth, and at 2, 4, 6, 8, 10, and 12 weeks of age.
- Daily fecal and respiratory scoring will occur during the pre-weaning phase.
- Body temperatures will be taken daily for the first 6 days of age.
- Daily intakes of milk and starter will be recorded.
- Total tract digestibilities of dry matter, organic matter, protein, neutral detergent fiber, starch, and fat will be determined.

Expected Outcomes

- Improve the formulation of calf starters for Jersey calves to support higher rates of growth and lower rates of morbidity.
- Gain important information for better understanding the nutritional requirements of the pre-weaned Jersey calf.

THANKS for the support from:

American Jersey Cattle Association Research Foundation

USJersey

CFAES

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

TEXAS TECH UNIVERSITY SYSTEM™

Jersey calves are susceptible to hypoxia-induced pulmonary hypertension

J.M. Neary,[1] A. Gulick,[1] and R.C. Cockrum[2]

[1]*Department of Animal and Food Sciences, Texas Tech University.*

[2] *Department of Dairy Science, Virginia Tech University.*

Outline

- Background
  - *Study objectives*
- Material and methods
- Results
- Implications

BACKGROUND

- Right-sided congestive heart failure secondary to pulmonary hypertension, commonly known as brisket disease, is a leading cause of calf mortality at altitudes over 7,000 ft. (Neary et al., 2013)
  - *The disease is caused by hypoxia-induced pulmonary hypertension*
- Brisket disease was recently reported to be the second leading cause of death loss in Holstein heifers on two dairies and a heifer-raising facility at an altitude of 1,524 m (5,000 ft.) in northern Colorado (Malherbe et al., 2012)
- The goal of this study was to determine if Jersey calves are susceptible to hypoxia-induced pulmonary hypertension.

MATERIALS AND METHODS

- Eight 2-month old Jersey calves were obtained from a local dairy. Calves were individually on a raised slatted floor inside temperature-controlled chambers.
- Five calves underwent surgery for the implantation of wireless telemetry equipment so that the development of pulmonary hypertension could be followed in real-time.
- Pulmonary arterial pressures were measured in 3 calves by traditional non-telemetric methods.
- After a 5-day acclimation period, the air within the chamber housing the hypoxic group was reduced to 14% oxygen, simulating an altitude of 4,570 m (Day 1 of the study). The air within the chamber housing the normoxic group remained at 21% oxygen.

MATERIALS AND METHODS

- On Day 14 of the study, calves were euthanized and a postmortem examination performed.
- Tissue sections of the heart, lung, and liver were preserved in formalin for histological analysis and semi-quantitative scoring of lesions.
- Two calves were housed under normoxic conditions
- Three calves were housed under hypoxic conditions

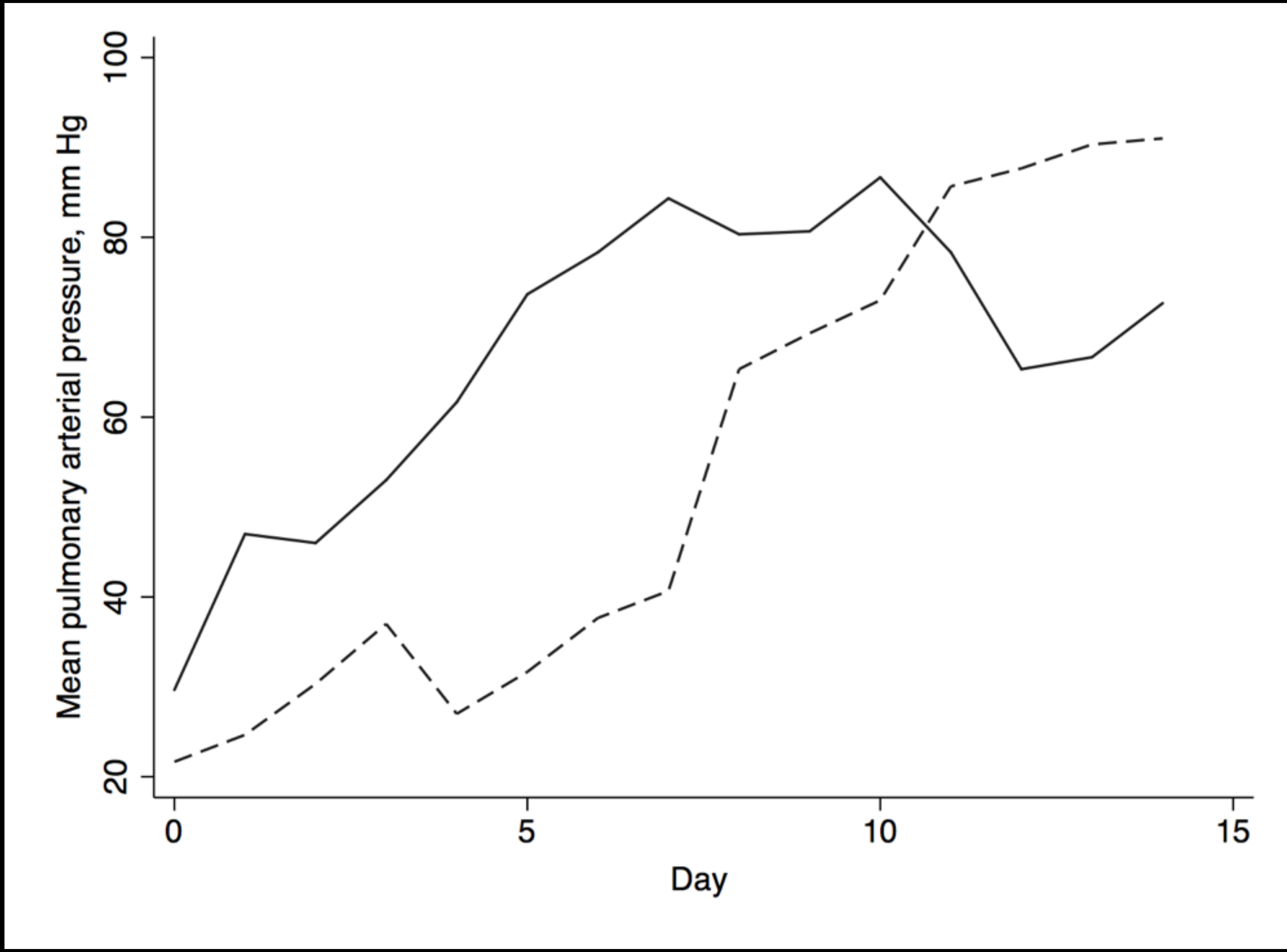
RESULTS

Group	Calf ID	Mean (systolic/ diastolic) PAP on Day 14	RV: Total ventricle mass ratio	Pulmonary medial hypertrophy	Liver
Normoxic	1	26 (41/18)	0.36	0	Normal
	2	26 (37/20)	0.31	1+	Normal
Hypoxic	3*	91 (127/73)	0.46	3+	Moderate congestion and hydropic degeneration
	4*	73 (92/63)	0.44	3+	Moderate congestion, sinusoidal dilation, and hydropic degeneration
	5	76 (88/70)	0.38	2+	Mild inflammation and hydropic degeneration

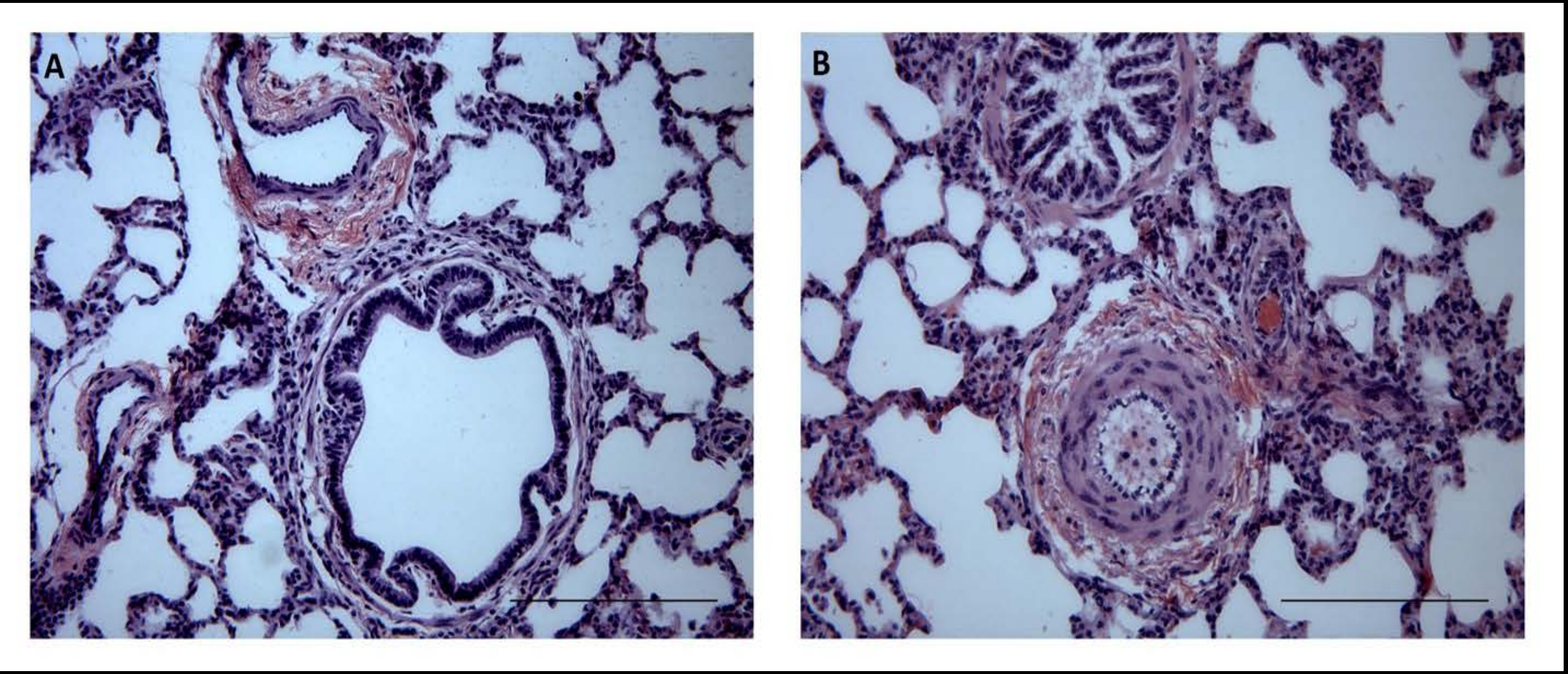
Pulmonary arterial pressures, right ventricle (RV) to total ventricular mass ratio, pulmonary arterial medial hypertrophy, and hepatic lesions observed in 2-month old Jersey calves housed under normoxic (975 m altitude) or hypoxic (4,570 m simulated altitude) for two weeks.

* Indicates calf implanted with wireless telemetry device

Change in pulmonary arterial pressure in two 2-month old Jersey calves during a 14-day exposure to a simulated altitude of 4,572 m



RESULTS



Bronchiole and pulmonary artery from a control calf (A) and a calf exposed to a simulated altitude of 4,572 m for 14 days (B). The control calf shows minimal smooth muscle hypertrophy within the tunica media of the pulmonary artery unlike the calf housed under hypoxic conditions (arrow). Scale bar 2 mm.

RESULTS

Moderate chronic passive congestion (zones 1 and 2), sinusoidal dilation, and hydropic degeneration (zone 3) of the liver of a 2-month old Jersey calf housed under hypoxic conditions (simulated altitude of 4,572 m) for two weeks.

Scale bar 2 mm

CONCLUSIONS

The findings of this study indicate that Jersey calves are susceptible to hypoxia-induced pulmonary hypertension.

The calves implanted with wireless telemetry equipment – which allowed for the real-time collection of pulmonary arterial pressure data – revealed that the progression of the hypoxia-induced pulmonary hypertension varies among calves over a 14-day period.

The findings of this study have considerable implications for high-altitude producers and indicate that field-based genetic evaluations of PAP in dairy breeds are warranted to mitigate the risk of death loss secondary to hypoxia-induced pulmonary hypertension and heart failure in young calves.

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EFFECT OF LIMIT-FEEDING HAY ON SUBACUTE RUMINAL ACIDOSIS IN PRE-WEANED JERSEY CALVES

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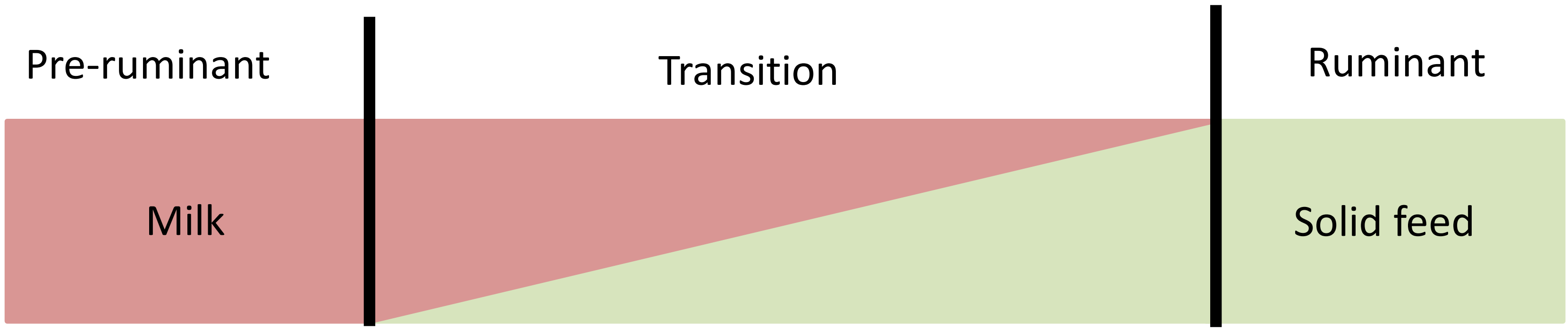
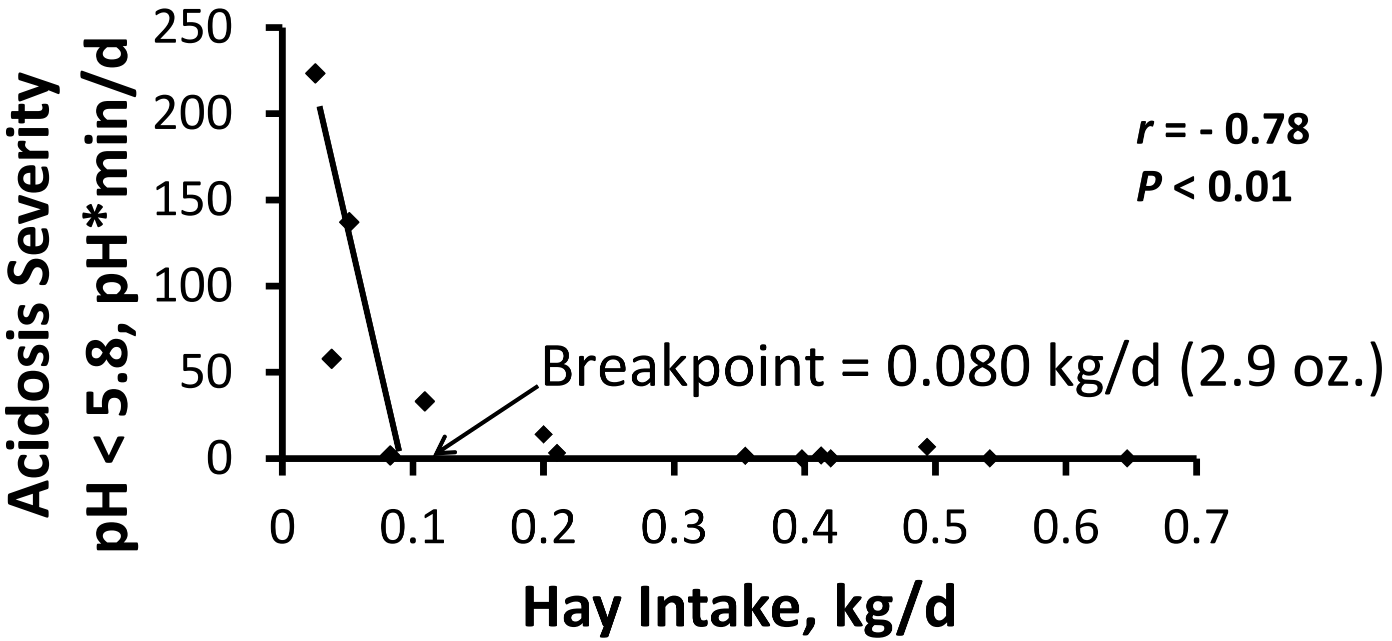
University of Idaho
College of Agricultural and Life Sciences

RUMEN DEVELOPMENT



- Newborn calves do not have a functional rumen (Lane et al., 2002)
- Transition stimulated by calf starter fermentation (Quigley et al., 1991)
  - Especially butyrate and propionate (Stobo et al., 1966; Warner et al., 1956)
- Fermentation also decreases rumen pH, causing subacute ruminal acidosis

HAY INTAKE AND RUMEN ACIDOSIS SEVERITY



- Calves that experience subacute ruminal acidosis all consumed less than 2.9 oz. hay daily (Laarman and Oba, 2011)
  - Subacute ruminal acidosis = rumen pH below 5.8

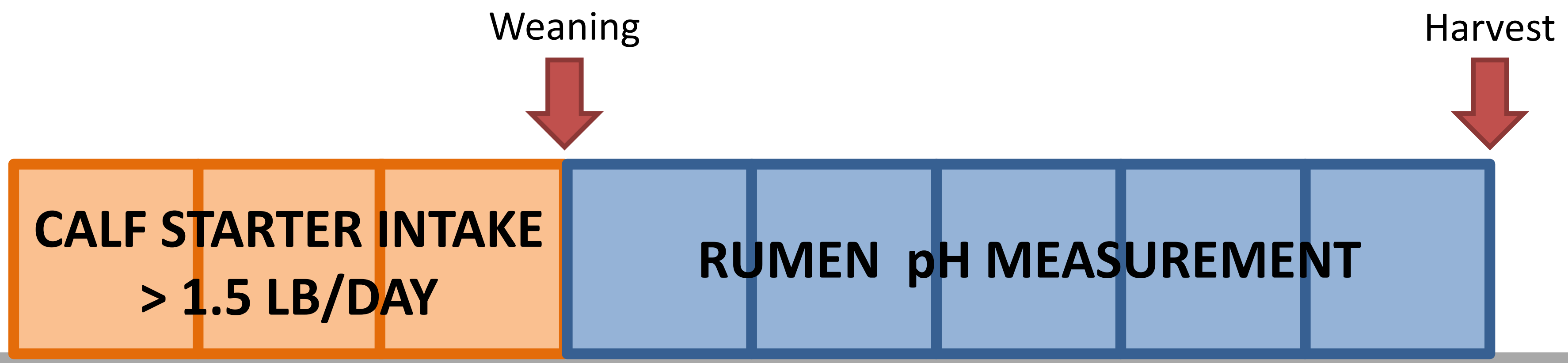
PROJECT GOALS

- Objective
  - Investigate use of limit-feeding hay as an on-farm monitoring system for subacute ruminal acidosis in pre-weaned Jersey calves

- Hypothesis
  - Calves that fail to consume all of limit-fed hay will be more susceptible to subacute ruminal acidosis

EXPERIMENT DESIGN – FEEDING REGIMEN

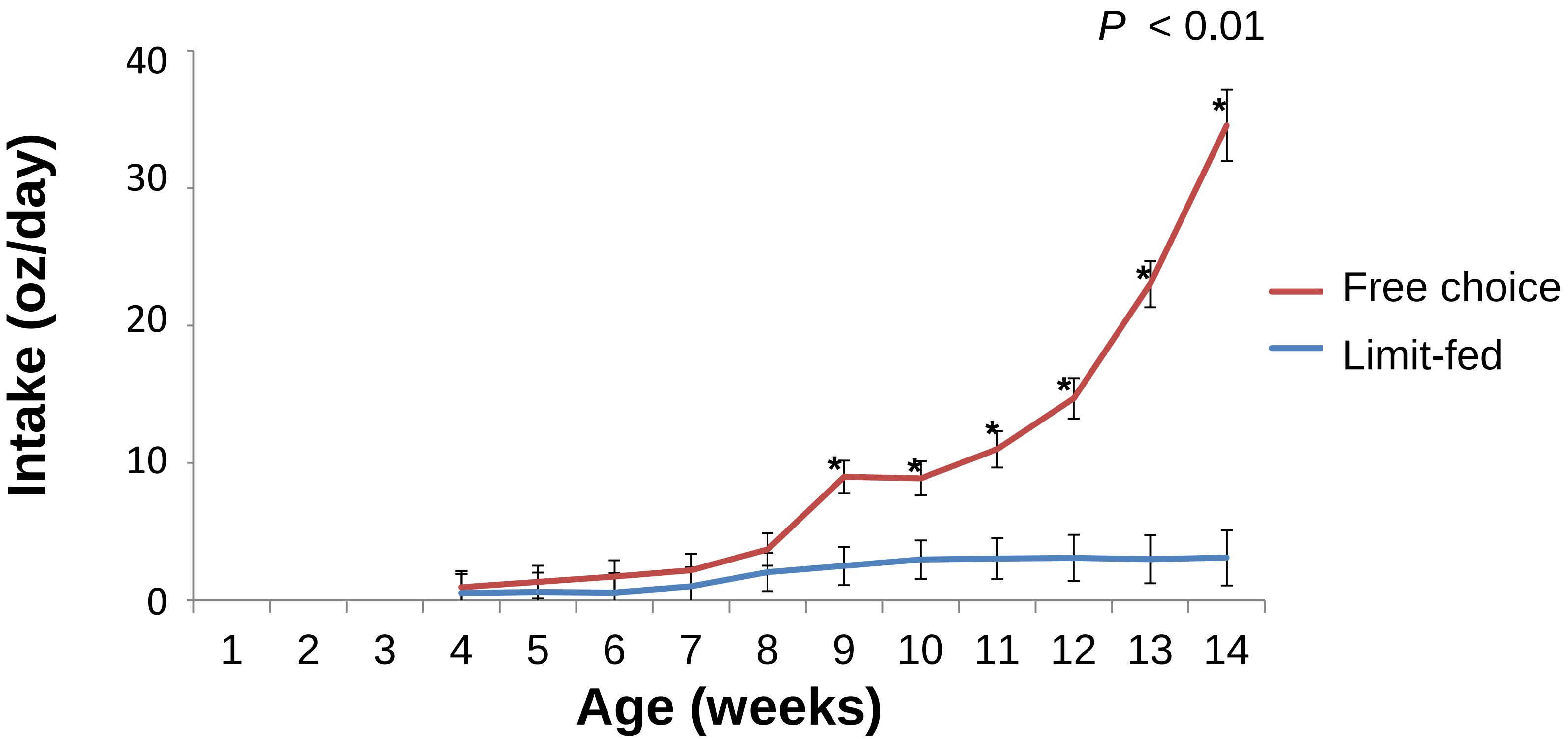
- Jersey calves (n=21) separated into:
  - ***AD LIBITUM* – *Unlimited hay/day provided (n=14)***
  - ***LIMIT-FED* – *3.0 oz. hay/day provided (n=7)***
- All calves fed unlimited water and calf starter
  - Milk replacer fed at 900 g/d



EXPERIMENT DESIGN – ANALYSIS

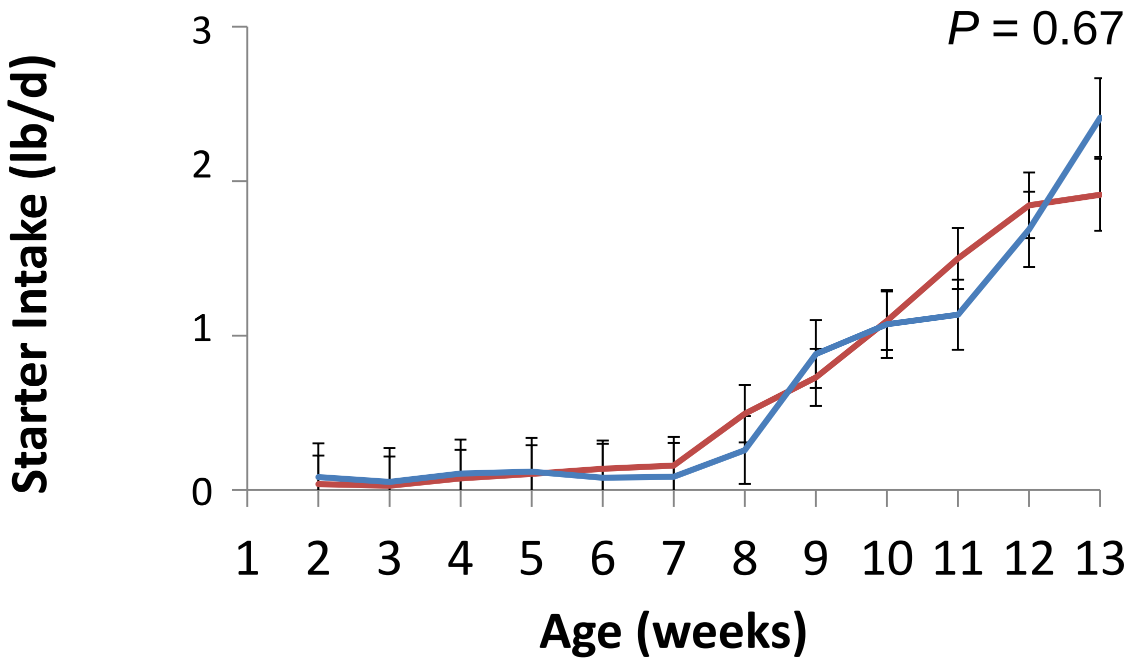
Sample	Frequency
Starter intake	Daily
Hay intake	Daily
Body weight	Weekly
Blood sample (glucose, BHBA)	Weekly
Rumen pH measurement	Once

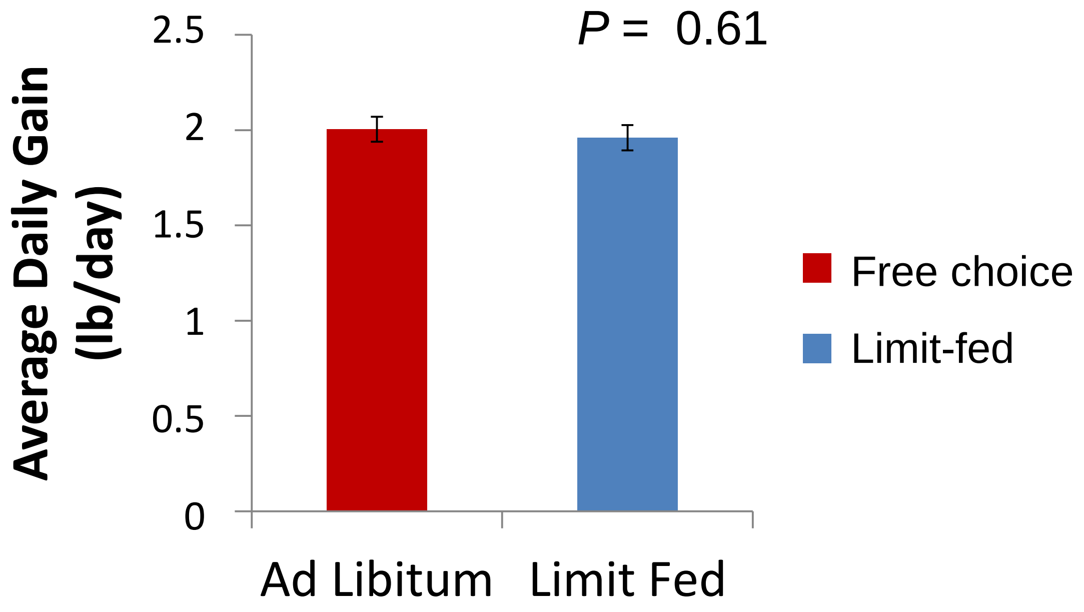
FORAGE INTAKE



- Calves fed hay free choice (ad libitum) have higher hay intake
  - Outbreak of contagious disease delayed start of solid feed consumption

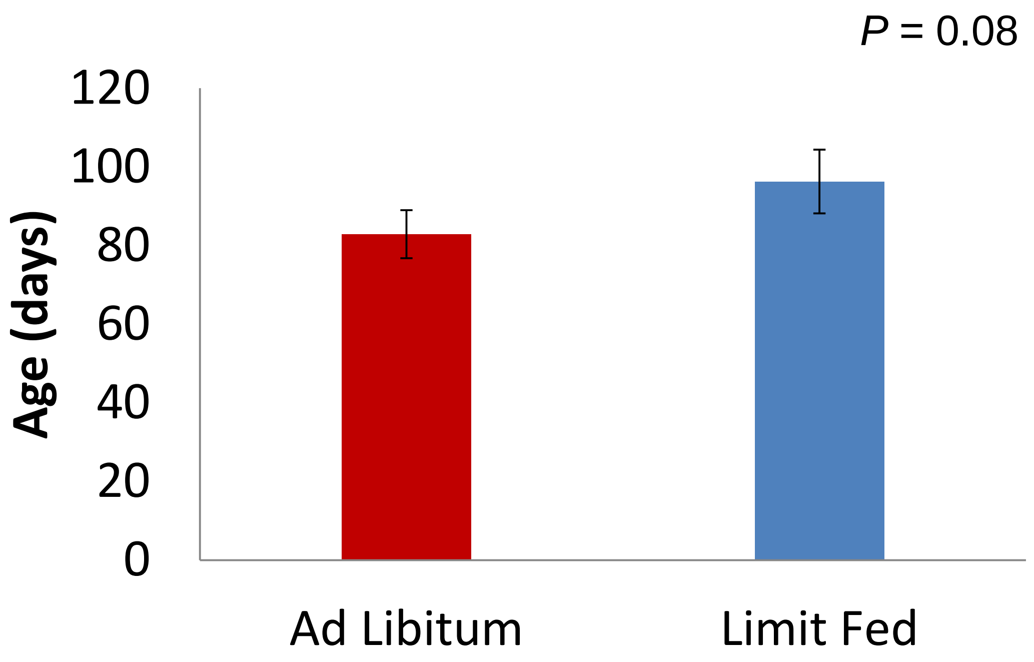
PERFORMANCE – STARTER INTAKE & AVG DAILY GAIN

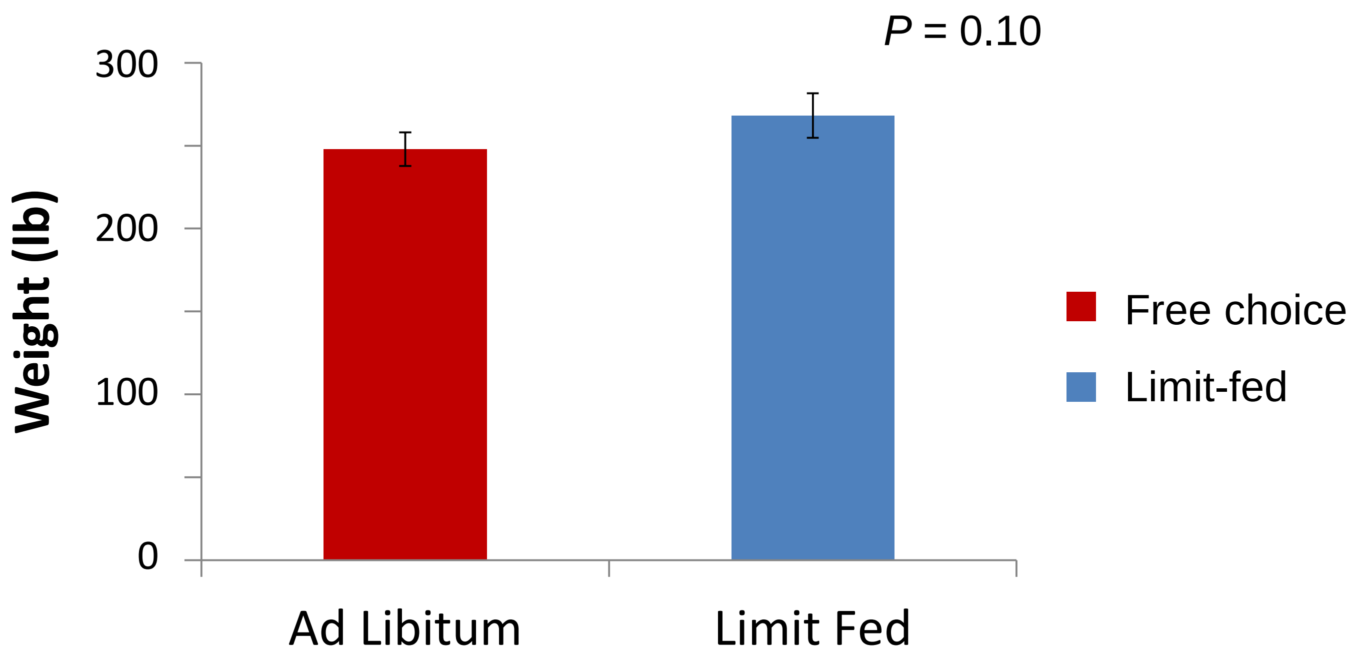




- Limit-feeding hay does not impact starter intake or average daily gain pre-weaning

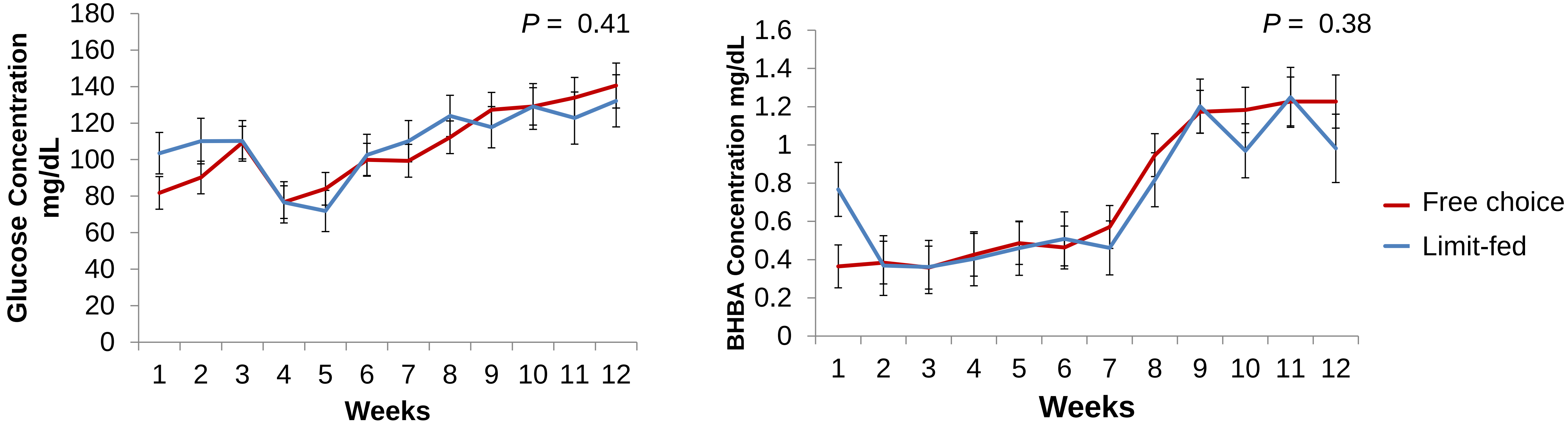
WEANING – AGE AND BODY WEIGHT





- Limit-feeding hay does not affect age or weight at weaning

BLOOD METABOLITES – GLUCOSE & BHBA



- Glucose concentrations not affected by limit-feeding hay
- BHBA concentrations not affected by limit-feeding hay
  - Increase in concentrations due to calf starter fermentation

RUMEN pH

	Free Choice	Limit-Fed	*P* Value
Min pH	4.88 ± 0.35	4.18 ± 0.53	0.17
Average pH	6.38 ± 0.16	5.98 ± 0.23	0.09
Max pH	7.25 ± 0.13	7.11 ± 0.20	0.40
Duration of subacute ruminal acidosis pH < 5.8 (min/d)	261 ± 133	796 ± 145	0.03
Severity of subacute ruminal acidosis pH < 5.8 (pH*min/d)	60 ± 43	249 ± 47	0.02

- Limit-feeding hay increases both duration and severity of subacute ruminal acidosis

CONCLUSIONS

- Limit-feeding hay to pre-weaned Jersey calves:
  - Does not impact productivity
  - Increases duration and severity of subacute ruminal acidosis
- Low hay intake pre-weaning may be an indicator of susceptibility to subacute ruminal acidosis
- Calves need free choice hay pre-weaning to manage subacute ruminal acidosis

ACKNOWLEDGEMENTS

- Funding:
  - American Jersey Cattle Association
  - Calva Calf Products
  - USDA Multi-State Hatch (NC-2040)
  - Idaho Agricultural Experiment Station
- Technical Help
  - Dr. Laarman Research Lab
  - University of Idaho Beef & Dairy Facilities
  - James Allison and Staff

Reduced Testicular Estradiol in Jersey Bull Calves:

Hormonal responses to a potential stimulant of Sertoli cell proliferation

Kimberly Miller and Trish Berger

Department of Animal Science □ University of California, Davis

Background

- Sertoli cells support spermatogenesis.
- The number of Sertoli cells in the testis is widely recognized as a major determinant of sperm production capacity.
- More Sertoli cells in the testis, more sperm produced.

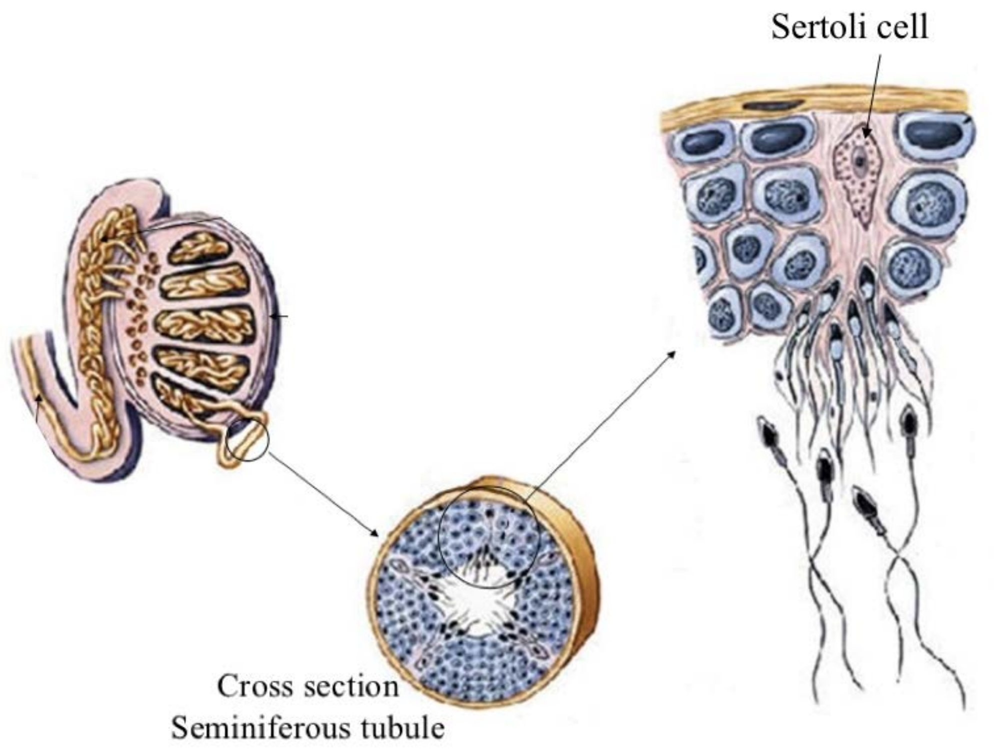


Image Source: http://image.slidesharecdn.com/malereproductivesystem-110531141354-phpapp01/95/male-reproductive-system-9-728.jpg

Background

- Reducing endogenous estradiol production in the boar leads to a sustained increase in Sertoli cell numbers, larger testes, and increased sperm production per testis without any apparent negative effects on other hormone levels.

    This was an approximate 25% increase in Sertoli cell numbers.

At-Taras, E. E., Berger, T., McCarthy, M. J., Conley, A. J., Nitta-Oda, B. J. and Roser, J. F. 2006, Reducing estrogen synthesis in developing boars increases testis size and total sperm production. Journal of Andrology, 27: 552–559.

Hypothesis: Reducing testicular estrogen production in the bull will increase number of Sertoli cells.

- Objective 1: Evaluate Sertoli cell numbers following treatment to reduce testicular estrogen production in Jersey bull calves.

- Objective 2: Evaluate hormonal responses in Jersey bull calves to reduced testicular estrogen production (aromatase inhibition).

Study Design: Treat Jersey bull calves with letrozole, an aromatase-inhibitor, to decrease testicular estradiol.

- Jersey bull calves obtained at birth
- At two weeks of age, oral treatment with aromatase inhibitor letrozole begins
- At weaning, treatment changes to intramuscular delivery to avoid rumen

Study Design: Treat Jersey bull calves with letrozole, an aromatase-inhibitor, to decrease testicular estradiol.

- Collect blood samples at 2, 4, 8, 12, 16, 20, 24 and 26 weeks of age to span development
- At age 26 weeks, collect testis samples

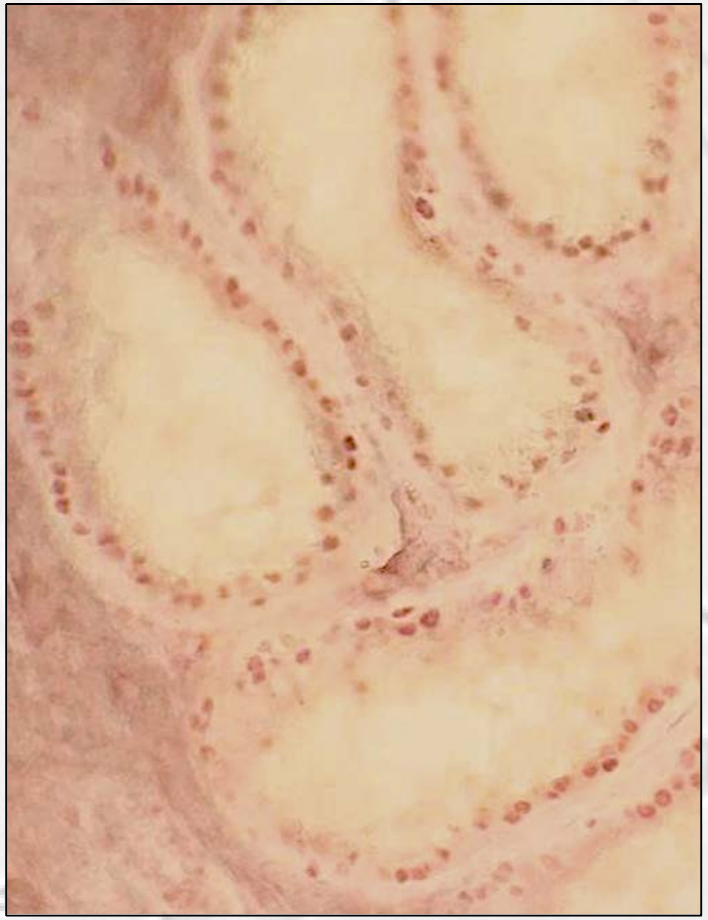
Hormone Assays

- Evaluate Sertoli cell numbers in testis samples to determine total number of Sertoli cells per testis.
- Analyze blood samples and testicular tissue for testosterone, estradiol, LH and FSH (AJCC funded).

Expected Value for Producers

If Sertoli cell numbers are increased in Jersey bull testes without adverse effects as appears to occur in boars, increased sperm production should occur.

Results



- Bulls treated with letrozole had significantly less testicular estradiol compared to control bulls.
- There was no significant difference in the number of Sertoli cells in bulls treated with letrozole compared with control animals.
- There was no significant difference in serum testosterone, estradiol, LH or FSH between treated and control bulls.

(AJCC Funded)

Sertoli cells lining seminiferous tubules in the testis, immunohistochemically stained brown for quantification.

Conclusion

- Decreasing testicular estradiol postnatally with an aromatase inhibitor did not stimulate Sertoli cell proliferation in Jersey bull calves.
- Although the reduction of estradiol in letrozole-treated bulls was significant, estradiol concentrations are very low compared with concentrations in the boar.
  - Testicular estradiol may be too low to inhibit Sertoli cell proliferation in bulls.
- Boars have two waves of Sertoli cell proliferation, while cattle have a single wave (unpublished data).
  - Postnatal proliferation of Sertoli cells in bulls may correspond to the second wave of Sertoli cell proliferation in boars, which is not responsive to a reduction in endogenous estradiol.

Thank You

Project Title:

Genomic Analysis of Bull Fertility in Jersey Dairy Cattle

Research Team:

Dr. Fernanda Rezende

Dr. Francisco Peñagaricano (PI)

Institution:

Department of Animal Sciences, University of Florida

Reproductive Efficiency

- fertility is an extremely **important economic trait** in dairy cattle
- despite its relevance:

  reproductive efficiency **remains suboptimal**, resulting in significant **economic losses**

- bull infertility is often overlooked as a potential cause of reproductive inefficiency

  most studies have focused on **cow fertility**

- **however:** significant percentage of reproductive failure is attributable to bull subfertility

❖ service sire represents an **important source of variation** for conception rate

Phenotypic Data: Sire Conception Rate

- **phenotypic evaluation of bull fertility** (since 2008; AIPL-USDA, CDCB)
- the evaluation model includes:
  - factors related to the **service sire** under evaluation
  - factors (nuisance variables) related to the **cow** that receives the unit of semen

❖ **interpretation:**

imagine a herd that average 32% conception rate and uses average SCR bulls

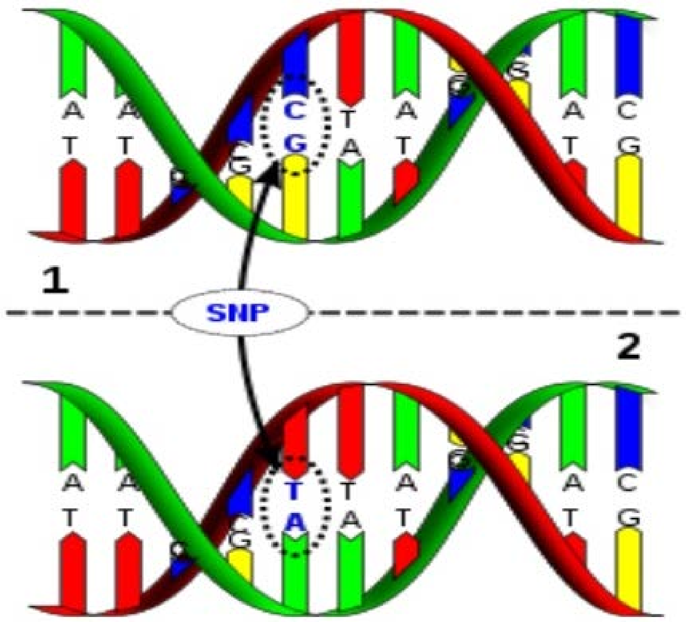
then a bull with **+5% SCR** is expected to achieved **37%** conception rate

Overall Objective

- to **unravel** the **genomic architecture** underlying **sire conception rate** in Jersey bulls
  - ❑ identify **genes** and biological **pathways** associated with sire fertility
  - ❑ new opportunities for improving bull fertility via marker-assisted selection

HIGH FERTILITY BULLS

LOW FERTILITY BULLS



Research Approach

- we **analyzed** the entire U.S. Jersey Sire Conception Rate dataset
  - more than **1,550 Jersey bulls** with official **SCR evaluations**
  - most bulls have **multiple records**; more than 6,300 SCR records since 08/2008

- we combined **SCR records** with **genomic data** and **pedigree information**

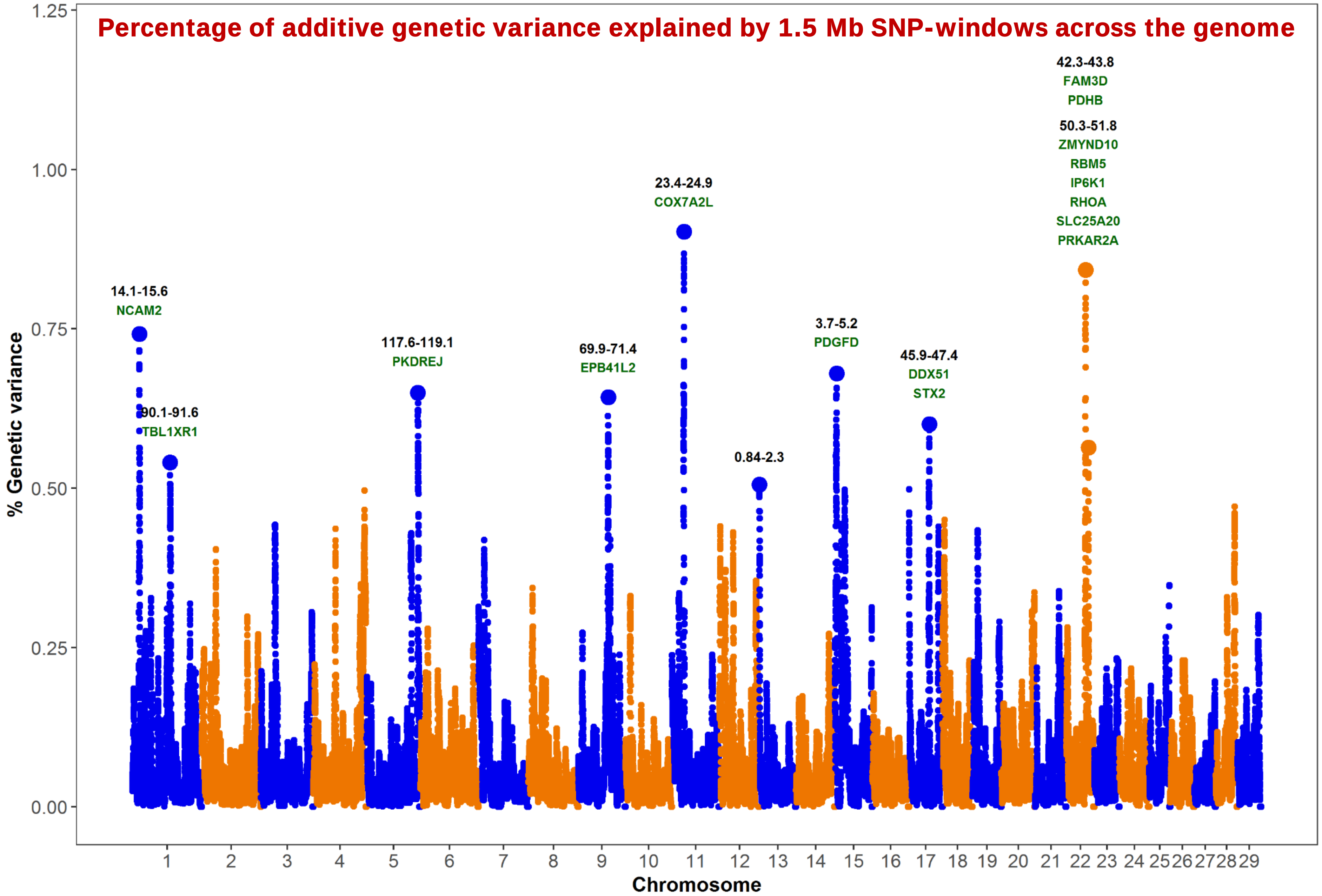
❑ alternative genome-wide association approaches

aim: identify **genomic regions** and **individual genes** affecting bull fertility

❑ novel gene-set analyses

aim: identify **biological pathways** affecting bull fertility

Genomic Analysis of Bull Fertility in Jersey Dairy Cattle



additive effects

Ten regions explained more than 0.5% of additive variance for SCR

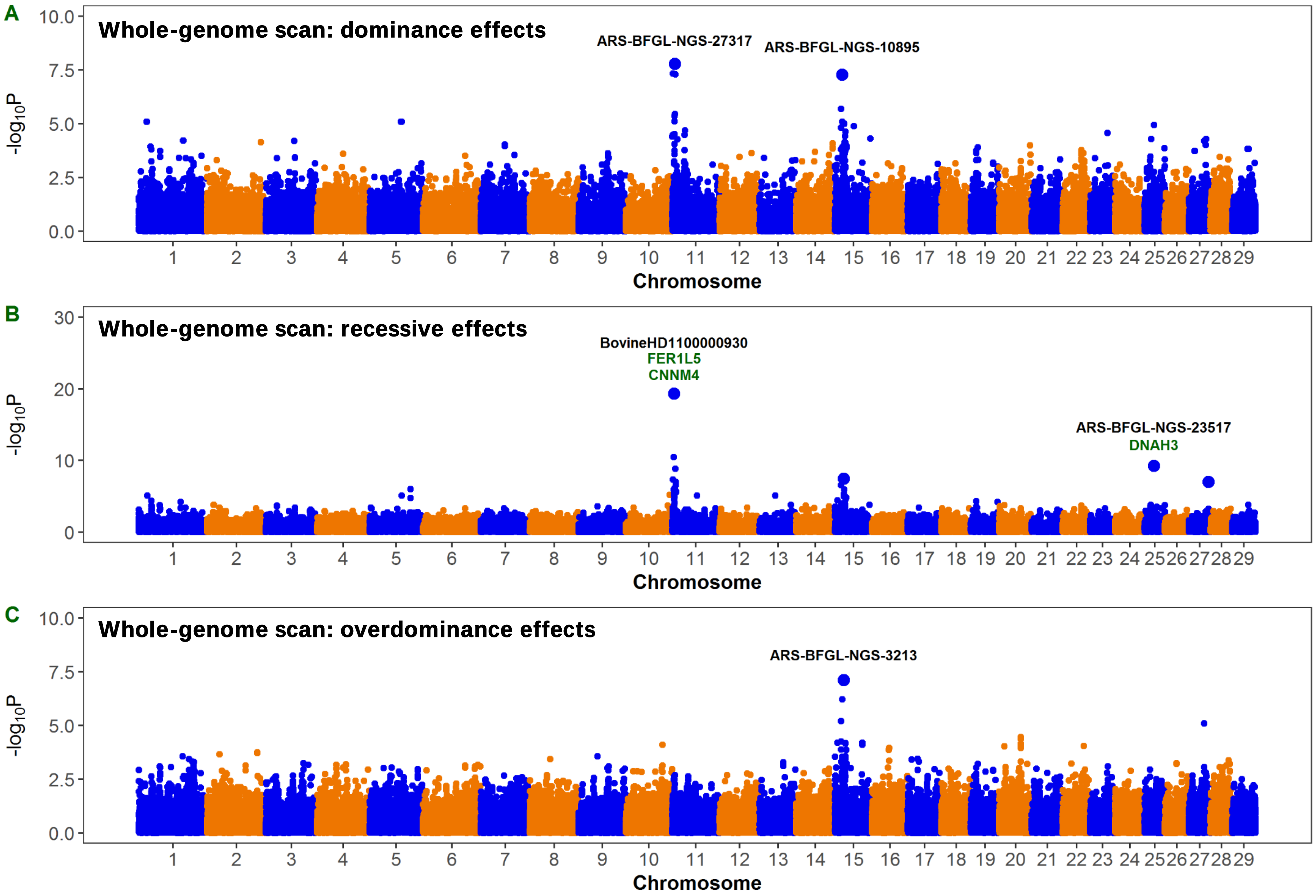
Putative genes affecting bull fertility are in green

These genes are implicated in:

- **testis development**
- **spermatogenesis**
- **sperm motility**
- **acrosome reaction**

Genomic Analysis of Bull Fertility in Jersey Dairy Cattle

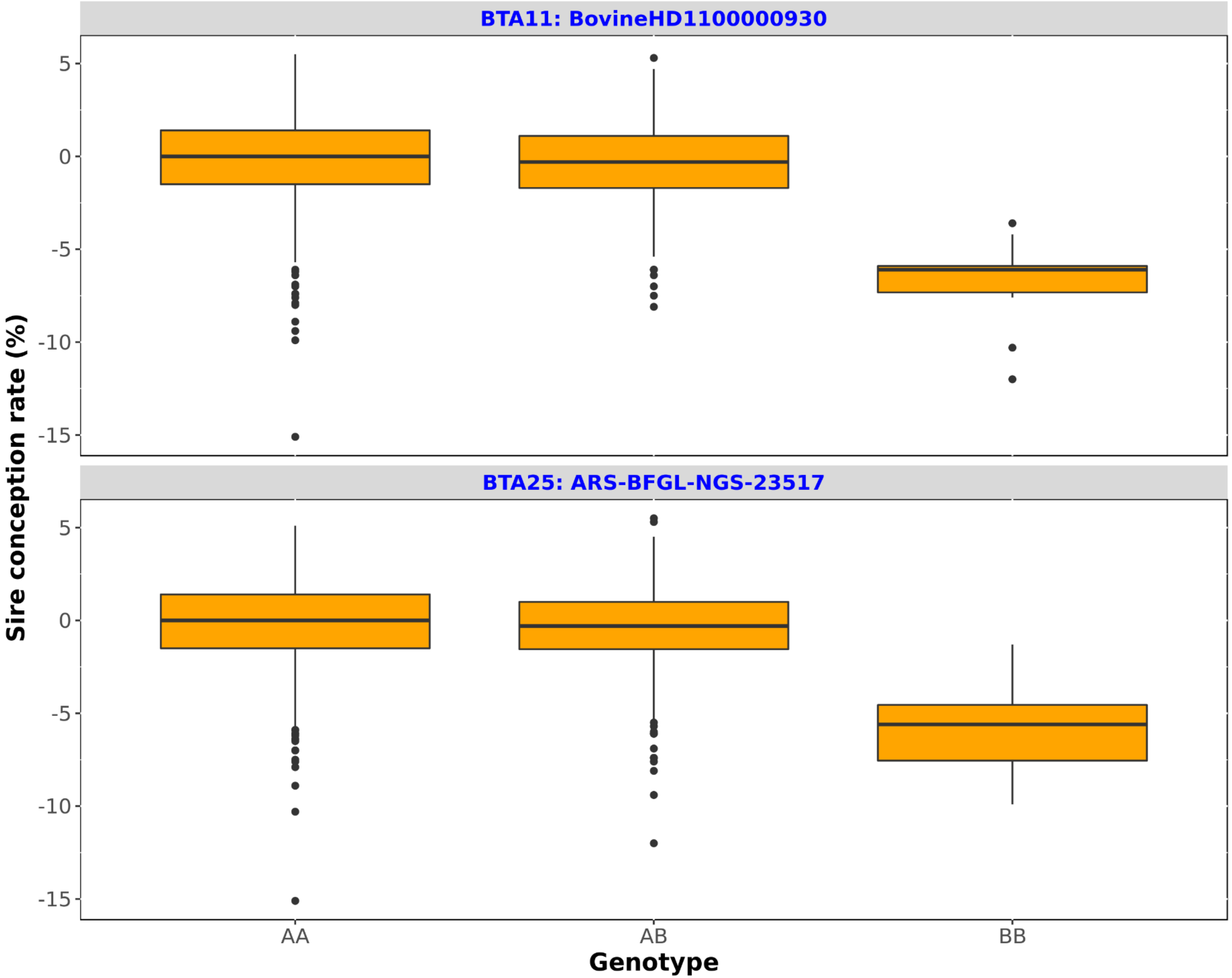
UF UNIVERSITY of FLORIDA



non-additive effects

Two regions on BTA11 and BTA25 showed marked **recessive effects**

Genes FER1L5, CNNM4, and DNAH3 plays key roles in **sperm biology**



Box plots showing the distribution of **Sire Conception Rate** phenotypes for **two SNP loci** with **marked recessive effects**

Each of these loci is explaining **differences in conception rates** of almost **6 %**

Gene-set analysis

Our analysis revealed significant gene sets related to:

Gene Ontology

Medical Subject Headings

- **calcium regulation and signaling**
- **pyrophosphatase activity**
- **membrane fusion**
- **cell energy metabolism**
- **GTPase activity**
- **MAPK signaling**

these terms are directly implicated in sperm physiology and male fertility

Conclusions

- This comprehensive study unraveled **genetic variants, individual genes** and **biological pathways** responsible for the variation in Jersey bull fertility

- These findings contribute to a **better understanding** of the **genetics** underlying this complex phenotype in dairy cattle

- This study is the foundation for the **development of novel genomic tools** for improving service sire fertility in Jersey dairy cattle

UNIVERSITY of FLORIDA

Acknowledgements

This study was funded by the American Jersey Cattle Club Research Foundation

The authors thank the Cooperative Dairy DNA Repository and the Council of Dairy Cattle Breeding for providing the genotypic data

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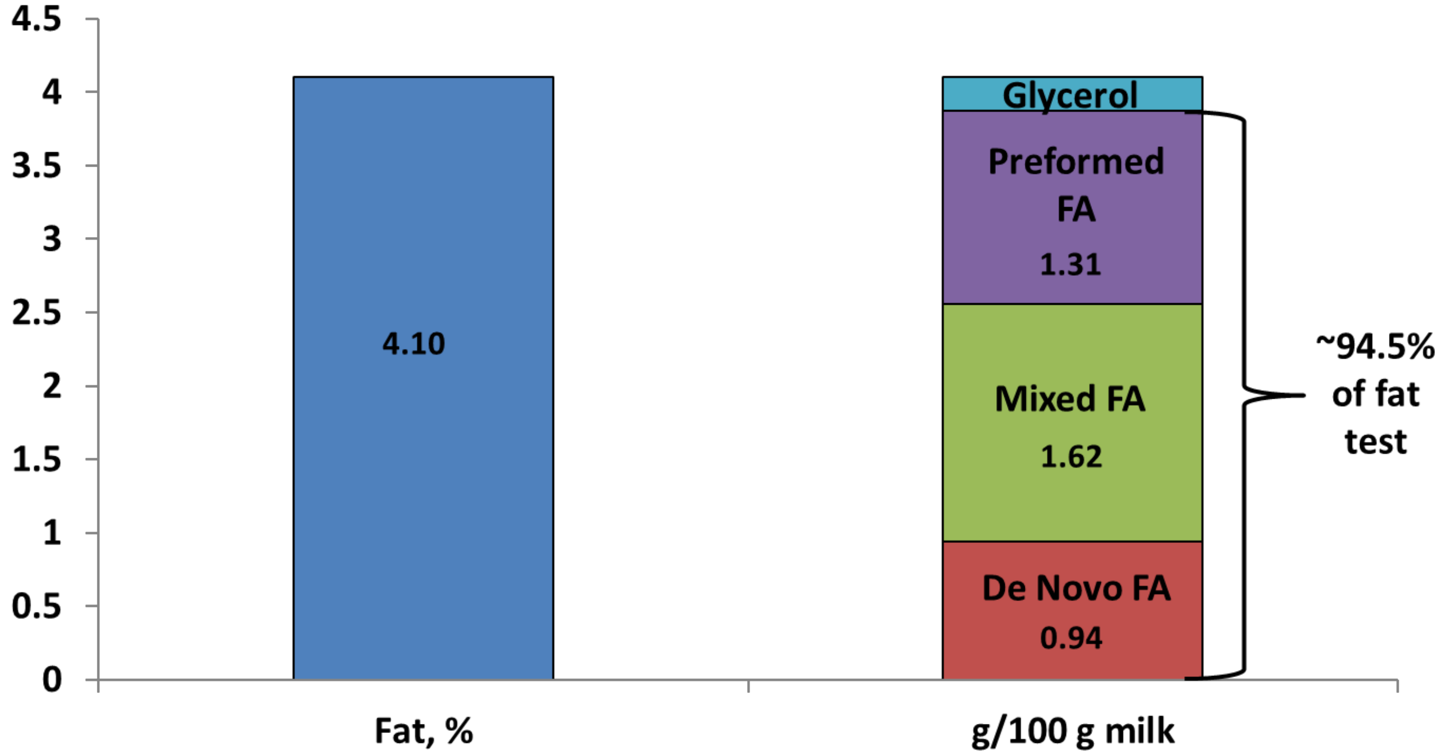
Development of Milk Fatty Acid Parameters for Feeding and Herd Management on Jersey Farms

Heather Dann, Rick Grant, & Dave Barbano

2018 AJCA-NAJ Annual Meetings, June 25-30, 2018

Justification for Study

- **Milk fatty acid parameters are tools that are becoming more available to farmers across the US**
  - De novo fatty acids
  - Mixed origin fatty acids
  - Preformed fatty acids
  - Milk fat unsaturation index



Justification for Study

- **These tools can help farmers increase their milk fat and protein content and yields through informed decisions related to their feeding and herd management practices**
- **In the past 3 years milk fatty acid data and benchmarks for Holstein herds have been produced and farm managers and dairy nutritionists have used this milk composition information to improve herd fat and protein tests**
- **The project will provide information that is not available currently for Jersey herds**

Objectives of Study

- This project addresses the AJCC Research Foundation's priority of "nutrition of high-producing Jerseys, particularly practical feeding methods to maximize production of valuable milk components"

- To develop a milk composition database for milk fatty acid composition and the relationships between milk fatty acid composition and bulk tank milk fat and protein percent with the goal of establishing benchmarks in support of feeding and herd management for Jersey herds to optimize fat and protein production per cow per day

Hypothesis of Study

- **Milk fat and true protein content will be associated positively with milk fatty acid parameters**

- **The relationships with milk fat and true protein content will be strongest for…**
  - **De novo fatty acids**
  - **Mixed origin fatty acids**
  - **Milk fat unsaturation index**

Approach – A Longitudinal Study

- Evaluate 40 Jersey herds over a 12-month period
  - Represent a large geographic distribution
  - Milk at least 40 cows

Bulk Tank Milk Collection and Analysis

Collect bulk tank samples one week per month for each herd

Send samples to Miner Milk Lab in a cooler with ice packs

Analyze samples at Miner Milk Lab for major milk components and milk fatty acid parameters using mid-infrared milk analysis

Analyze a subset of samples at Cornell Lab for milk fatty acids using gas chromatography (gold standard method)

Expected Outcomes

- Report analyzed milk components and milk fatty acids to each Jersey herd monthly

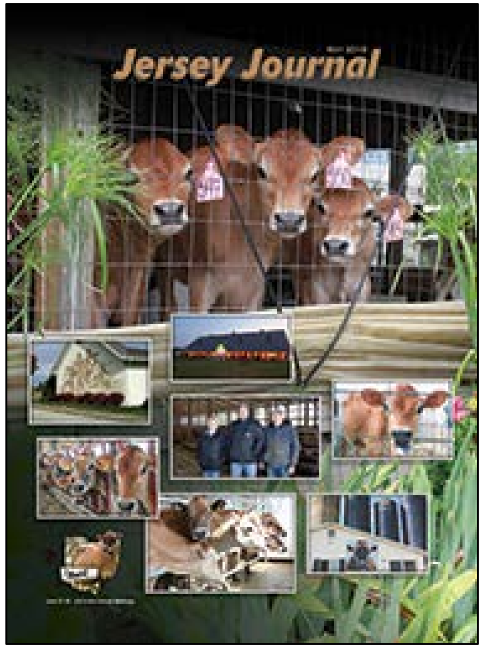
- Generate a database of major milk components and milk fatty acid parameters for Jersey herds located throughout the US
  - Within herd and between herd variation
  - Seasonal effects

- Establish benchmarks for use in the field to make feeding and management decisions

Expected Outcomes

- **Publish results in a scientific journal, popular press articles, and newsletters**

- **Share results at local, regional, and national dairy meetings and conferences**



Timetable

Time Period	Activity
Spring 2018	Identify and confirm 40 Jersey farms to participate in study
June 2018 to May 2019	Bulk tank milk sample collection and analysis; results shared monthly with herds
Summer 2019	Data summarization and final report to AJCC
Fall 2019 and beyond	Communicate results to dairy industry in written and oral formats

Correlation of fatty acid profile to total fat production in milk produced by Jersey cows

Dr. Stephanie Ward, Co-PI*
Dr. Dave Barbano, Co-PI†
Sarah Haney, graduate assistant*
Katie Kelly, graduate assistant*

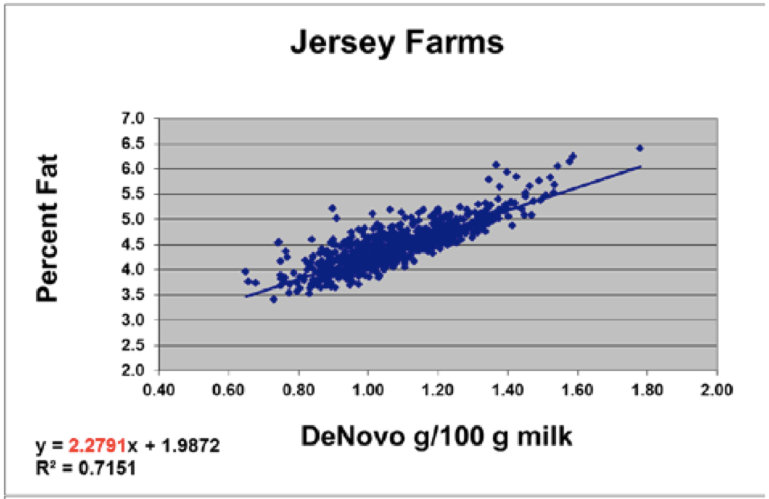
*Department of Animal Science, NCSU
†Department of Food Science, Cornell University

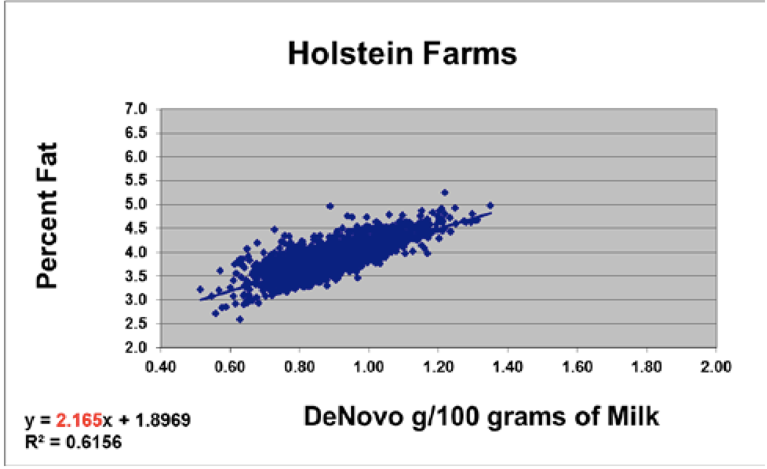
Fatty Acids

- Fat or lipids can come from different sources: the diet (preformed) or made by the cow herself (de novo)
  - De novo fatty acids
    - 4 to 14 carbons
    - Synthesized in mammary cells
  - Preformed fatty acids
    - 18 carbons and greater
    - Formed from mobilized body fat
  - Mixed origin fatty acids
    - C16:0, C16:1, C17:0
    - May be either preformed or de novo, determined by energy status of cow

Previous Research

- Recent advancements in analysis of milk fatty acid groups
  - Positive correlation with bulk tank fat between de novo and mixed origin fatty acids
  - Positive correlation with bulk tank protein between de novo fatty acids





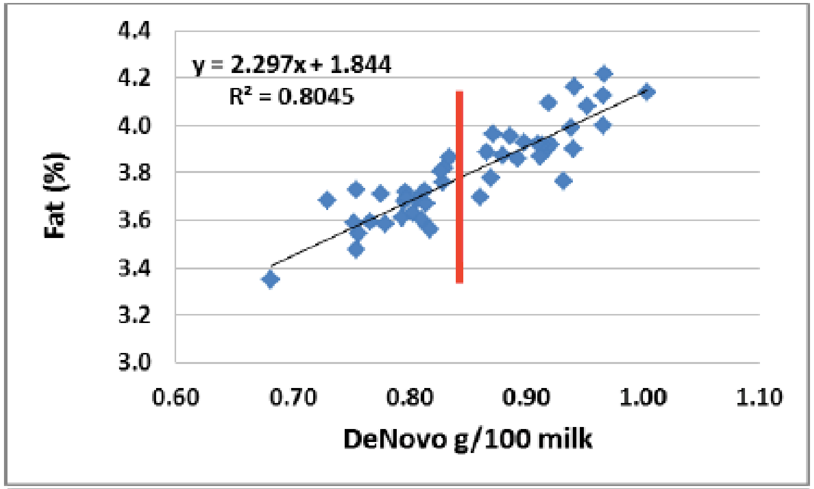
Barbano et al., 2014 and 2017

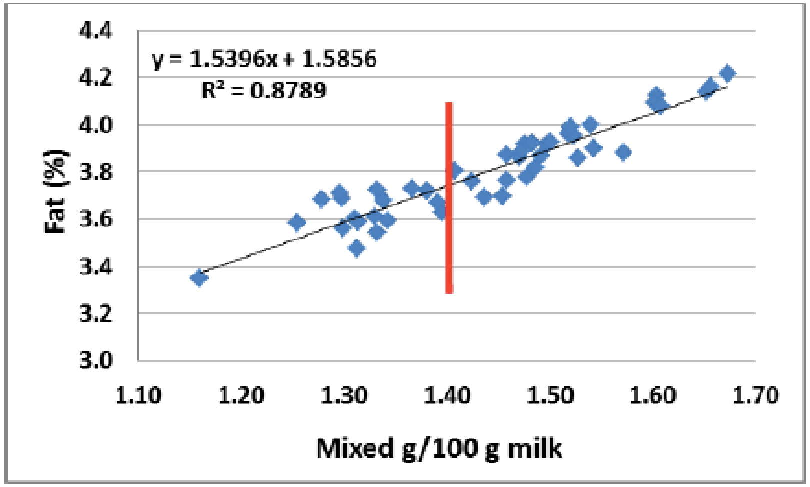
Previous Research

- Driver of milk production is more related to de novo and mixed origin fatty acids than preformed
- Optimizing production of de novo fatty acids may be the key to optimizing total milk fat and protein production
  - Maximize incentives received for components and increase profitability per cow

Previous Research

- To achieve a 3.75% fat test
  - De novo fatty acid concentration of 0.85g/100g milk
  - Mixed origin fatty acid concentration of 1.40g/100g milk
- Data has been collected from Holsteins, more data is needed from Jersey herds





Barbano et al., 2017

Methods

- Southeastern Jersey herds enrolled voluntarily

- Bulk Tank Samples
  - 7 bulk tank samples per month
    - Collected during milk pickup
  - Individual Cow Samples
    - Collected seasonally from select herds
  - Sample Handling
    - Preserved using Broad Spectrum MicroTabs II[1] then refrigerated
    - Analyzed for milk components and FA composition[2]

[1]Advanced Instruments, Norwood, MA
[2]Lactoscope FTA; Delta Instruments, Drachten, the Netherlands

Methods

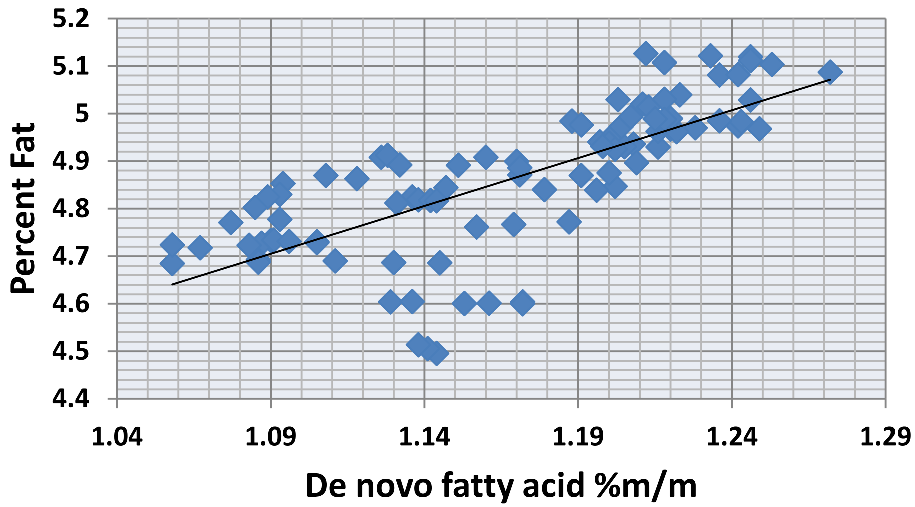
- Herd analysis performed seasonally
  - Bunk space
  - Stocking density
  - Nutritional management
    - Proximate analysis of feed
    - Feed management
  - BCS
  - locomotion scores

Implications

- Understanding the relationship between fatty acid composition and bulk tank components may influence a new method of increasing productivity in herds
- Information from Jersey producers will develop a baseline and target points
- Targeting de novo fatty acid production may increase bulk tank fat and protein
- Monitoring de novo fatty acids may influence a new method of monitoring herd productivity

Current Progress

- 2 NC Jersey Herds analyzed as of May 2018
- Additional 1 SC & 4 NC Jersey Herds to be analyzed beginning June 2018
- Farm evaluations to begin June 2018



R = 0.72541
R^2 = 0.5262

Survey of Top Producing Jersey Herds

Dr. Mike Hutjens
Dairy Extension Specialist
University of Illinois at Urbana-Champaign

The Team

- AJCA and Research Foundation for names and funding
- Mike Hutjens—co-leader with name recognition
- Jim Baltz—co-leader, our IT specialist to design the survey instrument and dairy background
- Sarah Morrison—graduate student from Jersey herd in New England, provided statistical analysis
- Kristen Glossom—graduate student from North Caroline pasture based herd, provided statistical analysis

Experimental Design

- AJCA provided a list of 110 top cheese yield herds in the U.S. in 2015 along with e-mail addresses.
- We developed an on-line survey instrument to collect on-farm management information and tested by the graduate students, Jim, and me.
- In addition, we requested DHI data summary from Nov/Dec 2016, current forage test results, and current milking and dry cow rations (up to seven could be submitted).

Timeline of the Field Study

- AJCA sent out an e-mail indicating that a survey would be sent out from the U of IL in early 2017.
- Electronic survey was sent out January, 2017.
- Data arrived for the next four months with one reminder from us (those not responding).
- In May, any “unusual” or missing data were requested and clarified from participating farms.

Publication of Results

- Summary data was published in October, 2017 Jersey Journal. A second article has been submitted on the statistical analysis.
- A Hoard Dairyman webinar is scheduled for April, 2018.
- Data will be present at the 2018 Four State Dairy Conference in June, 2018, in Dubuque, IA

Publication of Results (continued)

- Plan to submit an abstract to 2018 ADSA meeting in Knoxville, Tennessee
- Offer the AJCA articles to Hoards Dairyman(first choice) or Progressive Dairy magazine) after the webinar.
- Welcome your suggestions and comments!

Phase One Article
Herd Summary Data

Herd Stats

	Ave	Max	Min	SD	n
Cows	593.2	6,545	24	1,259	32
Milk Yield	63.4	78.5	50.4	7.6	31
Fat %	5.14	6.72	4.10	0.48	31
Protein %	3.77	4.10	3.50	0.17	31
SCC	180.3	475	42.5	94	29
RHA-Milk	20,124	24,195	16,987	1,786	31
RHA-Fat	995	1271	831	101	31
RHA-Protein	738	875	634	66	31
Age at 1st Calving	23.3	25	21	1.08	24

	High Group Rations					Dry Cows Rations				
	Ave	Max	Min	SD	n	Ave	Max	Min	SD	n
DM	52.0	88.6	40.0	10.7	21	50.7	79.9	41.0	9.5	15
CP	17.1	18.3	16.0	0.6	22	14.5	16.5	12.1	1.3	16
Fat	4.7	6.4	2.7	1.0	20	3.2	4.2	2.0	0.6	13
ADF	18.5	21.6	14.6	1.7	18	28.2	35.4	19.3	5.0	12
NDF	28.9	34.9	25.0	2.2	22	41.3	49.1	31.4	5.2	16
Sugar	5.1	6.5	3.1	1.2	16	4.3	8.2	2.7	1.7	9
Starch	26.5	30.9	21.1	2.6	21	15.3	23.5	4.5	6.4	15
% Corn Silage	64.3	92.0	35.0	13.7	27	55.3	81.0	20.0	20.6	16
% Haylage	30.6	65.0	9.0	15.4	21	37.4	66.0	4.0	20.6	11
% Hay	20.5	51.0	3.0	16.8	15	34.4	73.0	8.0	18.9	14
% Straw	5.0	6.0	4.0	1.4	2	20.3	36.0	11.0	7.6	10

Corn Silage Test Results

	Ave	Max	Min	SD	n
DM	35.9	43.1	27.7	4.5	23
CP	8.1	10.1	6.9	0.7	23
ADF	23.3	28.6	16.0	3.1	23
NDF	38.1	45.0	29.3	3.9	22
uNDF-240	10.8	28.0	5.2	5.4	14
Starch	33.8	43.3	26.8	4.7	23

Legume/Grass Forage Test Results

	Ave	Max	Min	SD	n
DM	58.1	91.4	30.6	23.2	22
CP	20.2	25.5	12.5	3.4	22
ADF	31.4	40.2	21.2	4.8	22
NDF	39.7	55.0	27.6	6.9	22
uNDF	15.7	20.4	5.7	4.4	10
RVQ/RFV	163.6	233.0	111.0	35.2	19

Bunk Space

	Bunk space per cow				
	<15"	16-22"	23-29"	>30"	n
All	12%	31%	40%	17%	121
All Dry Cows	7%	30%	41%	22%	27
All Milking	19%	33%	38%	11%	64
Close Up		25%	50%	25%	16
Far Off	7%	33%	53%	7%	15
Fresh		33%	42%	25%	12
Heifers	33%	11%	33%	22%	9

Housing

	Freestall	Tie Stall	Loose Housing	Corral / Open Lot / Pasture	Individual pens	n
All	66%	8%	20%	6%	1%	128
All Dry Cows	38%	6%	40%	15%	2%	48
All Milking	81%	10%	7%	1%		68
Close Up	17%		61%	17%	6%	18
Far Off	50%	6%	19%	25%		16
Fresh	92%		8%			12
Heifers	89%			11%		9

Stalls per Cow

Group	Stalls per Cow	Max	Min	n
Far Off	1.39	2.00	1.00	11
Close Up	1.37	2.00	0.90	10
All Dry Cows	1.29	2.00	0.90	31
All	1.08	2.00	0.49	105
Fresh	1.03	1.35	0.49	12
All Milking	0.98	1.50	0.49	75
Heifer	0.95	1.35	0.78	8

Additive Usage by Farms

	Product	n		Product	n
96%	Buffer	25	38%	Probiotics/DFM	21
89%	Rumensin/monensin	27	35%	Sodium bentonite	20
86%	Organic trace minerals	22	35%	Immune stimulation	23
85%	Anionic product	27	29%	Enzymes	21
79%	Yeast product	24	15%	Niacin	20
63%	Mycotoxin binder	24	10%	Calcium propionate	20
52%	Choline (rumen protected)	21	5%	Essential oil compounds	20
52%	Biotin	23	5%	Propyl glycol	20
48%	Cation product (heat stress)	21	0%	Organic Acids	20

Close Up Additives

Product	Sum	Percent	n
Anionic product	23	85.2%	27
Rumensin/monensin	19	76.0%	25
Organic trace minerals	16	72.7%	22
Yeast product	16	66.7%	24
Biotin	10	43.5%	23
Choline (rumen protected)	8	38.1%	21
Mycotoxin binder	8	33.3%	24
Sodium bentonite	5	25.0%	20
Immune stimulation	5	21.7%	23
Cation product (heat stress)	3	14.3%	21
Enzymes	3	14.3%	21
Probiotics/DFM	3	14.3%	21
Buffer	3	12.0%	25
Niacin	2	10.0%	20
Calcium propionate	1	5.0%	20

Far Off Additives

Product	Sum	Percent	n
Rumensin/monensin	14	56.0%	25
Organic trace minerals	11	50.0%	22
Anionic product	10	37.0%	27
Yeast product	8	33.3%	24
Mycotoxin binder	6	25.0%	24
Biotin	5	21.7%	23
Sodium bentonite	4	20.0%	20
Immune stimulation	4	17.4%	23
Buffer	3	12.0%	25
Cation product (heat stress)	2	9.5%	21
Choline (rumen protected)	2	9.5%	21
Enzymes	2	9.5%	21
Calcium propionate	1	5.0%	20
Niacin	1	5.0%	20
Probiotics/DFM	1	4.8%	21

Fresh Additives

Product	Sum	Percent	n
Buffer	22	88.0%	25
Rumensin/monensin	20	80.0%	25
Organic trace minerals	17	77.3%	22
Yeast product	15	62.5%	24
Mycotoxin binder	13	54.2%	24
Biotin	10	43.5%	23
Probiotics/DFM	7	33.3%	21
Sodium bentonite	6	30.0%	20
Cation product (heat stress)	6	28.6%	21
Choline (rumen protected)	6	28.6%	21
Immune stimulation	6	26.1%	23
Enzymes	5	23.8%	21
Calcium propionate	2	10.0%	20
Essential oil compounds	1	5.0%	20
Niacin	1	5.0%	20
Propyl glycol	1	5.0%	20
Anionic product	1	3.7%	27

High Group Additives

Product	Sum	Percent	n
Buffer	24	96.0%	25
Organic trace minerals	18	81.8%	22
Rumensin/monensin	20	80.0%	25
Yeast product	16	66.7%	24
Mycotoxin binder	14	58.3%	24
Biotin	11	47.8%	23
Probiotics/DFM	8	38.1%	21
Sodium bentonite	7	35.0%	20
Immune stimulation	7	30.4%	23
Cation product (heat stress)	6	28.6%	21
Enzymes	6	28.6%	21
Choline (rumen protected)	3	14.3%	21
Calcium propionate	2	10.0%	20
Essential oil compounds	1	5.0%	20
Anionic product	1	3.7%	27

Rumensin/Monensin Levels

mg/head/day	Close up	Far off	Fresh	High	Low
<200	15%	20%	5%	0%	10%
200 to 250	**40%**	**33%**	10%	14%	10%
250 to 300	25%	27%	**33%**	24%	**25%**
300 to 350	10%	13%	14%	19%	15%
350 to 400	10%	7%	10%	14%	15%
>400	0%	0%	29%	**29%**	**25%**
n	20	15	21	21	20

Percent of herd on rBST (n=38)

Do NOT use	63.2%
< 30%	5.3%
30 to 50%	10.5%
> 50%	21.1%

Milking Frequency

2X	64.9%
3X	18.9%
Combination of 2x-3x	8.1%
Combination of 3x-4x	2.7%
Robot	5.4%

Type of TMR Mixer (n=38)

Horizontal	Reel	Tumble	Vertical
11%	11%	5%	74%

Number or augers/screws in your TMR mixer?

1	2	3	4
42%	45%	3%	11%

"On average, how times a year do you review and/or reformulate your ration?“ (n=38)

4 or less (Quarterly)	5 to 8 (Bimonthly)	9 to 15 (Monthly)	16 to 30 (Biweekly)	>30 (Weekly or more)
9	6	13	6	4
24%	16%	34%	16%	11%

"On average, how times a year do you test your forages? “ (n=37)

4 or less (Quarterly)	5 to 8 (Bimonthly)	9 to 15 (Monthly)	16 to 30 (Biweekly)	>30 (Weekly or more)
7	10	15	2	3
19%	27%	41%	5%	8%

When do you check the moisture content of your TMR? (n=38)

Never check moisture content of TMR	6	16%
Every 3 months or more	3	8%
Monthly	9	24%
Weekly	6	16%
Daily	3	8%
Nutritionist checks	10	26%
After heavy rains	2	5%
Only when there is a problem	7	18%
Other	2	5%

Frequency of Feeding? (n=38)

1X	2X	3X	>3X
42%	53%	5%	0%

Number of times a day feed is pushed up? (n=38)

37%	5 to 12 times a day
34%	3 to 4 times a day
11%	We don't push up feed
11%	1 to 2 times a day
8%	>12 times a day

Amount of Weigh Back Dry Matter as % of Daily DMI (n=38)

Feed to empty bunk	Weigh Back			
	1 to 2%	2 to 3%	4 to 5%	>5%
16%	34%	26%	18%	5%

Where does the weigh back go? (n=34)

32% Heifers

24% Discarded

18% Remix in lower group ration

12% Dry cows

9% Steers

6% Remix in current ration

Forage Storage

	Bags	Bunkers	Piles	Silo	Wrapped bales	Silage inoculant	n
Corn Silage	41%	52%	14%	21%		52%	29
Corn Silage (BMR)	56%	50%	13%	25%		56%	16
Grass Silage	26%	32%	5%	16%	32%	42%	19
Legume Silage	42%	33%	4%	21%	21%	42%	24
Small Grain Silage	63%	19%	13%	13%	6%	56%	16
Sorghum Silage	71%	14%	14%		14%	71%	7

How do you handle a majority of your hay? (n=7)

53%	Big square bales
25%	Balage
14%	Round bales
8%	Conventional small square bales

Do you use a hay preservative/inoculant when baling?

37%	Yes (47%)
42%	No (53%)
21%	We do not bale hay

Do you require a hay preservative/inoculant when purchasing hay?

11%	Yes (16%)
55%	No (84%)
34%	We don't purchase hay

Health Issues: % Incidents

	Ave	Max	Min	SD	n
Milk fever	5.6	25	1	6.40	37
Ketosis	5.9	30	1	6.46	36
Displaced abomasum	1.8	5	0.005	1.36	30
Retained placenta	3.3	10	0.05	2.47	34
Metritis	3.8	15.3	0.05	3.80	35

Are you using calcium boluses?

37% Use as needed

32% Use only on 2+ lactation cows

24% Do NOT use

8% Use on all cows

How do you determine when the cow(s) are ready to move to another group? (n=26)

54%	Days in milk
31%	Cows general appearance
31%	Other
23%	Whenever there is a group of cows to move
19%	Milk production
8%	Feed intake
4%	Body temperature
4%	Rumination activity

Do you have a fresh cow group? (n=38)

Yes	47%
No	53%

How days are fresh cows kept in the fresh group? (n=17)

Average: 30.7

Max: 100

Min: 10

SD: 24.1

Phase Two Article Statistical Analysis

Effect of production level

- Farms that responded n = 38
- Farms with RHA milk < 19,800 lbs classified as LOW (n = 15)
- Farms with RHA milk > 19,800 lbs classified as HIGH (n = 16)

- Evaluated the effect of production level on different production parameters, diets, forages, management, and health on Jersey farms.

Low (<19,800 lbs) vs. High (>19,800 lbs) Production Level

	Production level			
	Low	High	SE	*P* value
n	15	16		
Milk Yield, lbs	58.6	67.9	1.6	<0.001
Fat, %	5.23	5.05	0.12	0.31
Protein, %	3.78	3.76	0.04	0.73
SCC	197.7	164.1	25.2	0.35
RHA milk, lbs	18,640	21,515	270	<0.001
RHA Fat, lbs	932.1	1053.2	21.1	<0.001
RHA Protein, lbs	687.2	785.0	11.6	<0.001
Age at 1^{st} calving, months	23.1	23.4	0.32	0.58

Effect of BST use

- Farms that responded n = 38
  - Farms that did not use BST were classified as NO (n = 25)
  - Farms that did use BST were classified as YES (n = 13)

- Evaluated the effect of BST use on production parameters, diets, forages, management, and health on Jersey farms.

Effect of BST Use (Yes vs. No)

	BST			
	No	Yes	SE	*P* value
n	25	13		
Milk Yield, lbs	63.31	63.53	2.4	0.94
Fat, %	5.16	5.09	0.15	0.68
Protein, %	3.77	3.77	0.05	0.97
SCC	168.0	203.8	30	0.34
RHA milk, lbs	19929	20533	567	0.39
RHA Fat, lbs	989.1	1006	33	0.67
RHA Protein, lbs	733.5	746.4	21	0.62
Age at 1st calving, months	23.3	23.2	0.45	0.75

Effect of herd size

- Farms that responded n = 38
  - Farms that had a herd size < 200 cows were classified as small (n = 21)
  - Farms that had a herd size >200 cows were classified as YES (n = 13)

- Evaluated the effect of herd size on production parameters, diets, forages, management, and health on Jersey farms.

Small (<200 cows) vs Large (>200 cows)

	Herd Size		SE	*P* value
	Small	Large		
n	21	17		
Milk Yield, lbs	63.8	63.1	2.1	0.81
Fat, %	5.2	2.1	0.1	0.71
Protein, %	3.7	3.8	0.04	0.26
SCC	186.3	175.5	27	0.77
RHA milk, lbs	19,856	20,344	481	0.46
RHA Fat, lbs	981	1006	27	0.50
RHA Protein, lbs	722	751	18	0.23
Age at 1st calving, months	23.2	23.4	0.3	0.66

Effect of Percent of Herd as Jersey

- Farms that responded n = 38
  - Farms that had <100% of cows as Jersey were classified as <100% (n = 22)
  - Farms that had 100% of cows as Jersey were classified as 100% (n = 16)

- Evaluated the effect of % of herd as Jersey on production parameters, diets, forages, management, and health on Jersey farms.

<100% vs 100% Jerseys in Herd

	Percent Jersey			
	<100%	100%	SE	*P* value
n	22	16		
Milk Yield, lbs	64.2	62.5	2.0	0.52
Fat, %	5.08	5.20	0.12	0.49
Protein, %	3.73	3.82	0.04	0.13
SCC	152.3	214.9	25	0.08
RHA milk, lbs	20,126	20,122	469	0.99
RHA Fat, lbs	976.5	1014	23	0.31
RHA Protein, lbs	731.6	744.1	17	0.61
Age at 1st calving, months	23.3	23.3	0.4	0.98

Our thanks to each of the 38 Jersey Dairy Farms for participating in our survey of top producing herds in the U.S. The American Jersey Cattle Association provided a research grant allowing us to collect and summarize your data. I have attached the data that will appear in your Jersey Journal in the future to give you an “early look”.

Mike Hutjens and Jim Baltz

University of Illinois at Urbana-Champaign

Jersey Milk Yield
(NC DHPC 2017 data)

Milk Yield (lb)	Lactation Number	Peak milk (lb/day)	1-40 days (lb)	41 to 100 days (lb)	101 to 199 days (lb)	200-305 days (lb)
21,000	1st	72	56	63	65	58
	2nd	85	71	76	71	59
	3rd +	92	73	81	75	62

Jersey Components (Fat % / True Protein %)
(NC DHPC 2017 data)

Milk yield	Lactation	1-40 days	41-100 days
21,000	3rd+	4.3 / 3.4	4.4 / 3.3
	1st	4.0 / 3.1	4.2 / 3.2
19,000	3rd+	4.4 / 3.3	4.3 / 3.2
	1st	4.1 / 3.1	4.3 / 3.2
17,000	3rd+	3.6 / 3.3	4.4 / 3.3
	1st	4.3 / 2.8	4.0 / 3.0

Milk Fat and Milk Protein Relationship

(Hoard's Dairyman—August 2017)

	Fat %	Protein %	Protein vs Fat	Fat vs Protein
Ayrshire	3.87	3.11	80%	1.24
Brown Swiss	4.03	3.31	82%	1.22
Guernsey	4.56	3.34	73%	1.37
Holstein	3.84	3.03	81%	1.26
Jersey	**4.84**	**3.65**	**76%**	**1.33**

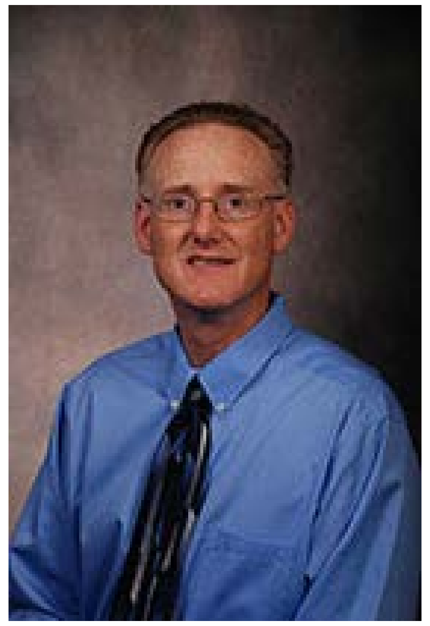
Questions?

Updating our Knowledge and Understanding Factors that Affect Heat Production by Lactating Jersey Cows

Paul J. Kononoff & Rick Stowell

Department of Animal Science, University of Nebraska-Lincoln, Lincoln, NE, 68583-0908

Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE, 68583-0908



2018 AJCA-NAJ Annual Meeting
Funded Project, AJCC Research Foundation
June 25-30, 2018
Canton, OH

Discovering the Jersey Advantage

- An advantage of the breed is its ability to robustly adapt to its surroundings and environmental temperatures (Collier et al., 2017).
- Kibler and Brody (1954a) also observed that Jersey cows usually have a high rate of respiration and as a consequence this may translate in a superior ability dissipate heat.

Background

- Much of the research around energy intake and utilization in lactating dairy cattle was conducted in the 50's, 60's and 70's.
- Since then milk production has more than doubled, while increased body size has also resulted in an animal that produces more body heat (Kadzere et al., 2002; de Alencar Naas, 2006).

Background (continued)

- Animals lose heat into their environment.
- When designing housing facilities for dairy cattle, engineers must ensure that ventilation rates are high enough to remove moisture produced by the animals (DeShazer et al., 2009).

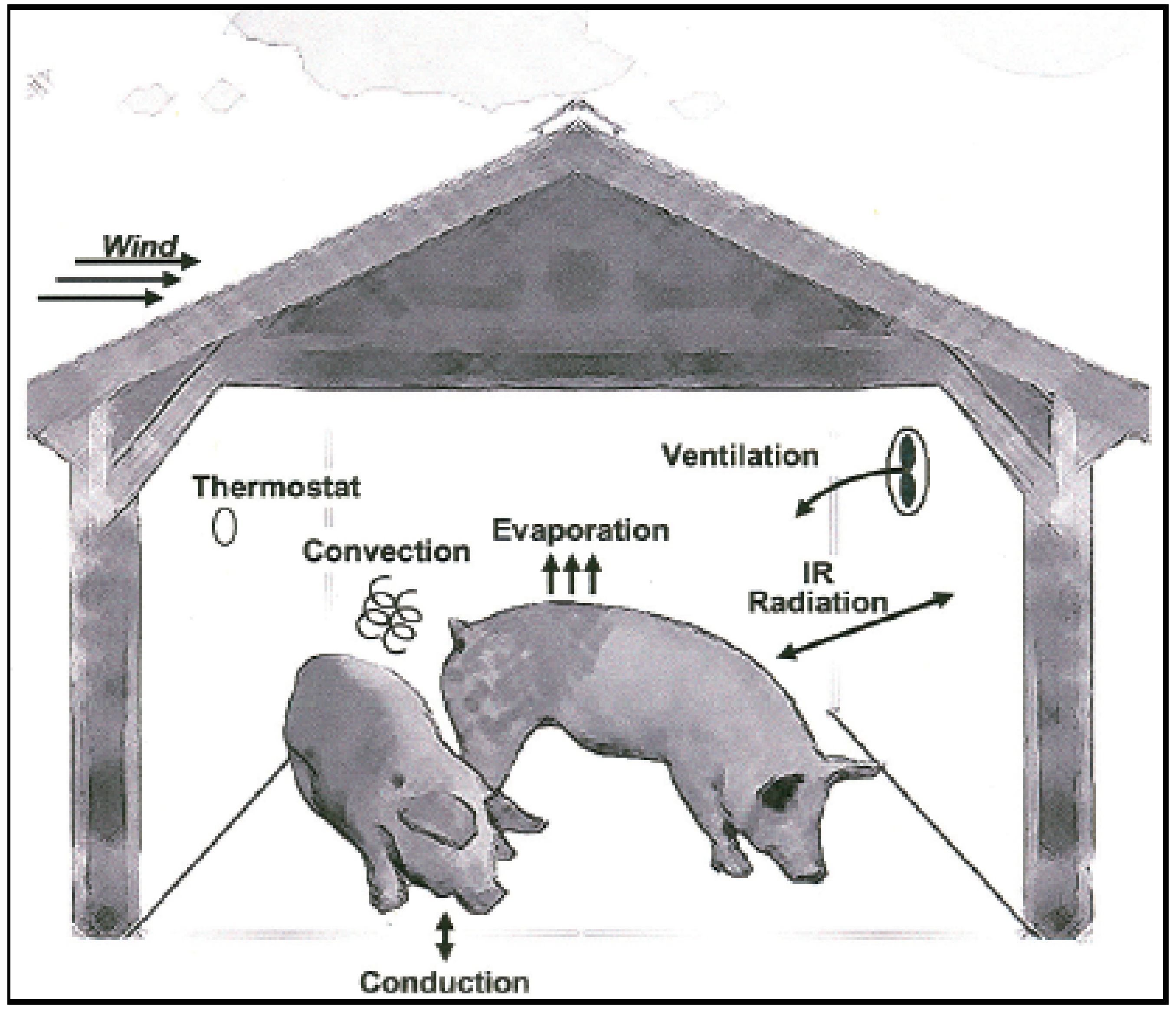


Figure 4. Thermal energy exchange between an animal and the enclosed buffered environment (Hahn, 1994).

Problem(s)

- Heat produced by the animal must be known so supplemental cooling strategies can be managed.
- **Important problem**: if heat production is underestimated in facility design, inadequate removal of heat from the facility may occur and this may result in heat stress and reduced milk yield.
- Most facility designs and management recommendations are based upon measures made on Holstein cattle and it is generally recognized, but not firmly established, that Jersey cattle produce less heat per unit of metabolic body weight.

Project Summary

Objectives

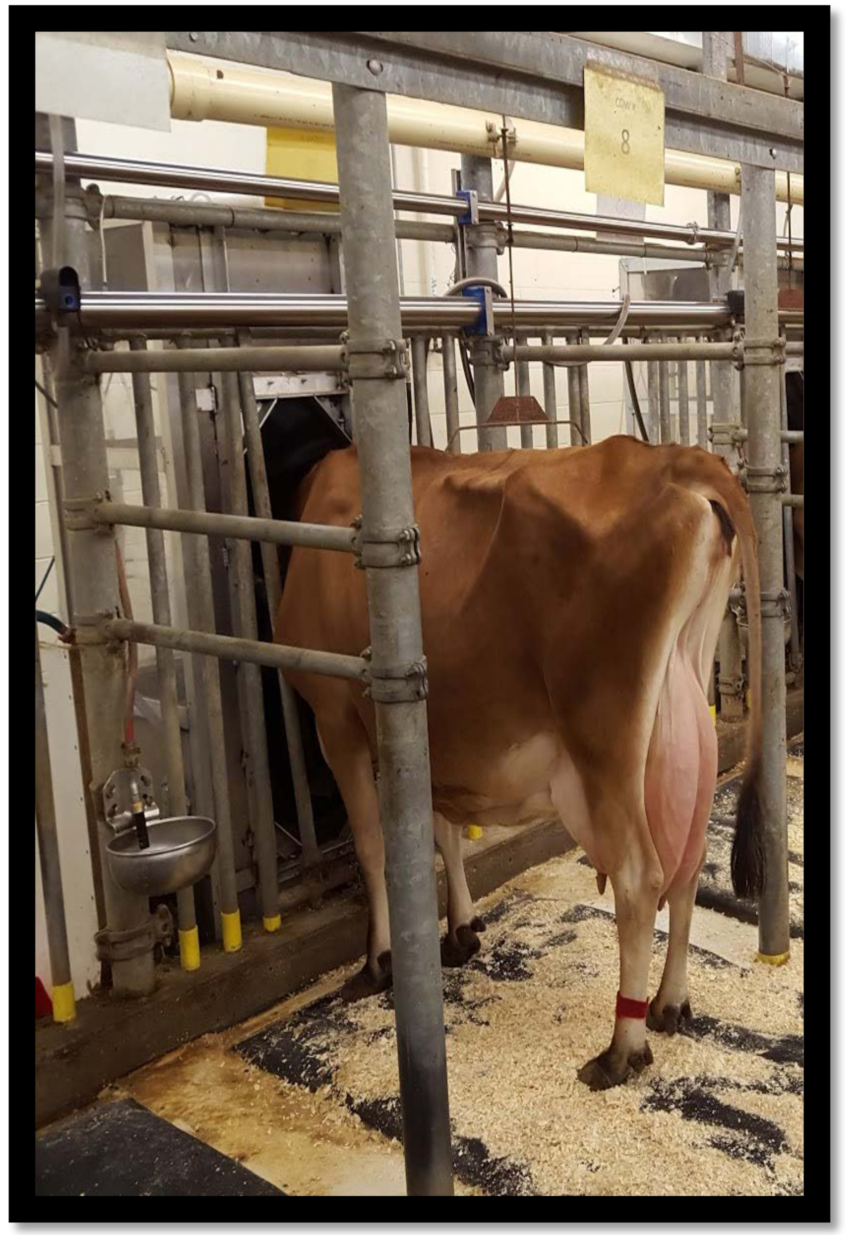
- The overall objective of this proposal is to estimate heat production in modern adult lactating Jersey cows and to quantify factors that affect it.

Hypothesis

- We hypothesize that our measures of heat production will be greater than those commonly assumed but heat per unit of milk produced will be lower than what has historically been observed.

Research Design

- Univ. Of Nebraska is among a small number of sites in the world that is equipped with a climate controlled indirect calorimeter headbox system to study energy utilization in lactating dairy cows.



Research Design (Continued)

- Over the last 5 years we have collected over 230 observations of heat production as well as energy represented in urine, feces, and milk.

Discovery Procedures

- major physiological and nutritional factors that affect heat production in our data will be studied.
- major factors that affect heat production will be studied and quantified: body weight, body condition score, pregnancy status, dry matter intake, nutrient intake and digestibility, milk yield, and milk composition.

Application

- More accurate estimate of heat production by Jersey cattle and this will be used by agricultural engineers and lead to improvements in design and construction of housing that assure proper animal wellbeing.
- This research will also shed light in the Jersey cow's ability dissipate heat.

Use of genomics to predict resistance to ketosis in Jersey cattle using producer-recorded health data

K.L. Parker Gaddis[1], J.H. Megonigal Jr.[1], J.S. Clay[2], C.W. Wolfe[3]

[1] Council on Dairy Cattle Breeding, Bowie, MD 20716

[2] Dairy Records Management Systems, Raleigh, NC 27603

[3] American Jersey Cattle Association, Reynoldsburg, OH 43068

COUNCIL ON DAIRY CATTLE BREEDING

Project Summary

- Ketosis is one of the most frequently reported metabolic problems in dairy herds
- Common among high-producing dairy cows, especially in early lactation caused by negative energy balance

CDCB
COUNCIL ON DAIRY CATTLE BREEDING

Objectives

- Estimate if ketosis resistance is heritable in Jersey cows
- Identify regions of the genome that may impact ketosis resistance

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Research Data

- Producer-recorded ketosis events on Jersey cows from DRMS
- Standardization and strict editing applied
  - Ketosis events occurring within 60 days after calving
- Lactation, pedigree, and genotype data available from CDCB

Research Data

Number of records	42,233
Number of cows	23,865
Average incidence of clinical ketosis recorded	2.81%
Number of genotyped animals	1,750
Number of SNP markers included	60,671

COUNCIL ON DAIRY CATTLE BREEDING

Heritability Results

- Estimated heritability was 8%
  - This is within the range of previous reports despite most studies not using Jersey data
- Selection for improved ketosis resistance is possible!

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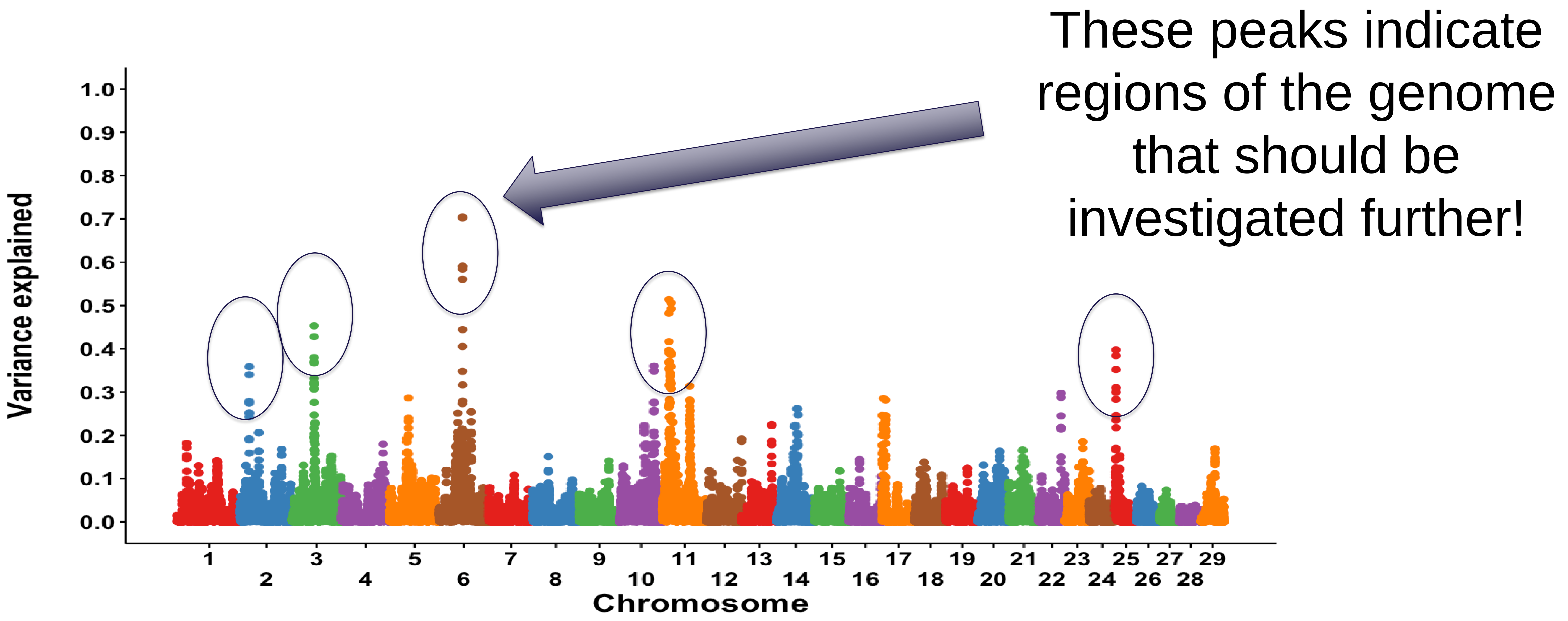
Association Results

- Several regions of the genome indicated associations with ketosis



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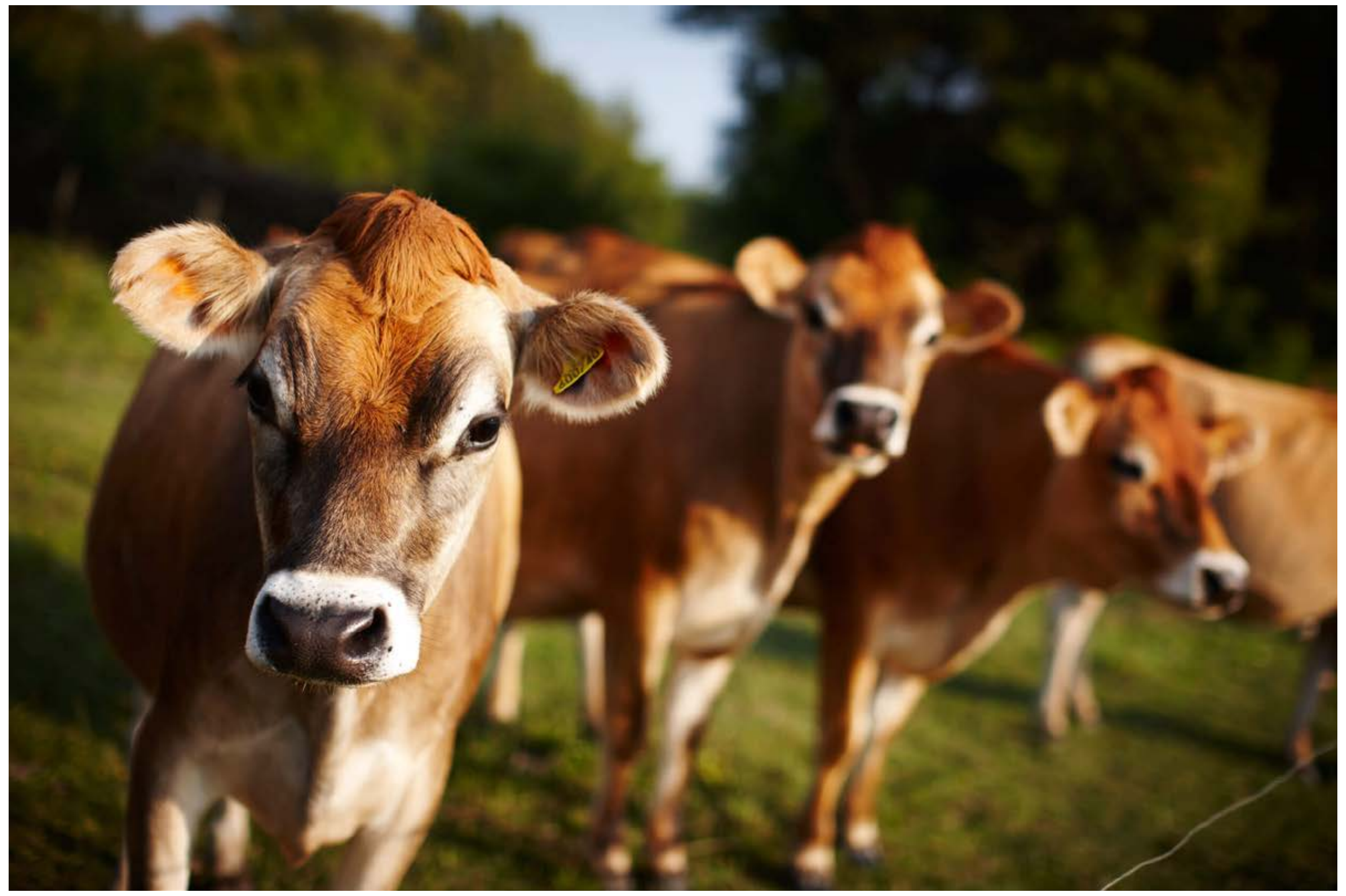
Association Results

- Genes in these regions associated with...
  - Immune response
  - Diet
  - Inflammation
  - Lipids
  - Insulin secretion & regulation
  - Reproduction



Association Results

- Ketosis resistance is a complex trait
  - Many genes have a small effect
- Identified regions provide starting points for further investigation

COUNCIL ON DAIRY CATTLE BREEDING

Improvements

- Ketosis is a costly disease impacting Jersey cows
  - $23 for direct costs (treatment, vet) *
  - Total costs range from $77-181 (decreased yield, reproduction, etc.)*
- There is a genetic component for ketosis resistance
  - Genetic improvement is possible!

* Liang et al., 2017

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Conclusions

Phenotype is KING!

- Even with genomic technologies, phenotypes are critical!
- In order to have accurate evaluations, more data is needed
  - Possibility to provide additional health trait evaluations
  - Is *your* health data coming into the National database?

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COUNCIL ON DAIRY CATTLE BREEDING

WASHINGTON STATE UNIVERSITY

Identification of Loci Associated with a Deficiency of Colostrum Production in Jersey Cows

J.N. Kiser, D.A. Moore, K. Gavin, A. Hoffman, H.L. Neibergs

Objective:

Identify loci associated with poor colostrum production in Jersey cows

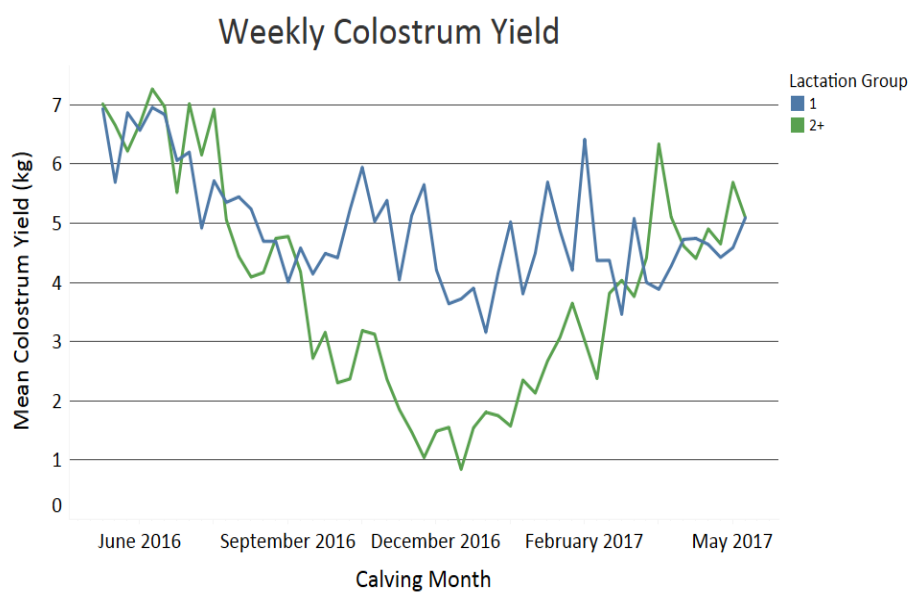
Rationale:

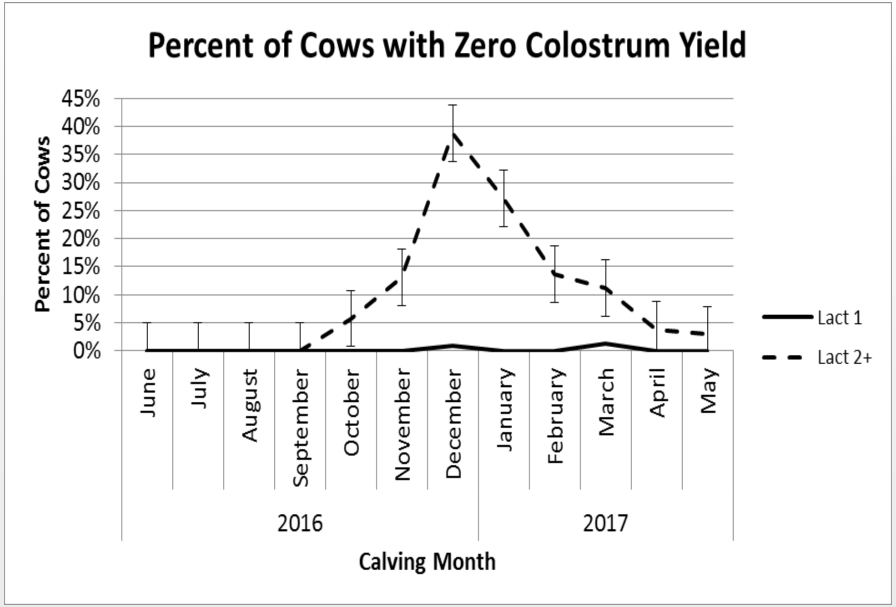
Identification of loci associated with the production of little or no colostrum provides the opportunity to identify and select cows through genotyping that will produce adequate levels of colostrum

Methods

Animals

- 345 cows remained after quality control and were analyzed
- Colostrum ranged from 0 to 31.9 pounds (14.5 kg)
  - Average weight was 6.66 pounds (3 kg)
- Birth year impacted ($p = 5.3 \times 10^{-5}$) colostrum production and was used as a covariate in the analysis
- Freshening dates ranged from 10/1/16 to 12/21/16 for BRIX data

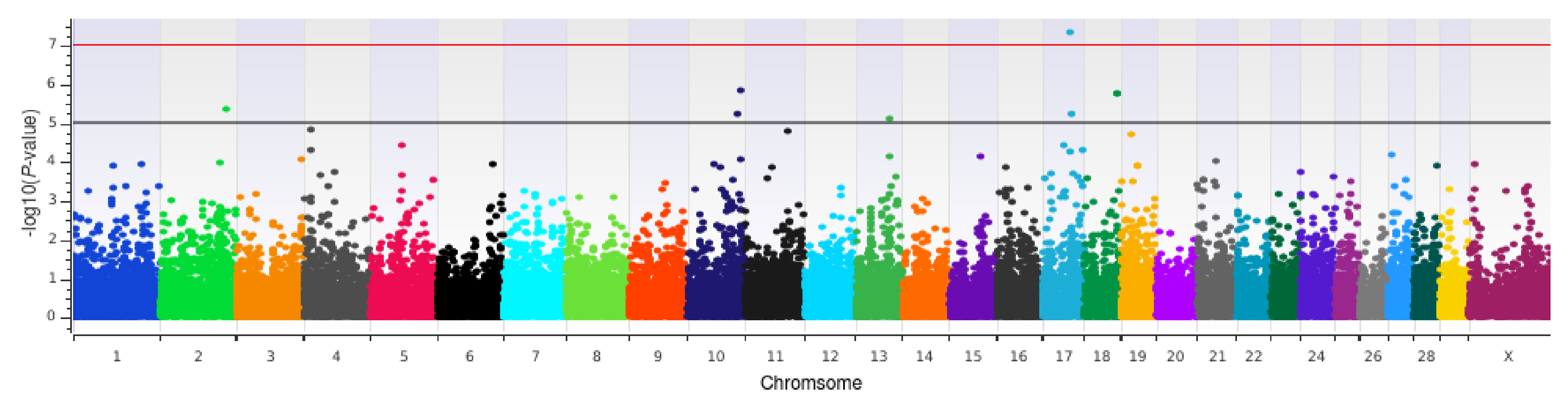

Weekly Colostrum Yield
Lactation Group
1
2+
Mean Colostrum Yield (kg)
0
1
2
3
4
5
6
7
June 2016
September 2016
December 2016
February 2017
May 2017
Calving Month


Percent of Cows with Zero Colostrum Yield
Percent of Cows
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
June
July
August
September
October
November
December
January
February
March
April
May
2016
2017
Calving Month
Lact 1
Lact 2+

Genome Wide Association Analysis Colostrum Weight

- 38,475 SNPs remained after quality control
- Heritability estimate for colostrum weight was 0.76 ± 0.12
- $\lambda_{GC} = 1.05$
- 7 loci associated with colostrum weight

Genome Wide Association Analysis
Colostrum Weight



- 6 loci associated with colostrum weight were identified between the grey and red lines ($p < 1\times10^{-5}$ to $5\text{x}10^{-8}$)
- 1 locus was highly associated with colostrum weight (identified above the red line $p < 5\text{x}10^{-8}$)

Genome Wide Association Analysis
Colostrum Weight

BTA	Position	# SNP in locus	Lead SNP ID	P-value Lead SNP	FDR
2	119,059,379	1	*rs109132347*	4.72×10^{-6}	0.04
10	89,055,823	1	*rs42341516*	5.76×10^{-6}	0.03
10	96,309,668	1	*rs134301532*	1.42×10^{-6}	0.03
13	62,137,558	1	*rs43406561*	8.13×10^{-6}	0.04
17	51,072,187	1	*rs110033106*	4.58×10^{-8}	0.002
17	53,080,341	1	*rs110145575*	5.73×10^{-6}	0.04
18	58,180,538	2	*rs210108864*	1.84×10^{-6}	0.02

BRIX values (Colostrum Quality)

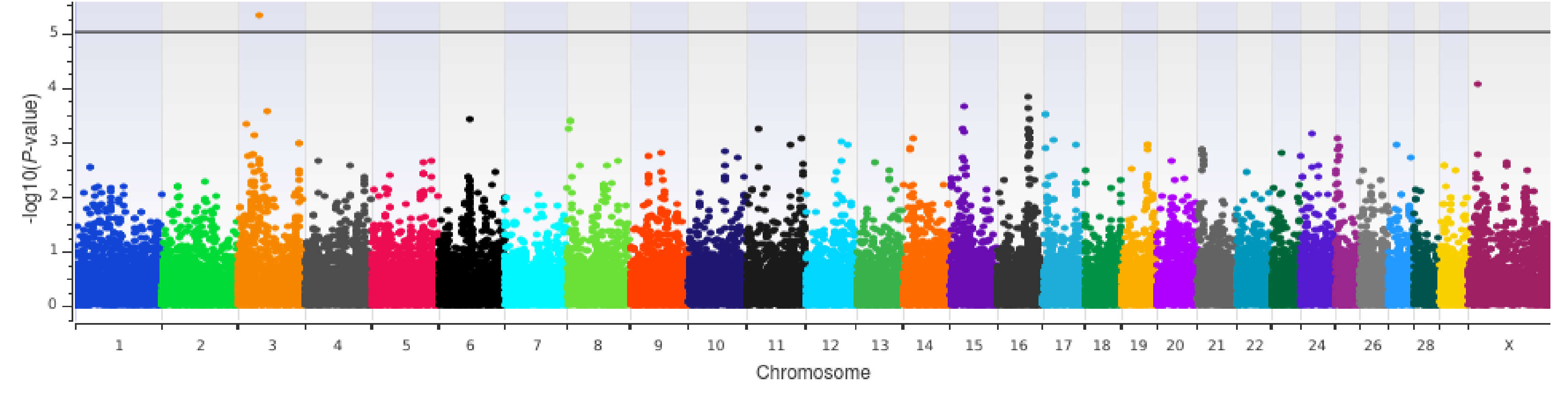
BRIX Data

- Ranged from 14.2% to 37.4% with an average of 26.9%
  - Threshold for quality is 22%
- Birth year was associated with colostrum quality and was used as a covariate in the analysis

Genome Wide Association Analysis
Colostrum Quality

- Heritability estimate for BRIX values was 0.19 ± 0.06
- $\lambda_{GC} = 0.94$
- 1 locus associated ($P<1 \times 10^{-5}$) with BRIX values

Genome Wide Association Analysis
Colostrum Quality



- 1 locus was associated with BRIX values (SNP above the grey line $p < 1\times10^{-5}$)

Genome Wide Association Analysis Colostrum Quality

BTA	Position	# SNP in locus	Lead SNP ID	P-value Lead SNP	FDR
3	37,602,383	1	*rs41567949*	4.77×10^{-6}	0.18

Conclusions

- Year of birth (parity) had significant impact on colostrum yield and quality
- There were high heritability estimates for both colostrum quantity and quality suggesting selection could positively improve both colostrum traits

Acknowledgement

Research was funded by the American Jersey Cattle Club Research Foundation

Updating Jersey and Holstein Lactation Curves

For use in the Ruminant Farm Systems Model (RuFaS)

Investigators:
Principle Investigator:
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University of Wisconsin, Madison

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PhD Student
University of Wisconsin, Madison

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Animal Scientist
USDA-ARS Dairy Forage Research Center

Outline

- Introduction
- Summary
- Model & module
- Lactation curve
- Data & Methods
- Preliminary result
- Applications

Introduction

How can we know the influence of Jersey breed characteristics on whole farm efficiencies?

Using an integrated system model to compare breed performance
in different U.S. dairy regions

How can we make sure the model accurately represents breed performance?

Updating lactation curves with the latest data

Project Summary

Investigate the impact in milk production by updating the parameters of lactation curves to better represent the actual animal performance of Jersey and Holstein breeds in a holistic dairy farm system model through integrated simulations

Current

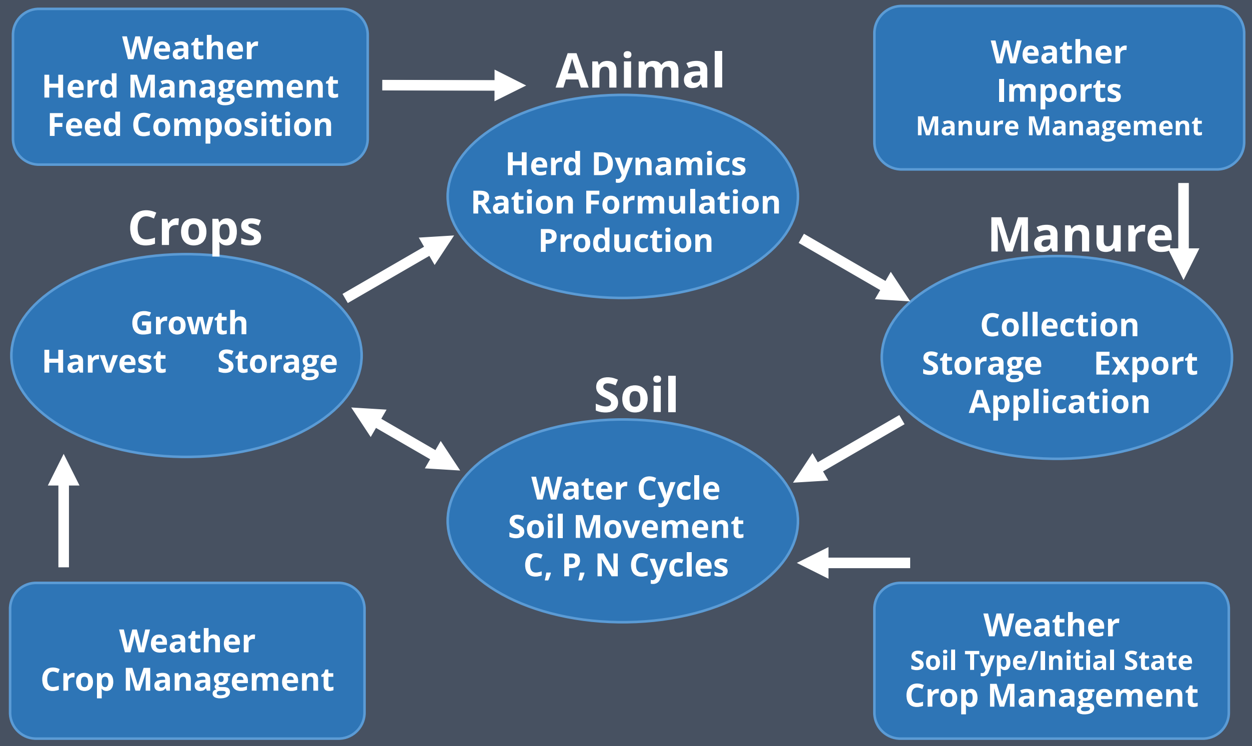
Integrated Farm System Model (IFSM): Two old sets of parameters, first and later lactations, define the curves

Updated

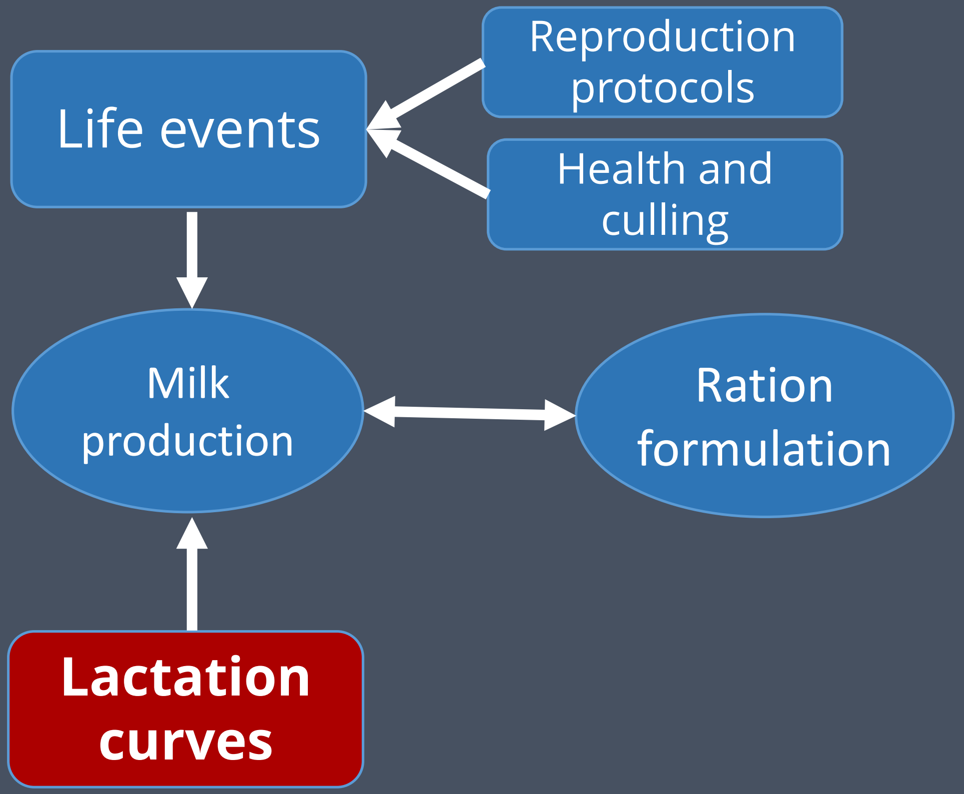
Ruminant Farm Systems Model (RuFaS): Multiple sets of parameters for 1st, 2nd and later lactations at different production levels

Ruminant Farm Systems Model (RuFaS)

Whole Model



Animal Module



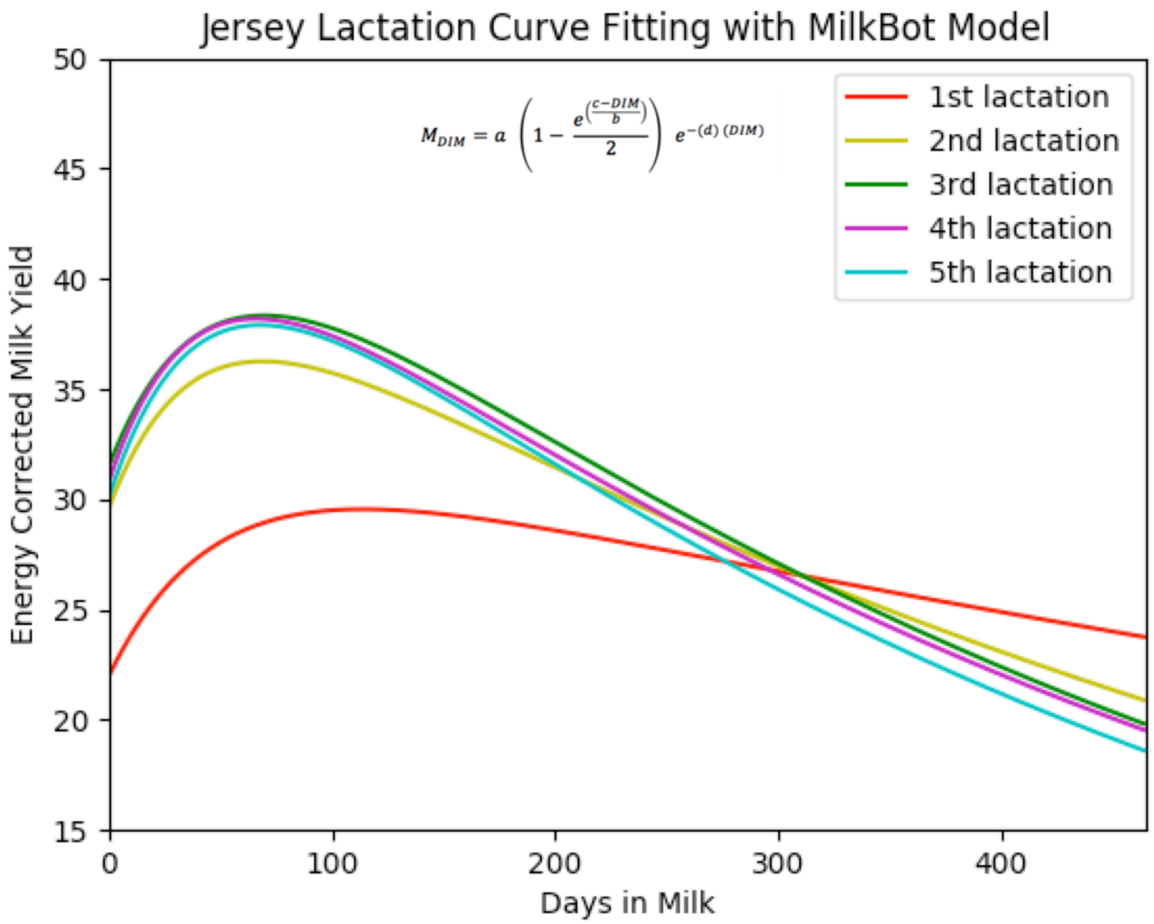
Lactation curve updating

Select the best model to fit the lactation curves

Distinguish parameters for different lactations at different production levels for more accurate estimations

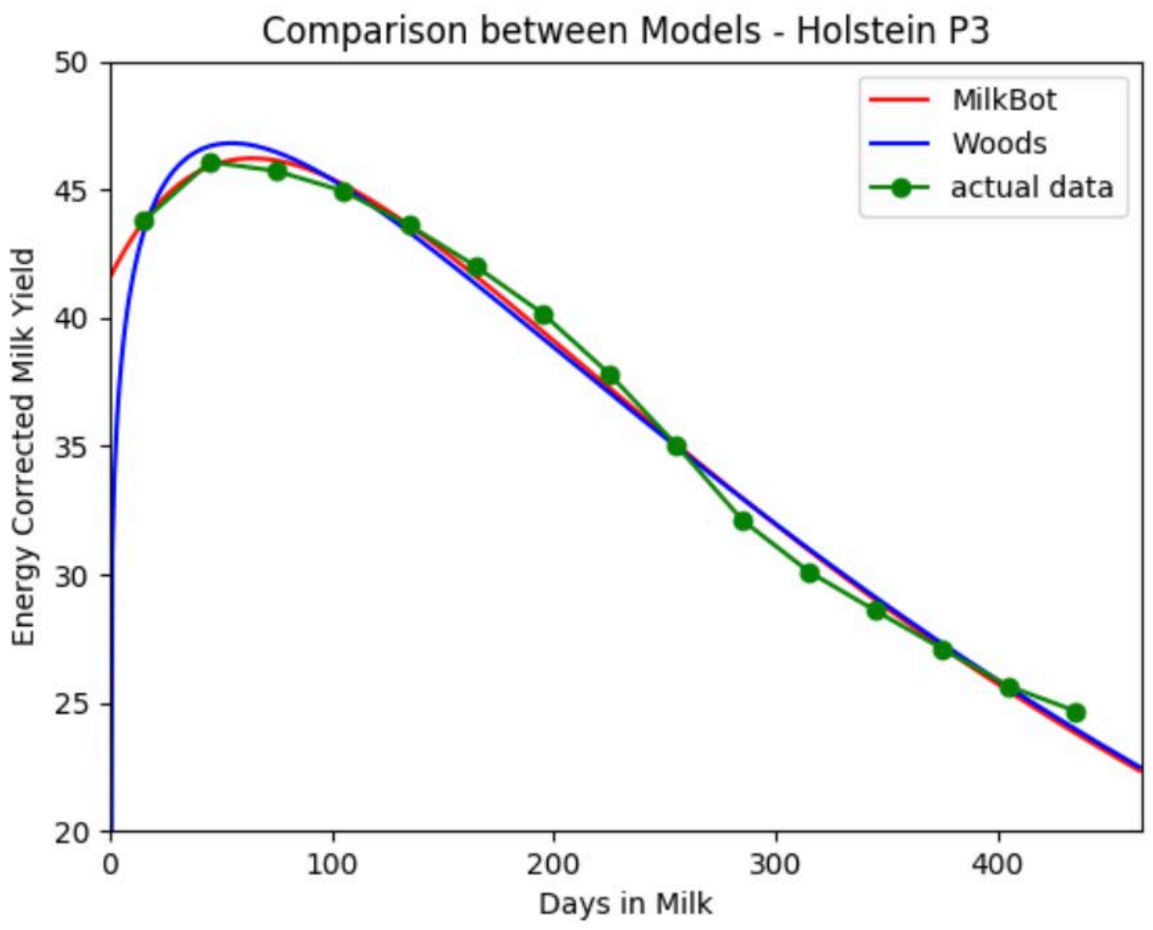
Integrate with other model components

Calibrate parameters of lactation curves



AgSource summary data for Jersey's lactations.
ECM milk = (milk production * (0.383 * % fat + 0.242 * % protein + 0.7832) / 3.1138).

Lactation curve shapes



The commonly model used: (Wood's)

$$Y = at^{b}e^{[-ct]};$$

t = days in milk,

a, b and c = parameters

Alternative model: (MilkBot)

$$Y = a\left(1 - \frac{e^{\frac{c-t}{b}}}{2}\right)e^{[-dt]};$$

t = days in milk,

a, b, c and d = parameters

Data and Method

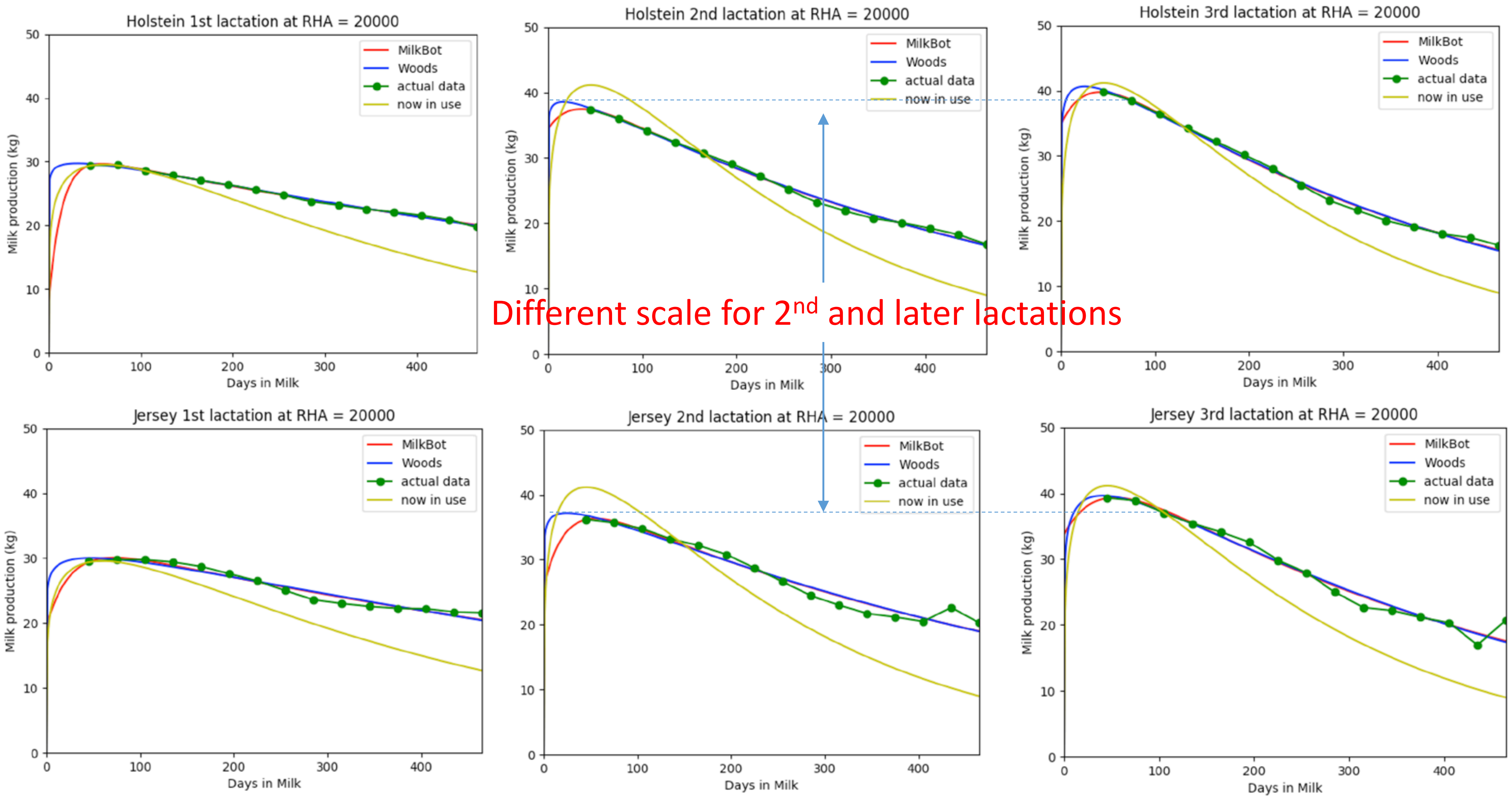
Data

- AgSoure (Wisconsin)
  - Summary data set for the last 5 years
- Council on Dairy Cattle Breeding (U.S.)
  - Individual records for

Method

- Fit data with MilkBot and Wood's lactation curve models
- Non-linear least square methods
- Update parameters for
  - Both Jersey and Holstein
  - 1st, 2nd and later lactations
  - Different production levels

Preliminary results



*actual data from AgSource

Jersey has better persistency

Why Jerseys?

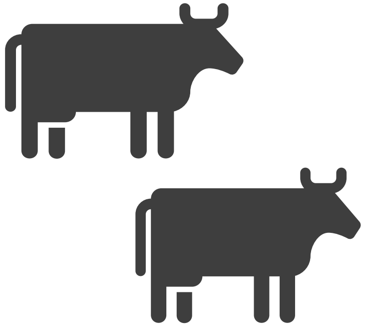
Jersey
vs.
Holstein

→

Higher milk component content
Smaller body size

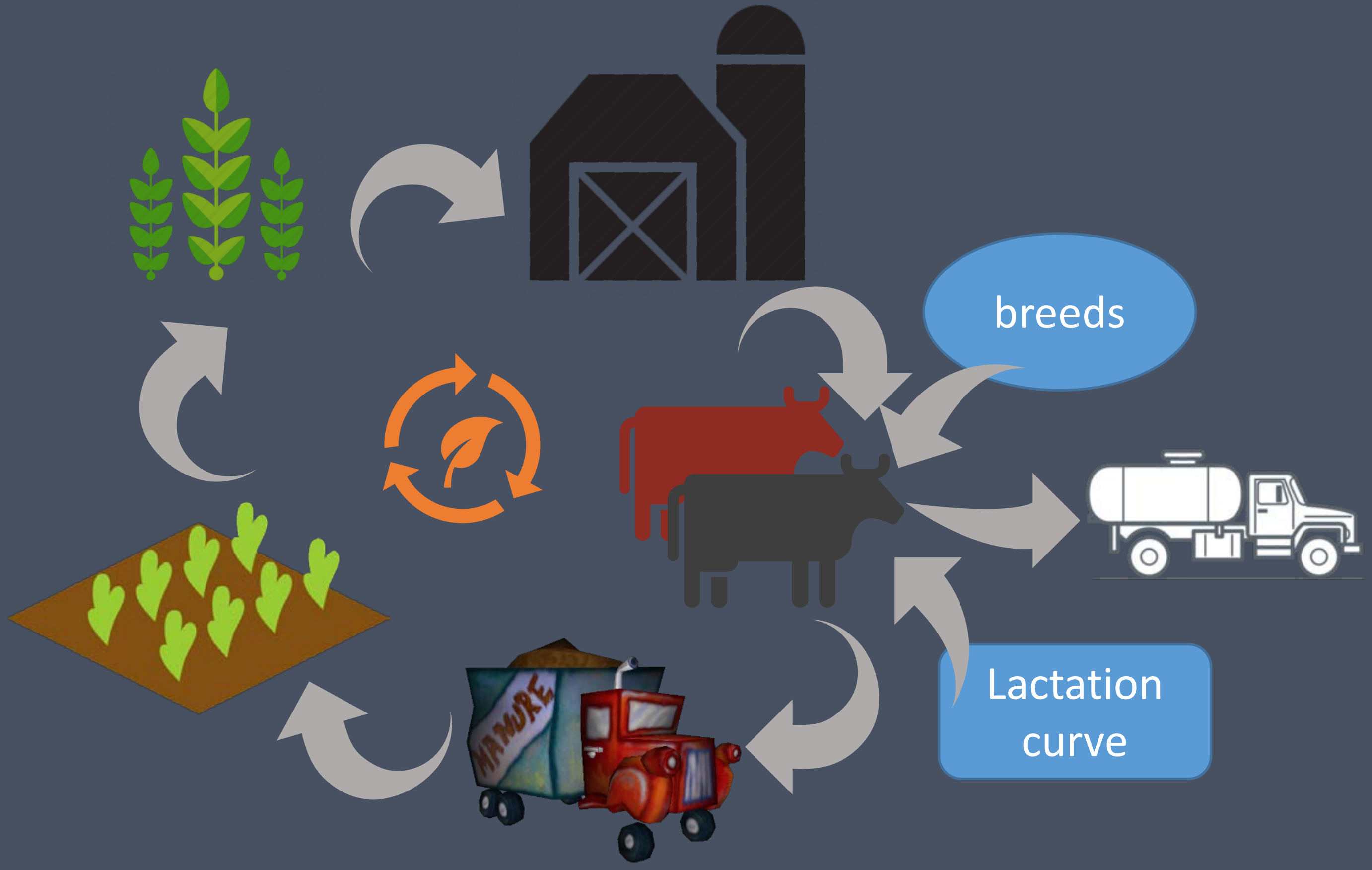
↓

?



Lower carbon footprint
More sustainable
More nutrient use efficiency for certain scenarios

Applications



With updated lactation curve in RuFaS, we will be able to simulate dairy farms in major U.S. regions with distinct management strategies and environmental conditions, thus:

1) ***Factors affecting economics of Jerseys can be investigated such as efficiencies, net income, longevity and lifetime profit***

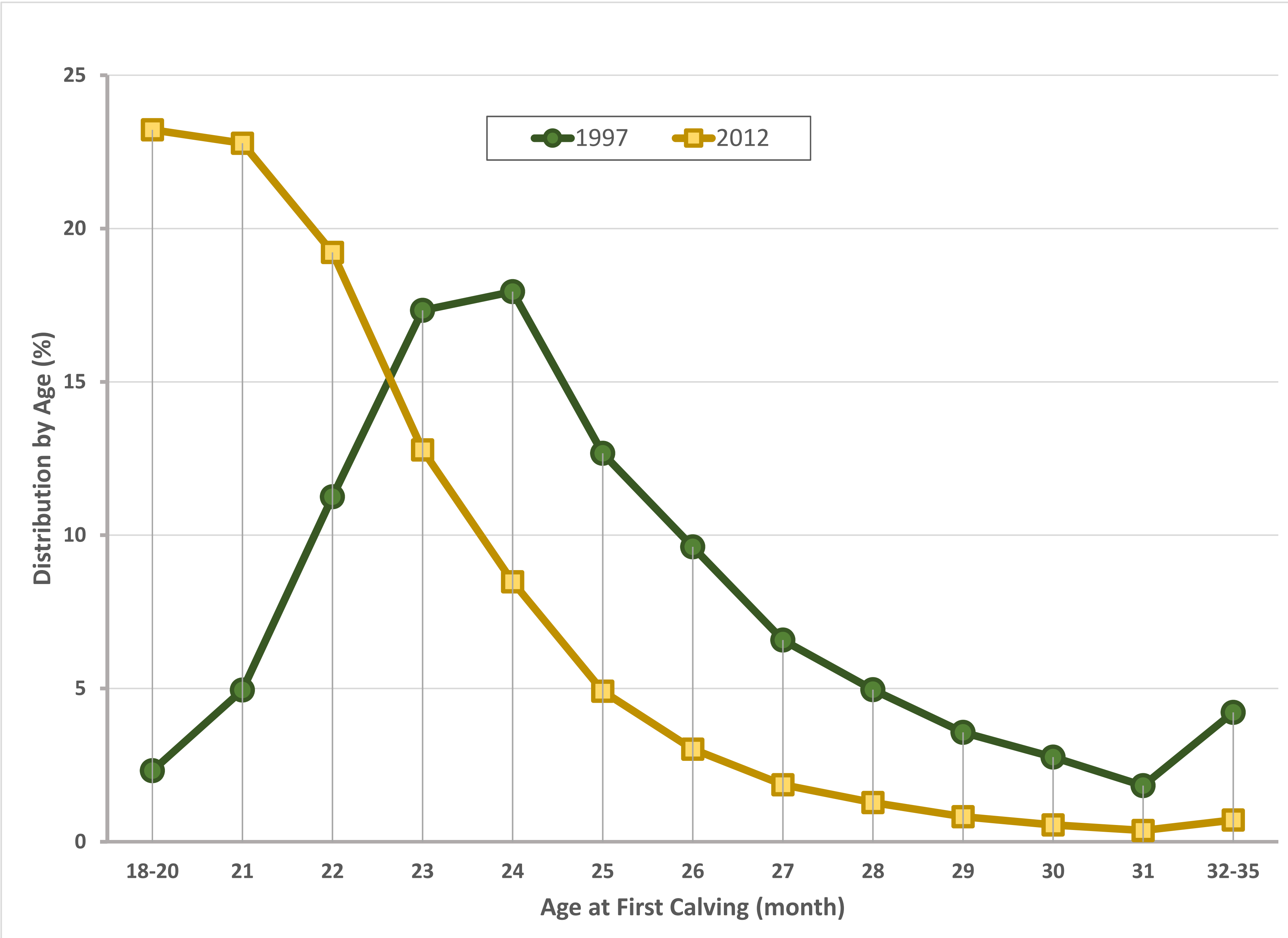
2) ***Environmental impact associated with Jerseys can be assessed by having the relative efficiencies of Jersey and Holstein cows with respect to the carbon, nitrogen, and water footprint associated with common levels of milk production***

DEPARTMENT OF DAIRY SCIENCE
University of Wisconsin-Madison

USDA

USJersey

Thank you!



1997
2012
25
20
15
10
5
0
Distribution by Age (%)
18-20
21
22
23
24
25
26
27
28
29
30
31
32-35
Age at First Calving (month)