Cornell University
Cooperative Extension
Northwest New York Dairy, Livestock & Field Crops Team

December 7-8, 2016
DoubleTree Hotel
East Syracuse, New York

Calf & Heifer Congress

"Laying the Foundation for Top Herd Performance"

2016

PRO-DAIRY

PROCEEDINGS

CALF & HEIFER CONGRESS 2016

"Laying the Foundation for Top Herd Performance"

December 7 - 8, 2016

Doubletree Hotel

East Syracuse, New York

Presented by:

Northwest New York Dairy, Livestock & Field Crops Team
Cornell University Cooperative Extension
In conjunction with Cornell University / PRO-DAIRY

Conference Speakers, Producer Panelists & Staff

Conference Speakers

Jerry Bertoldo, DVM, Cornell Cooperative Extension
Chris Rossiter Burhans, VMD, MS, Poulin Grain, Inc.
Laura Daniels, Heartwood Farm & Dairy Girl Network
Chelsea Hoover, BS, Shur-Gain USA
Jonathan Lamb, Lamb Farms, Inc.
Sam Leadley, PhD., Attica Veterinary Associates, P.C.
Harry Momont, DVM, College of Veterinary Medicine, University of Wisconsin
Danielle Mzyk, DVM/PhD candidate, College of Veterinary Medicine,
N. Carolina State University
Theresa Ollivett, DVM, College of Veterinary Medicine, University of Wisconsin
Roberto Palomares, DVM, College of Veterinary Medicine, University of Georgia
Sue Puffenbarger, MS, Land O' Lakes
Fernando Soberón, PhD, Shur-Gain USA
Mike Van Amburgh, PhD, Cornell University PRO-DAIRY Program

Producer Panelists

Meghan Hauser – Table Rock Farm, Castile, NY
Darlene Hull – Thornapple Farm, Leicester, NY
Paul Molesky – Allenwaite Farm, Schaghticoke, NY
Kazzie Nero – Oakwood Dairy, Auburn, NY
Paul Tillotson – Cottonwood Farms, Pavilion, NY

Program Committee

Jerry Bertoldo – Conference Chair
Libby Eiholzer – Conference Co-Chair
Cathy Wallace – Conference Coordinator
Chris Rossiter Burhans
Mike Van Amburgh

Calf & Heifer Congress - 2016

Wednesday, December 7

10:00 a.m.	**Welcome & Opening Remarks**
10:15 a.m.	**Application of Genomic Technology in Dairy Herds** *Jonathan Lamb, Lamb Farms, Inc.*
11:15 a.m.	**Best Practices for Calving Assistance** *Harry Momont, DVM, College of Veterinary Medicine, University of Wisconsin*
12:15 p.m.	**LUNCH, Exhibits Open**
1:30 p.m.	**Preventing Disease Outbreaks – Records, Oversight & Assessment** *Theresa Ollivett, DVM, College of Veterinary Medicine, University of Wisconsin*
2:30 p.m.	**BREAK, Exhibits Open**
3:00 p.m.	**Role of Trace Minerals in Active Immunity & Respiratory Vaccine Effectiveness** *Roberto Palomares, DVM, College of Veterinary Medicine, University of Georgia*
4:00 p.m.	**Antibiotic Use and Considerations in Calves and Heifers** *Danielle Mzyk, DVM/PhD candidate, College of Veterinary Medicine, North Carolina State University*
5:00 p.m.	**RECEPTION / CASH BAR / DINNER, Exhibits Open**
7:30 p.m.	**Needed "Hitch Pins": Connecting and Sharing Your Values** *Laura Daniels, Heartwood Farm & Dairy Girl Network, Cobb, WI*
8:30 p.m.	**Conclude**
8:45 p.m.	**Dairy Girl Network Event** *Affiliated event for women, www.dairygirlnetwork.com*

Calf & Heifer Congress - 2016

Thursday, December 8

6:30 a.m.	**Complimentary Continental Breakfast**
7:55 a.m.	**Welcome & Opening Remarks**
8:00 a.m.	LifeStart: The Science Behind the Concept *Fernando Soberón, PhD, Shur-Gain USA*
9:00 a.m.	**Feeding Strategies for Older Heifers** *Mike Van Amburgh PhD, Cornell University PRO-DAIRY Program*
10.00 a.m.	**BREAK, Exhibits Open**
10:30 a.m.	**Keeping Things Clean: Biofilms, Troubleshooting, Culturing & Protocols** *Speakers: Sam Leadley, PhD, Attica Veterinary Associates, P.C. and Sue Puffenbarger, MS, Land O' Lakes* *Panelists: Darlene Hull: Thornapple Farm & Kazzie Nero: Oakwood Dairy* *Moderator of Panel Discussion: Jerry Bertoldo, DVM, Cornell Cooperative Extension*
11:30 a.m.	**5 Tips for Inspiring Your Team, followed by Panel Discussion** *Laura Daniels, Heartwood Farm & Dairy Girl Network, Cobb, WI* *Producer Panelists: Meghan Hauser: Table Rock Farm, Paul Molesky: Allenwaite Farm & Paul Tillotson: Cottonwood Farms*
12:30 p.m.	**LUNCH, Exhibits Open**
1:45 p.m.	**Respiratory Disease: Diagnostic Tools and Economic Losses** *Theresa Ollivett, DVM, College of Veterinary Medicine, University of Wisconsin*
2:45 p.m.	**Leading by Example: A Virtual Tour of Well-Managed Heifer Operations** *Chris Rossiter Burhans, VMD, MS, Poulin Grain, Inc.* *Jerry Bertoldo, DVM, Cornell Cooperative Extension* *Chelsea Hoover, BS, Shur-Gain USA*
3:45 p.m.	**Conclude**

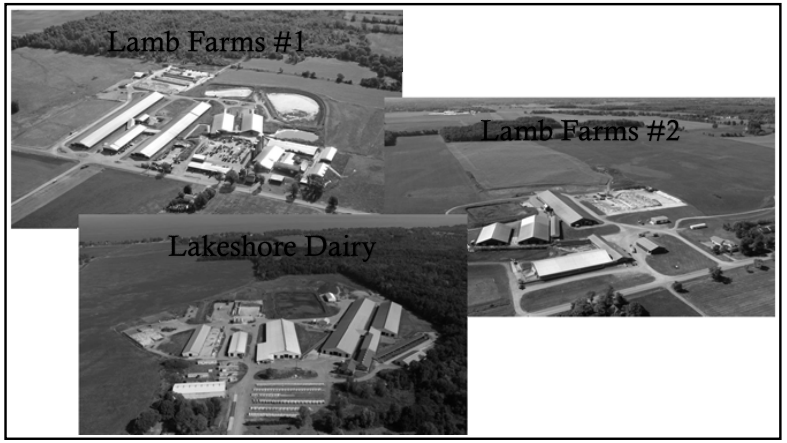
Table of Contents

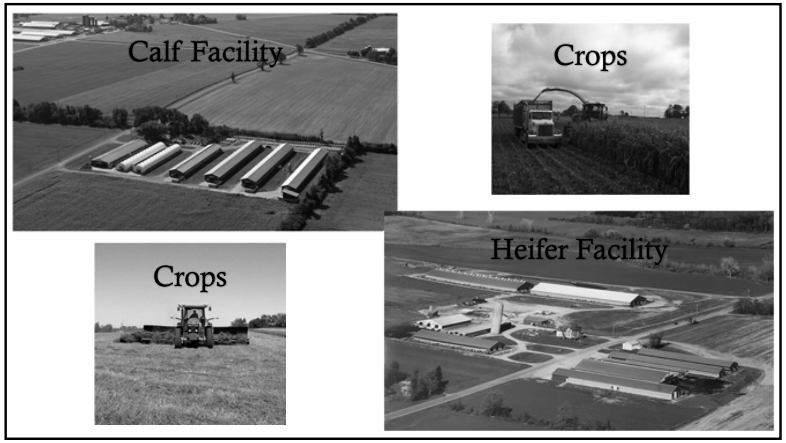
Applications of Genomic Technologies in Dairy Herds

Jonathan Lamb
Oakfield Corners Dairy/Lamb Farms, Inc.
December 7, 2016

Acknowlegments

- Dr. Tom Lawlor, Holstein USA
- Dr. Dan Weigel, Zoetis
- Dr. Kent Weigel, University of Wisconsin
- David Hill, Alta Genetics
- Chuck Sattler, Select Sires, Inc
- Dr. George Wiggans, AGIL

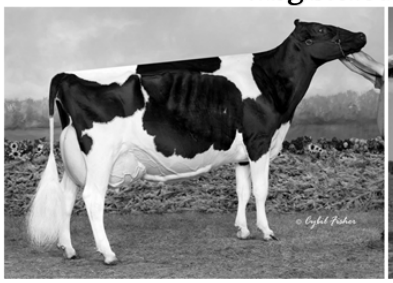




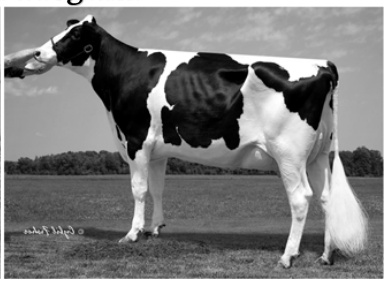
My Background in Genomics

- Member of Holstein Association's Genetic Advancement Committee since 2002
- Chairman of Genetic Advancement Committee 2011-2015
  - Make recommendations to the Holstein Board
    - Total Performance Index formula
- Board Member Holstein USA 2010-2015
- Early adopter of Genomics
  - Initial 50K test very expensive, used to identify elite cattle only
  - Now have Low Density test, $45, used for more applications
- Extensive flush program
  - 4500 embryos transferred per year
  - ¾ index, ¼ show type

Registered Program



Budjon-JK Emilys Edair
EX-95-2E – EEEEE
Res All-American & Res All-Canadian Jr 3 Yr Old 2010



EDG Ruby Uno Rae 2054
+2580 GTPI – EX-90
From the Della Family

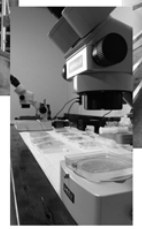
Lamb Farms # 2 Genetics Barn

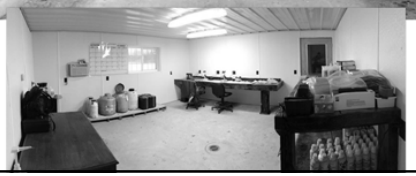
Management of Type Cattle

Management of High GTPI Cattle



Lamb Farms # 3 Donor Facility



Embryo Transfer Program

Craigcrest Rubies Rachelle
EX-91 – EEVVE @ 3Y
2nd Place Jr 3 Yr Old, Int'l Holstein Show 2016

- IVF (In-Vitro Fertilization) vs Traditional Flushing
- Over 4500 embryos implanted past 12 months
- Overall conception rate: 50%
- IVF embryos: 45%
  - Frozen IVF embryos: 50%
- Conception rate quality #1 fresh conventional embryos in heifers: 64%
- Focus on pregnancy rate, not conception rate
- Cost difference IVF vs Traditional Flushing
  - ~$300 per pregnancy IVF vs $100 traditional

Embryo Transfer Program


Dr. Tom Mercuro, TransOva Genetics

Dr. Craig Lamb, Perry Vet Clinic

Adam Dresser, Lamb Farms Repro Mgr

Marketing Cattle at Oakfield Corners Dairy

- High pedigreed registered cattle
  - High genomics
  - Show type/pedigreed
- Commercial cattle
  - Fresh 2 year olds
- Bulls to AI
  - ~30 sold 2016
- Genomically tested cattle for export

Value of Genetics

Do First Lactation Cows Milk as Expected by Sire PTA Milk?

SUM ME305 DOWNBY SPTAM\Q4 FOR LACT=1 SID>H

By Sire PTAM		%	Count	AvME305
Hi	1646	25	86	30728
	709	28	98	28139
	101	27	93	27371
Low	-444	20	68	27698
	Total	100	345	28476

Expected difference in Sire PTAM = 2090
Actual difference in Sire PTAM = 3030

Do First Lactation Cows Conceive as Expected by Sire DPR?

SUM … DOWNBY SDPR\Q4 FOR LACT=1 SID>H

By Sire DPR		%	Count	PR	HDR	CR
Hi	3.9	25	86	30	63	49
	1.9	26	88	30	55	55
	0.2	26	88	27	56	51
Low	-1.3	24	83	18	51	34
	Total	100	345			

Expected difference in Sire DPR = 5.2%
Actual difference in Sire DPR = 12.0%

Does Productive Life Predict Metabolic Issues in First Lactation Cows?

SUM … DOWNBY SPL\Q4 FOR LACT=1 SID>H

By Sire Productive Life		%	Count	Abort	Sold	Died	DA	Ket	Mast	RP	Total
Hi	6.3	25	198	16	87	3	4	18	33	9	170
	4.7	28	221	22	84	2	1	20	32	17	178
	3.3	22	175	20	107	6	0	29	38	12	212
Low	0.7	25	197	28	145	5	4	30	41	20	273
Total		100	608								

Value of Genetics

- 6 units of semen to make a heifer
- 4.25 years before semen investment generates full returns. Net present value of $100 in 4.25 years at 5% interest is $81.26

$13.54 more value

per unit for every $100 of PTA NM$

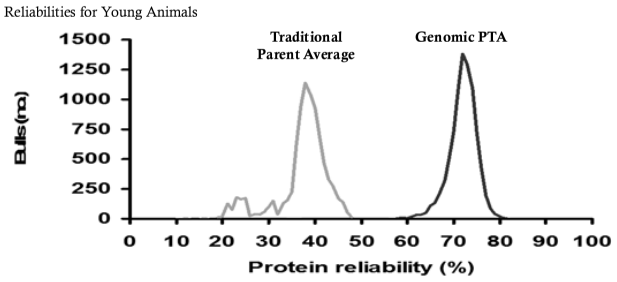
Genomics in Practice

With Genomics, we're able to determine if an offspring received good or bad alleles from its parents

chromosome from her **sire**

chromosome from her **dam**

A genomic test gives you a more accurate prediction of genetic merit



Accuracy = √ reliability

Genomics in Practice

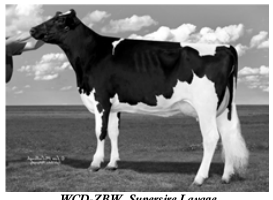
- Introduced commercially in 2008
- No one predicted its rapid adoption
- Increase use of young sire "genomic" bulls
- Increased cost of semen of elite bulls
- Rapid rise in values of genomic index animals

Genomics in Practice

- Reasons to test
  - Determine the **genetic merit** of elite animals at a young age
  - Cull low end replacement heifers
- Secondary reasons
  - Verify or discover **Parentage**
  - Track **haplotypes** or **single genes**
  - Manage the rate of **Inbreeding**

Genomics in Practice

- Identifying Elite Cattle
  - Very exciting aspect of genomics!
  - For Dairymen wanting to propagate top genetics, they must start with elite stock (top 2% of the breed)
  - Dairymen with access to recipients have a competitive advantage
  - Takes a high level of management to run a successful large ET program
  - Homeruns are few and far between, but pay off well when they come



WCD-ZBW Supersire Lawage
+2560 GTPI – VG-85 – DOM

Oakfield Corners Dairy
Spring Sensation Sale 2015

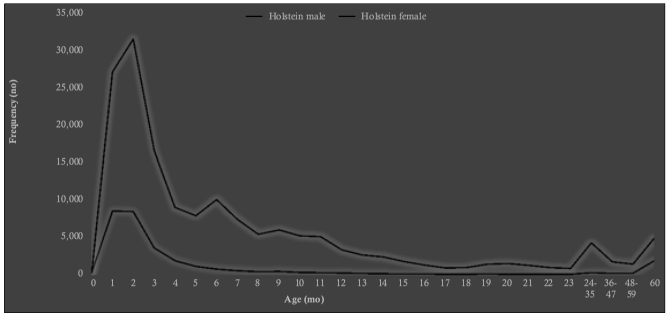
$14,509 Average
74 Full Lots
$1,117,400 gross

High Sellers:
OCD SS Free Willy 4224-ET $175,000 and
OCD Delta Missy 4252-ET $190,000

Genomics in Practice

- Breeding With Genomic Young Sires
  - We have entered a new era of genomic progress
  - We identify top genetics earlier than ever before

Most Animals are Tested Less Than Four Months of Age



Genomics in Practice

- Breeding With Genomic Young Sires
  - We have entered a new era of genomic progress
  - We identify top genetics earlier than ever before
  - Reducing generation interval allows for greater progress

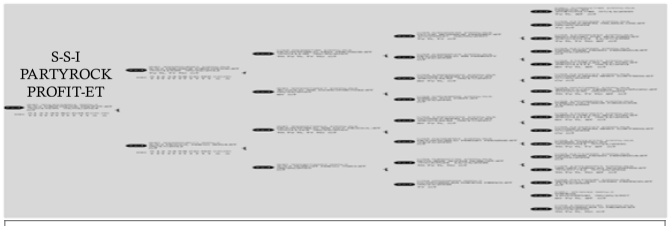
Genetic Gain per Year

(Accuracy x Intensity x Genetic Variation)
Generation Interval

What we want to do

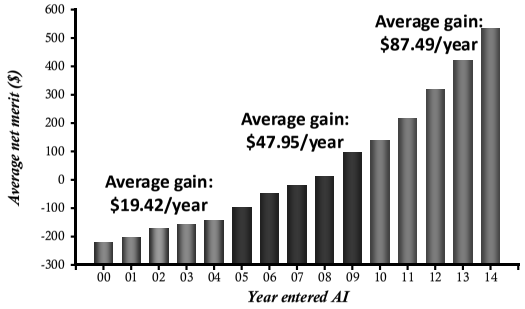
↑ Accuracy by using genotypic data
↑ Select more intensely
↓ Generation interval by obtaining evaluations earlier in life

Generation Interval



Age of Parents when he was born	Age of Grand Parents when his parents were born	Age of Great Grand Parents when Grand Parents were born	Age of Great Great Grand Parents when Great Grand Parents were born
20 months	22.5 months	33.8 months	62.1 months

Genetic Merit of Marketed Holstein Bulls Improving at a Faster Rate



Genomics in Practice

- Breeding with Genomic Young Sires
  - We have entered a new era of genomic progress
  - We identify top genetics earlier than ever before
  - Reducing generation interval allows for greater progress
  - Using almost exclusively genomic bulls should be in the breeding plan of commercial dairies
    - Avoid risk of young bulls lowering over time by using a greater number of bulls

Genomics in Practice

- Test and Cull Commercial Heifers
  - Strategy
    - Test heifers soon after birth to identify those with poor genetic potential
    - Cull the bottom 10-20%

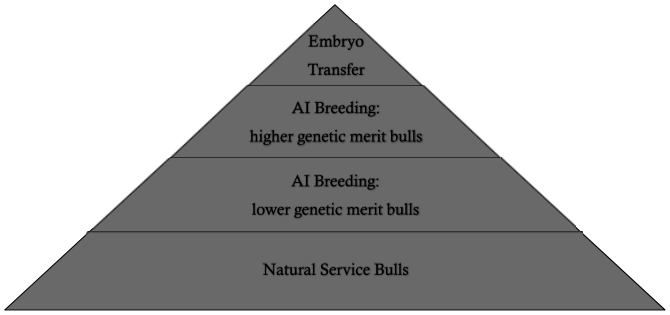
Decision To Raise All Heifers

- Are all heifers needed?
- Plans for growth/expansion
- Sufficient land available for feed and manure application?
- Are heifer costs fixed or marginal?

Genomics in Practice

- Test and Cull Commercial Heifers
  - Pitfalls
    - Common sense must prevail
      - Heifers with challenges (i.e. damaged lungs) must go first
    - Comprehensive breeding program must precede testing
      - Level of genetics used
      - Sexed semen usage
        - Consider on highest indexing heifers/cows
      - Embryo Transfer program

Genetic Levels in Dairy Herds



Genomics in Practice

- Test and Cull Commercial Heifers
  - Pitfalls
    - Common sense must prevail
      - Heifers with challenges (i.e. damaged lungs must go first)
    - Comprehensive breeding program must precede testing
      - Level of genetics used
      - Sexed semen usage
        - Consider on highest indexing heifers/cows
      - Embryo Transfer program
      - Mating program
        - Manage inbreeding
    - Accurate Identification is important
- If all of the above are considered, test and cull strategy can be successful

Potential Economic Benefits

Weigel et all (2012)

- Simulated a 1000-cow commercial US dairy herd
  - Replicated 100 times
- $40 per animal cost for low-density genomic te
  - Genomic testing applied to heifer calves
  - 15% sire misidentification rate
  - Economic gains from culling inferior heifer calves
    - - Complete, partial or missing pedigree
    - - Testing all calves or pre-sorting by parent average

Potential Economic Benefits

Weigel et all (2012)

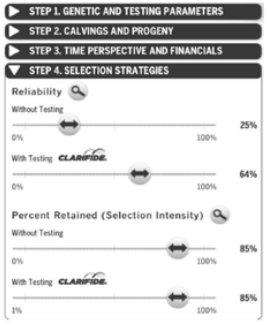
- If an unknown pedigree and all heifers tested
  - $66 net gain for each of 360 heifers if bottom 20% culled
  - $26 net gain for each of 405 heifers if bottom 10% culled

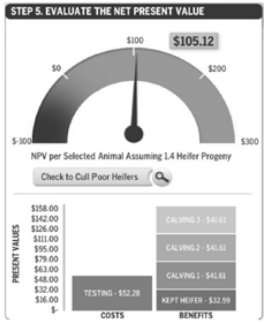
(and mostly correct)

- If complete pedigree and bottom 50% of heifers tested
  - $19 net gain for each of the 360 heifers if bottom 20% culled
  - $8 next gain for each of 405 heifers if bottom 10% culled

Economic Benefits

Economics of Genetics Selection in Heifers

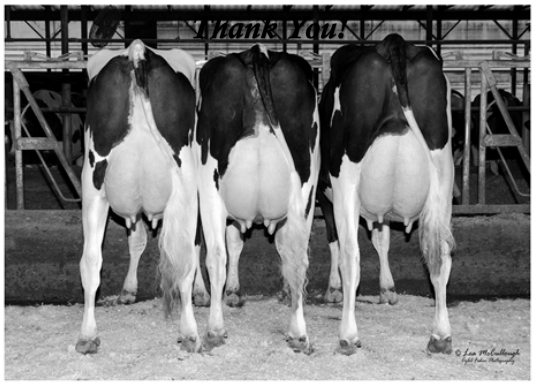




zoetis

Take Home Messages

- Breeding to propagate top genetics using genomics
  - Should be done with elite stock only
  - Has the potential to add significant "non-milk income"
- Breeding heavily to genomic young bulls should be in every commercial farm's breeding strategy
- Using genomics for a "test and cull" strategy should be done only after careful planning
- Breeding with the best genetics is a worthwhile investment!!!
  - Well though out breeding plans take patience and discipline
  - Cattle will exhibit the traits they are bred for



Best Practices for Calving Assistance

H. Momont
University of Wisconsin-Madison
harry.momont@wisc.edu

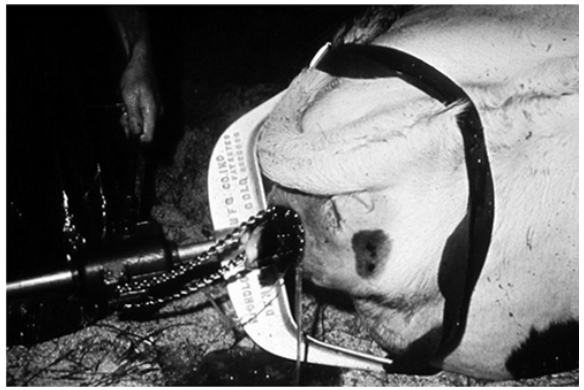
Why it matters

- Prevalence estimates for dystocia in Holstein heifers range from 30-50%
- Dystocia costs you money
  - Dead calves
  - Lower fertility
  - Illness in calf and cow
  - Less milk
  - Veterinary bills

Maximizing normal births

- An ounce of prevention is worth a pound of cure (Benjamin Franklin).
- Prevention requires basic knowledge and a commitment to the long view

This is not the answer!



Goal for Every Calving is Eutocia - Normal Birth

- Calf is appropriate size
- Calf is normally situated
- Dam is capable of normal uterine and abdominal contractions
- Dam has normal birth canal

Calving Environment

- Sanitary (clean and dry)
- Good footing
- Roomy
- Quiet
- Conveniently located for observation and assistance
- Ideally, separated from cows

Feto-maternal/pelvic disproportion accounts for the majority of heifer dystocia (FMD/FPD)

Calf birth-weight

- Gestation Length
- Gender
- Sire
- Breed
- Nutrition

Heifer pelvic size

- Age
- Breeding Weight (nutrition)
- Body Condition (nutrition)

Did I mention nutrition?

- Take a professional approach to feeding heifers to reinforce the long view
  - Quality feeds
  - Formulated and tested ingredients
  - Only healthy animals
  - Monitor the results!
    - Withers and hip height
    - Heart girth
    - Calf weights
  - Know the benchmarks for your breed and cow size

"General" Guidelines for Holstein Heifers

First Breeding

- 13 months
- 875 pounds
- Withers height – 50 inches

First Calving

- 22-24 months
- 1250 pounds
- Withers height – 55 inches

Calving Ease Scores: A tool for long-term dystocia prevention strategies

Score	NAAB Dairy	Alternative Simplified System
1	No problem or unobserved	No assistance
2	Slight problem	Minor assistance (one person)
3	Needed assistance	Hard pull/C-section
4	Considerable force	
5	Extreme difficulty (mechanical pull or c-section)	

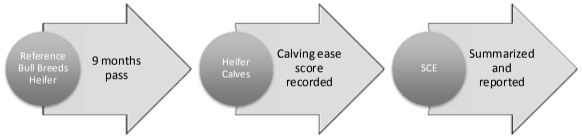
Calf Mortality Related to Calving Ease Score

CE Score	Heifers % Dead	Parity 2-3 % Dead
1	6	4
2	14	14
3,4,5	28	27

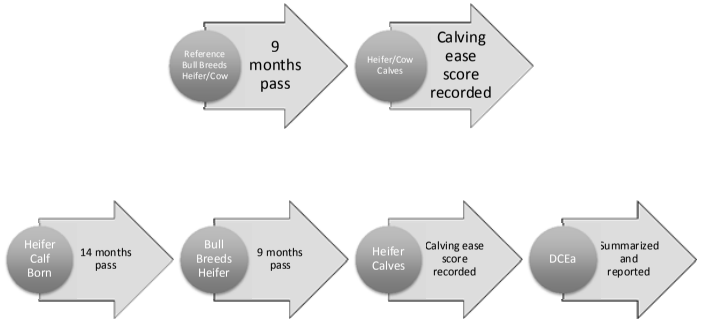
Calving ease as a selection trait in dairy cattle

- Service Sire Calving Ease – the expected percentage of difficult births in first-calf heifers (scores of 4 and 5); this is a sire-of-calf effect and the Holstein breed average is approximately 8% (heritability≅16%)
- Daughter Calving Ease – the cows ability to deliver a calf easily and her propensity to gestate a calf that is born easily (same scoring as above); this is a sire-of-cow effect on calving ease (heritability≅10% and of course it is more slowly generated and poorly monitored)
- These two traits are not necessarily correlated
- **Which one is more important to you?**

SSCE (Cooperating Herds)



DCE (Cooperating Herds)



How to use this information

- Select bulls based on an economic index (e.g., NM or TPI)
- Use DCE as a secondary selection criteria to improve herd calving performance over time
- Preferentially use bulls with a better (low) SSCE score on heifers

Consider Using Sexed Semen

- Up to 95% heifer (smaller) calves
- More costly
  - Higher semen cost
  - Lower conception rates (about 20% lower)

Preventing Stillbirths (Death Within 48 Hours of Birth)

- Target rates below 6-8%
- Prevent dystocia
- Avoid long and short gestations (<275 or >289 days)
- Avoid young and old heifers at first calving (<22 or >26 months)

Stillbirth Scoring System (NAAB)

Status of Calf	Score
Alive	1
Dead at birth	2
Dead within 48 hours	3

Take Home

- Commit to a plan to prevent dystocia in your heifers
  - Monitor the plan
    - Calving ease and stillbirth score recorded for all heifer deliveries
    - Confirm herd progress or re-evaluate the plan

Managing Dystocia in Dairy Heifers

First Stage Labor

- Characterized by uterine contractions and cervical dilation
- Calf is positioned for birth
- Duration and intensity vary widely
- Restless, tail up, off feed, leaking milk

Second Stage Labor

- Active expulsive efforts of uterine and abdominal muscles mediated by massive oxytocin release as the calf enters the vagina
- Usually coincides with rupture of the allantochorion (water bag) and appearance of membranes or feet at the vulva
- .5-1 hr in multiparous cows
- Up to 4 hours in heifers
- Ends with delivery of the calf

Orientation of the Calf

- Head first and aligned with the heifer
- Upright in the heifer
- Both forelimbs, head, and neck extended

Third Stage Labor

- Detachment and expulsion of the placenta
  - Considered retained after 12 hr
  - Initial uterine involution

Dystocia (Difficult Birth)

- Causes
  - Fetal-maternal disproportion (heifers)
    - Age of dam, fetal sex, nutrition, genetics
  - Maternal
    - Uterine inertia (primary or secondary) or deficient abdominal press
    - Abnormal birth canal (trauma, fat, fractures, torsion)
  - Fetal
    - Improper orientation of the fetus (multiparous cattle)
    - Fetal anomalies
    - Prolonged gestation
    - Twins
    - In vitro fertilization and culture

The WHO, WHEN, WHERE and WHAT of Calving Assistance

WHO

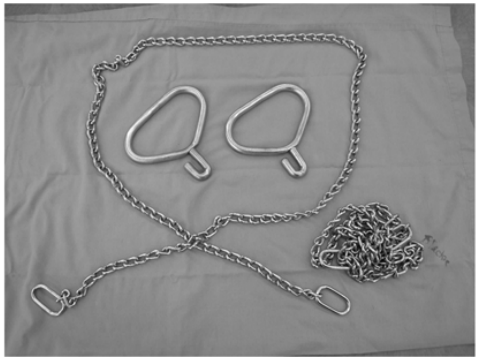
- Trained personnel following established protocols
- Available 24-7

WHEN

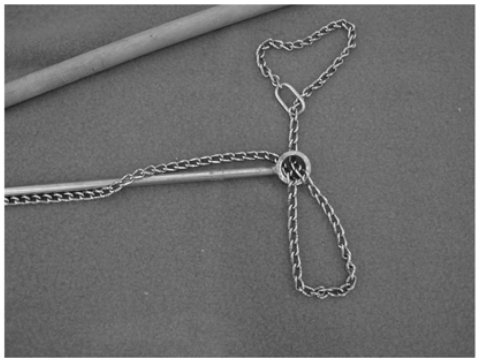
- Whenever a problem is apparent
  - Excessive straining or hemorrhage, abnormal odor or appearance to membranes, more or less than 2 feet, or 2 feet and no head
- Whenever delivery is delayed
  - 1st stage > 6 hr
  - 2nd stage > 2-3 hr
  - No progress after 30-60 minutes of 2nd-stage labor

WHERE

WHAT



Detorsion Rod



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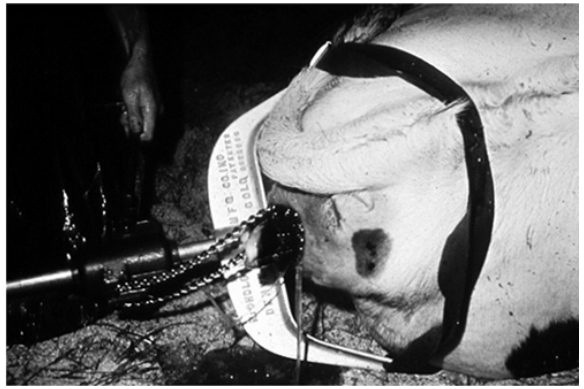


Principles of Bovine Obstetrics

- 1. Sanitation
  - Have plenty of warm water and disinfectant soap
  - Wear sleeves
- 2. Lubrication
  - Water based methyl cellulose or powdered lubricants
- 3. Repulsion
  - Required if there is a retained head or limb

Principles of Bovine Obstetrics

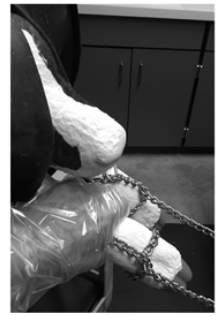
- It's an emergency but you don't need to rush
- Weak abdominal press and slow separation of fetal membranes
- Calf can survive for hours if umbilical cord is functioning
- Cows rarely traumatize themselves
- Always determine the number and orientation of calves

Management of Dystocia

- Controlled Vaginal Delivery (Forced Extraction) is your goal
- Fetotomy and C-section reserved for trained professionals

Assessing Size for Vaginal Delivery

- Guidelines for forced extraction during second stage labor:
  - Normal head-first orientation
    - 2 people pulling
    - Fetlock out 4 in
  - Backwards delivery
    - 2 people pulling
    - Hocks at vulva



Know When to Quit

- Obvious trauma has occurred
- Excessive hemorrhage
- Half-hour rule – If no progress in 30 minutes, call for help

Calf Care

- Assume dystocia calves need help
- Normal calves:
  - Are upright within minutes
  - Stand within an hour
  - Actively suckle by 2 hours
  - Maintain a normal body temp. (100-102°F)

Calf Resuscitation

- Stimulate breathing
  - Straw in nose
  - Ice water
  - Briskly rub or dry calf
  - Prop upright
- Keep calf warm
- Feed colostrum

Take Home

- Working with your veterinarian:
  - Create written protocols for providing calving assistance
  - Provide training for personnel working in the calving environment
    - Problem Recognition
    - Basic Calving Assistance Techniques
    - Calf Resuscitation Techniques

TRACE MINERALS ON THE IMMUNE RESPONSE FOLLOWING VACCINATION AGAINST BOVINE RESPIRATORY DISEASE

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ABSTRACT

Bovine respiratory disease (BRD) has a major impact on the profitability of the cattle industries in North America, resulting in substantial economic losses. Effective transfer of maternal antibodies in conjunction with appropriate biosecurity measures and vaccination programs are essential to prevent and control BRD. Trace minerals (TM) are crucial for the development of an adequate immune response in cattle, especially in stressed animals. Field and experimental studies focused on improving the TM status of stressed feeder calves have shown positive effects of administration of TM improving feed efficiency, decreasing morbidity and treatment costs and improving performance and production traits. Our studies revealed that administration of injectable TM (Se, Zn, Cu and Mn) concurrently with modified-live virus vaccination in dairy calves resulted in earlier and increased antibody titer and leukocyte proliferation upon stimulation with BRD viruses compared to the control group. Additionally, TM provided additional beneficial effects when administered concurrently with respiratory MLV vaccine: 1. Injectable TM increased average daily gain during the 14 day post- BVDV challenge period. 2. Clinical scores were lower for TM compared to saline-injected group on days 5 and 8 post challenge. 3. Administration of TM prevented BVDV-induced thrombocytopenia compared to saline-injected calves and positive control group, and 4. TM enhanced protection from BVDV-2 infection by MLV vaccine, helping to maintain adequate health and performance of growing calves. Addition of injectable TM supplements to calf management protocols might represent a promising tool to improve livestock health on commercial farms.

THE IMMUNE SYSTEM IN CATTLE

Innate Immunity

The innate immune system represents the first line of defense against a pathogen before the adaptive system can develop the appropriate response. The innate immunity is not antigen specific and does not include anamnestic or memory response. Components of nonspecific immunity are present both prior to and following antigen exposure and they do not discriminate against most foreign substances. These components include natural barriers (skin, epithelial lining, anti-microbial substances, enzymes, etc.), complement proteins, and white blood cells (granulocytes, macrophages) that engulf and eliminate pathogens (phagocytosis and killing).

Further, the innate immunity also includes type I interferon (IFN) antiviral response and natural killer cells (NKC) which are lymphocytes able to destroy infected cells. Granulocytes are also called polymorphonuclear leukocytes (PMN), mainly neutrophils. The main function of neutrophils is to monitor for infection to perform phagocytosis and killing of pathogens. Neutrophils identify pathogens by the recognition of pathogen-associated molecular patterns (PAMPs) using specific receptors, called Toll-like receptors. Microbes have molecules not typically found in mammalian cells (e.g. double-stranded RNA, CpG DNA sequences, and unusual carbohydrate residues), so that neutrophils are able to detect these molecules to eliminate the infectious agents. After binding of PAMPs to Toll-like receptors, neutrophils activate and initiate the phagocytosis and killing. Microbial destruction by phagocytosis involves the production of reactive oxygen species (ROS) which are bactericidal.

Adaptive Immunity

The adaptive or acquired immunity has the capacity to recognize specific antigens and has memory. The primary components of the adaptive immune system involve humoral (antibody production by B lymphocytes) and cell mediated immunity (developed mainly by $CD4^+$ helper T cells, $CD8^+$ cytotoxic T cells and $WC1^+$ γδ T cells).

B-cells mature in bone marrow and are released into blood, where they circulate and populate lymphoid tissues. These cells also act as antigen presenting cells (APC) so that they can recognize antigens and present them to helper T cells, which enhance further antibody production. B lymphocytes activate and undergo proliferation and differentiation, a process termed “clonal expansion”. Each clone of B lymphocytes can recognize a specific target antigen. Production of antibodies by B lymphocytes following interaction with the antigen requires input of interleukins-2 (IL-2), IL-4 and IFN-γ. These cytokines also cause formation of B memory cells from the activated B-cell population. Antibodies are Y-shaped proteins, containing a constant (C) region and a variable (V) region. The V region contains the antigen binding site. The constant region is assembled from distinct genes that yield different antibody isotopes, such as IgG, IgM, IgD, IgA and IgE. Each of these isotopes has different physical properties and specific roles in the animal’s immune system. The roles of antibodies in adaptive immune response include: neutralization or microbe and toxins, opsonization and phagocytosis, antibody-dependent cellular cytotoxicity, and complement activation.

T-cells are produced in the bone marrow and mature in the Thymus (hence the name “T”-cell). T-cells are responsible for “cell-mediated immunity”. Similar to B cells, clonal expansion and differentiation of T-cells results in the development of effector and memory T-cells. During cell-mediated immunity, T lymphocytes recruit and stimulate phagocytic (nonspecific) activity as well as participate in direct lysis of infected cells (e.g. viral infected cells). Helper T-lymphocytes ($CD4^+$) orchestrate the adaptive immune response through the production of cytokines and costimulatory molecules, while cytotoxic T-cells ($CD8^+$) have the capacity to destroy infected cells (e.g. during virus infection).

VACCINATION TO PREVENT BOVINE RESPIRATORY DISEASE IN DAIRY CALVES

Bovine respiratory disease (BRD) has a major impact on the profitability of the dairy and beef industries in North America, resulting in substantial economic losses that exceed $1 billion annually (Griffin, 1997; McVey, 2009). The infectious agents most consistently implicated in BRD include *Bovine viral diarrhea virus* (BVDV), *Bovine herpes virus 1* (BHV1), *Bovine respiratory syncytial virus* (BRSV), *Parainfluenza 3 virus* (PI3V), *Mannheimia haemolytica, Pasteurella multocida, Histophilus somni,* and *Mycoplasma bovis*. Appropriate biosecurity measures and vaccination program are crucial to prevent and control BRD.

Vaccination against BVDV1, BVDV2, BoHV-1, BRSV, and PI3V is considered a key management strategy to minimize mortality and economic losses associated with BRDC in weaned calves. However, vaccines are not 100% effective. Several factors affect the immune response and protection elicited by vaccination in dairy calves, including nutrition, stress, climate, presence of maternal antibodies, vaccination route, vaccine handling.

There are two types of commercially available respiratory vaccines in the USA: modified-live virus (MLV) and inactivated. These two types of vaccines have advantages and disadvantages. The major advantage of MLV vaccines, in general, is activation of all phases of the immune system yielding a balanced systemic and local immune response, and a balanced humoral and cell-mediated response. Modified-live virus vaccines contain limited antigen mass, requiring viral replication in the host to develop optimal immunity. During the replication cycle, a live virus could recombine or mutate and occasionally revert to virulence and be shed to other susceptible individuals, resulting in clinical consequences. A further disadvantage of MLV vaccines is the immunosuppressive effect on leukocyte function by BVDV, resulting in increased susceptibility to other infections. Furthermore, MLV vaccines have the potential risk for contamination with adventitious virulent strains becoming a source of spread of BVDV infections. On the other hand, the major advantages of inactivated vaccines are that they are not either immunosuppressive nor fetopathogenic. Disadvantages of inactivated BVDV vaccines include a weaker neutralizing antibody response and shorter duration of protection (which indicates a need for increased frequency of administration). Also, inactivated vaccines may have a disadvantage in relation to modified-live vaccine with respect to limited cell mediated immune response, which plays an important role in recovery from and resistance to disease.

Before developing a vaccination program, it is important to develop a risk assessment in order to know which vaccines will be needed. This risk determination will be based on the presence of certain pathogens (and their infection pressure) and the level of passive immunity in the group of calves.

The vaccination program of the dairy calf will depend mostly on the management practices as well as the quantity and quality of colostrum consumed during the first hours of life. Neonatal dairy calves, are separated from the dam at birth or shortly later. Thus, titers of maternally derived antibody varies widely depending on the quality and

quantity of the colostrum consumed, as well as the efficiency of immunoglobulins' intestinal absorption. Chamorro et al., 2014 reported high variability in the level of neutralizing antibodies in young dairy calves; with a high proportion of calves having low titers to BVDV, BoHV1, PI3 and BRSV, which represents a high risk for developing respiratory disease. This suggests that a high percentage of neonatal dairy calves have failure of immunoglobulin transfer. Therefore dairy calves should be vaccinated during the first 3 months of age. Moreover, the newborn calf has a functional immune system that is able to respond to antigens, provided maternal antibody is not present. Therefore, if calves are at high risk of digestive and respiratory disease due failure of passive transfer, priming vaccination during the first weeks of life to develop humoral and cellular protection is required.

Some calves might have moderate to high level of maternal antibodies, which may interfere with the immune response after SQ or IM vaccination. One strategy to overcome the presence of maternal antibody in these animals is to use intranasal vaccines (IN), which will result in the development of antibodies on the respiratory mucosa (i.e. immunoglobulin A; IgA). This local immune response has shown to elicit protection against BRD, since most respiratory pathogens gain entry though this route. Mucosal antibody response neutralize infectious agents at the respiratory mucosa; thus preventing infection. Furthermore, IN vaccines also induce interferon production at the mucosal surface, which will provide a nonspecific antiviral environment and may stimulate maturation of the immune system.

A common protocol used in young dairy calves include a priming dose of IN vaccination containing BoHV1, PI3 and BRSV accompanied by a booster of SQ MLV vaccine containing BVDV, BoHV1, PI3, and BRSV 60-90 days after priming vaccination. In these programs, calves may be vaccinated several times during the first 6 months of life.

One of the goals of vaccinating adult dairy cows is to achieve an adequate level of protection and induce increased level of antibodies in colostrum. However, cows in a dairy herd are normally at various reproductive stages. This limits selection of vaccines to those that are safe to use in pregnant animals. Healthy replacement heifers should be vaccinated at least twice with MLV vaccine before breeding. These animals need to be isolated from pregnant cows during and after vaccination. Vaccination should be scheduled so that maximal protection is achieved during the critical first 4 months of gestation to maximize the potential for adequate duration of immunity and enhance protection against fetal infection. Replacement dairy heifers are commonly vaccinated with MLV vaccines at 3 months of age (when there is a significant decay in antibody titers), at 6 months of age and 30-60 days before breeding. If inactivated vaccines are administered, vaccination of heifers before breeding should be timed so that maximal responses are afforded by first 4 months of gestation to maximize protection against fetal infection. Thus, the second booster should be given 2-4 weeks before breeding. Cows should be revaccinated annually, 4 weeks before breeding.

ROLE OF TRACE MINERALS IN THE IMMUNE RESPONSE

Nutritional status, and particularly mineral levels, have been demonstrated to impact cattle health and performance (Enjalbert et al., 2006; Galyean et al., 1999; Underwood and Suttle, 1999). Trace minerals such as Zinc (Zn), Manganese (Mn), Copper (Cu), and Selenium (Se) are important for optimal immune function (Chirase et al., 1991; Percival, 1998; Underwood and Suttle, 1999) and growth (Spears and Kegley, 2002) in cattle, particularly in highly stressed, and newly received feeder calves (Duff and Galyean, 2007). Zinc contributes with the structure and function of more than 2,500 enzyme systems involved in metabolism (Andreini et al., 2009; Cousins and King, 2004). Zinc activates the enzyme superoxide dismutase, which plays a crucial role in stabilizing cell membranes against reactive oxygen species (ROS) (Bonaventura et al., 2015; Haase and Rink, 2014). Zinc is involved in DNA replication through the actions of ribonucleotide reductase, and is necessary for lymphocytes proliferation and differentiation. Zinc's major roles in the immune response involve signaling and adhesion of neutrophils and macrophages (Bonaventura et al., 2015), production of pro-inflammatory cytokines by monocytes (Rink and Kirchner, 2000), regulation of IL-2 secretion, signal transduction for T cell activation, clonal expansion, differentiation and T_H cells polarization (Haase and Rink, 2014), B-cell function, and antibody production (Pinna et al., 2002; Tomlinson et al., 2008).

Copper is important in the mitochondrial metabolic cascades for energy production to supply different organs, including those of the immune system (Failla, 2003). Copper also plays a role in superoxide dismutase activity and neutralization of ROS (Maggini et al., 2007), and contributes to the process of phagocyte killing (Linder, 1991). Ceruloplasmin is a copper-containing enzyme whose production increases dramatically during inflammation in response to the necessity of scavenging oxygen radicals released by immune cells (Percival, 1998). In rodents, copper deficiency is associated with decreased IL-2 production, lymphocyte proliferation and T cells counts (Bala and Failla, 1993; Bonham et al., 2002; Klotz et al., 2003; Linder and Hazegh-Azam, 1996; Minatel and Carfagnini, 2000; O'Dell, 1993; Pan and Loo, 2000; Percival, 1998). Similarly, studies in cattle fed a copper-deficient diet showed a significant reduction in B-lymphocytes and impaired neutrophil activity (Cerone et al., 1998).

Selenium appears to be very important to the migration of neutrophils into tissues and subsequent inflammation (Maddox et al., 1999). Selenium is a component of the enzyme glutathione peroxidase that inactivates ROS production and prevents released ROS from causing cellular damage (Maddox et al., 1999; Neve, 1991). Selenium deficiencies have been associated with depressed neutrophil migration and killing ability, and reduced B-cell response and antibody production. Moreover, Se supplementation enhanced both humoral and cell-mediated and immune responses (Maggini et al., 2007). The level of Se in tissues and blood affected the total IgM levels and BHV1-specific antibody titers after challenge (Reffett et al., 1988). Evidence that Mn plays a role in the immune system is limited. However, Mn has an essential function in removing ROS produced by active phagocytic cells (Tomlinson et al., 2008).

EFFECT OF INJECTABLE TRACE MINERALS (ITM) ON THE PROTECTION ELICITED BY VACCINATION AGAINST BOVINE RESPIRATORY DISEASE (BRD).

Arthington and Havenga (2012) assessed the effect of administration of ITM on the humoral immune response after BRD specific MLV vaccination in cattle. That study demonstrated that ITM given concurrently with viral vaccination enhanced the production of neutralizing antibodies to BHV1 in beef calves. Additionally, recent studies have shown that treatment with ITM concomitantly with MLV vaccination induced a faster BVDV-specific antibody response in newly received, highly stressed calves (Roberts et al., 2015).

A growing body of evidence suggests that both humoral and cell mediated immune (CMI) responses are critical in protection against viral agents involved in BRD (Collen and Morrison, 2000; Howard 1990; Nobiron et al., 2003). A more complete evaluation of the immune responses induced by MLV vaccination requires the use of methods to assess both humoral (antibody response) and cellular effector mechanisms (recall antigen induced proliferation and induction of IFN-γ as the core Th1 cytokine).

A study was performed at University of Georgia to evaluate the effect of an injectable trace mineral (ITM) supplement containing zinc, manganese, selenium, and copper on the humoral and CMI responses to vaccine antigens in dairy calves receiving a modified-live viral (MLV) vaccine containing BVDV, BHV1, PI3V and BRSV (Palomares et al., 2016). A total of 30 dairy calves (3.5 months of age) were administered a priming dose of the MLV vaccine containing BHV1, BVDV1 & 2, BRSV, PI3V, and an attenuated-live *Mannheimia-Pasteurella* bacterin subcutaneously (SQ). Calves were randomly assigned to 1 of 2 groups: (1) administration of ITM SQ (ITM, Multimin 90® Multimin USA®, n = 15) or (2) injection of sterile saline SQ (Control; n = 15). Three weeks later, calves received a booster of the same vaccine combination SQ, and a second administration of ITM, or sterile saline, according to the treatment group.

Throughout the study, the calves grazed Bermuda grass (*Cynodon dactylon*) and Fescue grass (*Festuca arundinacea*) with no access to mineral supplementation. Animals had access to hay (Bermuda grass and Fescue grass) and water *ad libitum*. Additionally, calves received 2.7 kg/head/day of concentrate supplement (Bulk Cattleman's Special; Godfrey's Warehouse; Madison-GA; Palomares et al., 2016) divided into two meals.

In this study, calves had adequate liver tissue concentration of all the study trace minerals assessed at all sampling dates according to standard reference values (Herdt and Hoff, 2011). Administration of ITM resulted in increased concentrations of liver Se (on days 21 and 56), Cu (on day 56) and Mn (on day 56) compared to saline injected calves (Palomares et al., 2016). Administration of ITM concurrently with MLV vaccination resulted in higher antibody titers to BVDV1 on day 28 after priming vaccination compared to the control group (P = 0.03). This higher BVDV1 specific humoral immune response was associated with both higher production of antibody (Fig.

1A) and a numerical tendency of greater proportion of sero-conversion (≥ 4-fold increase compared to day 0) to BVDV1 on day 28 in the ITM group (12/15; 80.0%) compared to the control group (8/15; 53.3%; *P* = 0.13; Fig. 1B).

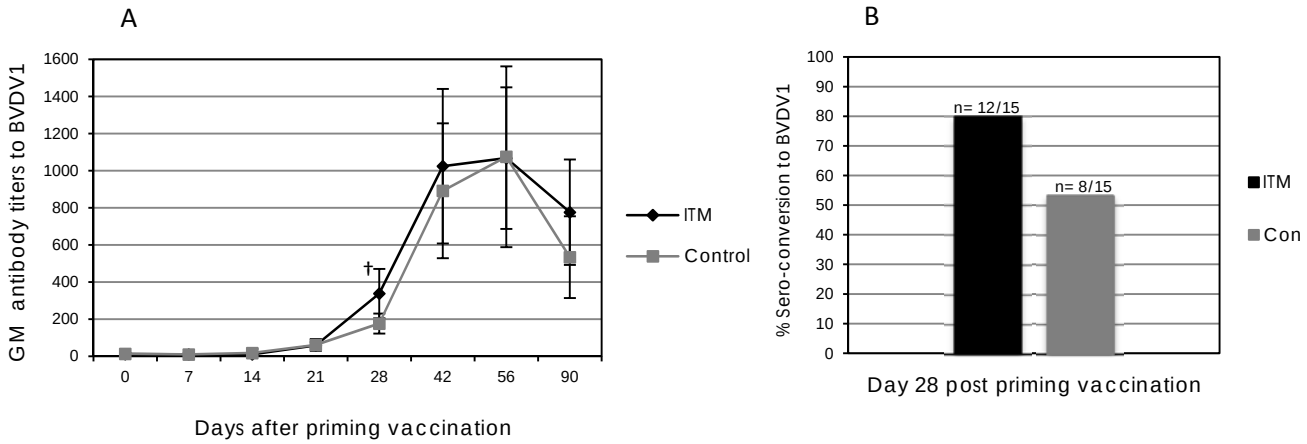

Figure 1. Geometric means serum neutralizing (SN) antibody titers to BVDV1 (A), and proportion of sero-conversion or ≥4-fold increase in SN antibody titer to BVDV1 on day 28 relative to the day of priming vaccination (B) in dairy calves that received injectable trace minerals (ITM) or saline (Control) concurrently with a MLV vaccine. †Significant differences between groups for each day (P = 0.03).

This quicker BVDV-specific antibody response elicited by an MLV vaccine delivered concurrently with ITM might be of significant value by conferring earlier protection following vaccination. This could be particularly important in newly received, highly stressed cattle that are at high risk of respiratory viral infections. A rapid increase in serum neutralizing antibodies against BVDV after vaccination may be beneficial to prevent infection and disease development.

The antibodies may neutralize extracellular virus particles, inhibiting attachment of the virus to host cells, and contribute to antibody dependent cell mediated cytotoxicity (Forthal, 2014). Similarly, previous reports have shown that ITM enhanced humoral immune response to pathogens of clinical significance in cattle production, including BVDV (Roberts et al., 2015), BHV-1 (Arthington and Havenga 2012), *E. coli* (Panousis et al., 2001) and *Pasteurella haemolytica* (Droke and Loerch, 1989). In the study performed by Arthington and Havenga (2012), administration of trace minerals concurrently with an MLV vaccine to steers induced a significant increase in BHV-1 serum neutralizing antibody titers on days 14, 30, and 60 post-vaccination compared to the base line titers on day 0 and to the titers in the saline injected steers.

Calves treated with ITM showed an earlier enhancement in mononuclear leukocyte proliferation to BVDV1 following vaccination compared to the control group

(peak of leukocyte proliferation occurred 14 days later). Proliferation of mononuclear leukocytes after BVDV stimulation tended to be higher on day 14 after priming vaccination in calves treated with ITM than in the control group (P = 0.08; Fig. 2A). Calves that received ITM showed higher mononuclear leukocyte proliferation to BRSV stimulation on day 7 after priming vaccination compared to the control group (P = 0.01; Fig. 2B). Moreover, calves in the ITM group also had an enhanced production IFN-γ by PBMC after stimulation with BRSV on day 21 after priming vaccination compared to day 0 (P < 0.01).

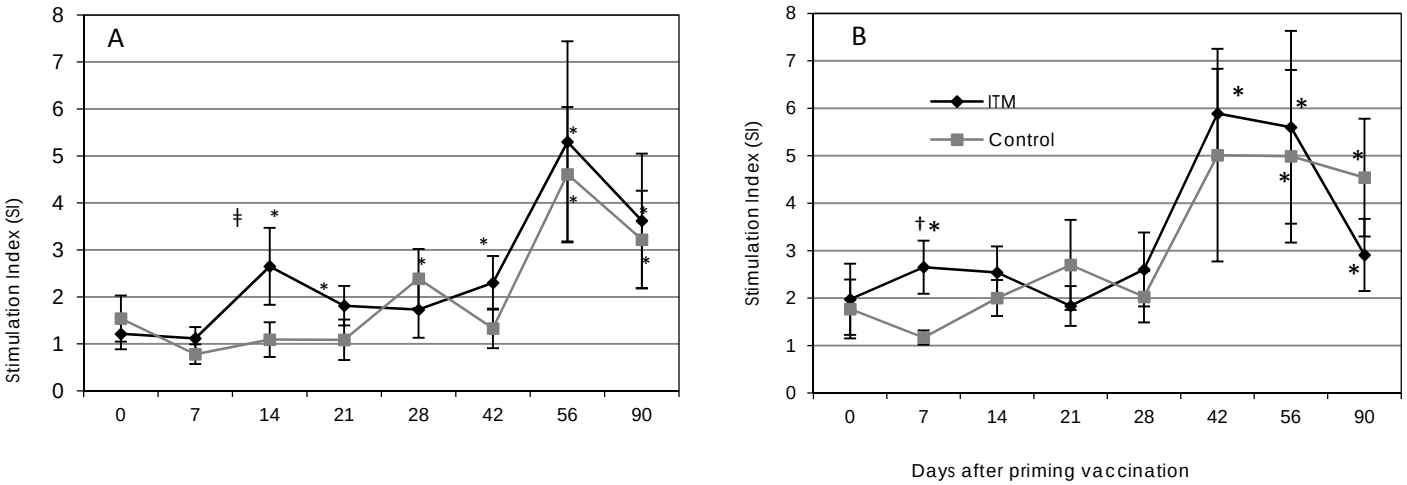

Figure 2. Peripheral blood mononuclear leukocyte proliferation (expressed as stimulation index; SI) in response to BVDV1 (A), and BRSV (B) in dairy calves injected with a trace mineral supplement (ITM) or saline (Control) concurrently with administration of a MLV vaccine. * Value differs significantly from the value on day 0 for each group (3A: P < 0.05; 3B: P < 0.01).‡Suggests a tendency of higher leukocyte proliferation compared to the control group (3A, P = 0.08). †Significant difference between groups (3B, P= 0.01).

In a subsequent study, 20 dairy calves belonging the previous trial (ITM, n=10; Control, n=10) were intranasally challenged with ncp BVDV-2 (5 mL containing 5 x 10^5 $CCID_{50}$) five months after vaccination and ITM treatment to evaluate the effect of ITM administered concurrently with a MLV vaccine on protection against acute BVDV-2 infection. Additionally, five BVDV-naïve dairy calves were also inoculated and served as positive control group. In that study, respiratory MLV vaccine (in both ITM and Control groups) conferred protection against acute BVDV infection, preventing moderate clinical disease, leukopenia, lymphopenia, and viremia. Further, ITM provided additional beneficial effects when administered concurrently with respiratory MLV vaccine: 1. ITM increased average daily gain during the 14 day post-challenge period. 2. Clinical scores were lower for ITM compared to saline-injected group on days 5 and 8 post challenge. 3. Administration of ITM prevented BVDV-induced thrombocytopenia compared to saline-injected calves and positive control group (unpublished data). A more recent study using 45 beef calves demonstrated that ITM administered with a MLV vaccine appeared to mitigate the decrease in $CD4^+$ and $CD8^+$ T cells associated with BVDV-2

acute infection in calves that were challenged five days after immunization (unpublished data), which supports our previous findings on increased mononuclear leukocyte proliferation (Palomares et al., 2016). It was concluded that ITM enhanced protection from BVDV-2 infection by MLV vaccine, helping to maintain adequate health and performance of growing calves.

Adequate supply of Zn, Cu, Se and Mn has been documented to be essential for cell signaling and cytokine production during lymphocyte activation (Puertollano et al., 2011; Spears, 2000). These trace minerals are fundamental elements in the structure and function of several metalloproteins that participate in general housekeeping processes involved in cellular clonal expansion including metabolic cascades for energy production, DNA replication and transcription, as well as protection against ROS (Failla, 2003). The enhancement of these general cellular functions might be contributing to the higher leukocyte proliferation response observed in the ITM group.

Trace minerals are crucial for the development of an adequate immune response in cattle, especially in stressed animals. Field and experimental studies focused on improving the trace mineral status of stressed feeder calves have shown positive effects of ITM improving feed efficiency, decreasing morbidity and treatment costs and improving performance and production traits (Arthington et al., 2014; Berry et al., 2000; Clark et al., 2006; Genther, and Hansen, 2014; Richeson et al., 2011). The results of the current study support our hypothesis, and recapitulate the findings of previous studies demonstrating the benefits of trace mineral supplementation on the immune response to MLV vaccines in cattle. This suggests that addition of ITM to calf management protocols might represent a promising tool to improve livestock health on commercial farms.

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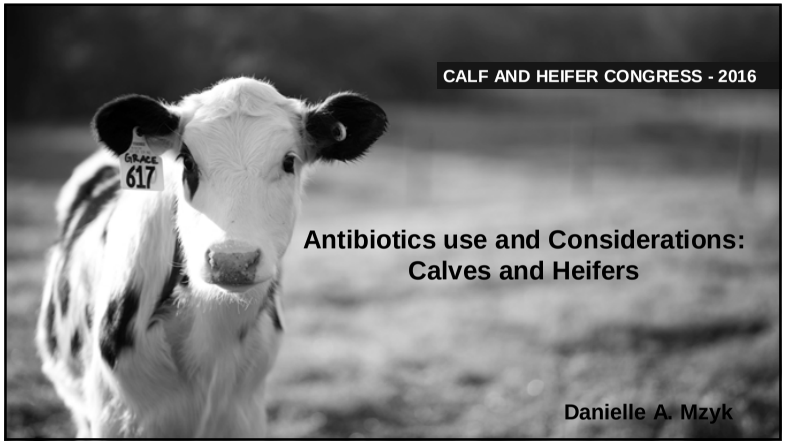

Today's Presentation

- **Classification of Calves**
  - Define 'Preruminant'
    - Veal vs preruminant vs ruminant calves
- **On Farm antibiotic use**
  - Preweaned heifers
  - Weaned heifers
- **Define Medicated Feed**
  - Medicated milk replacer
  - Use of Waste milk as feed
- **Antimicrobial Decision Making in Different Age Calves**
  - Tetracyclines
  - Cephlasporins
  - Fluoroquinolones
  - Macrolides
- **Veterinary Feed Directive**
  - Impacts on Calf Raisers

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CLASSIFICATION OF CALVES

VEAL CALVES

Bob Veal, Formula Fed

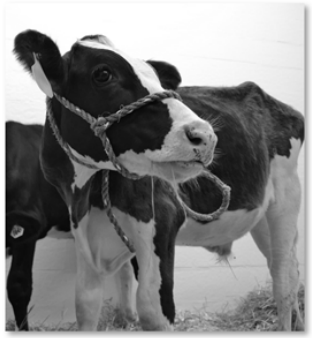
- Immature cattle (including dairy breeds) lacking a functional rumen and intended for meat production
- Recognized as a distinct regulatory class, due to proximity to slaughter, handling, housing

PRERUMINANT CALVES

Non-lactating dairy cattle, dairy calves, suckling calves

- Classes of dairy cattle have not yet, or would never produce, milk for human consumption
- Includes: replacement dairy heifers, replacement dairy bulls, and dairy calves
- Female or male dairy breed cattle being fed a ration that includes milk or liquid milk replacer and which are not intended for veal production

RUMINANT CALVES



- Functional rumen
- Not fed milk replacer
- Replacement heifers, steers

On farm antibiotic use

Preweaned Heifers	Weaned Heifers	Adult Cattle
• Diarrhea • Respiratory disease	• Respiratory disease • Ionophores	• Dry cow therapy • Mastitis • Lameness • Respiratory disease

NAHMS dairy – 2011

MOST COMMONLY USED – PREWEANED CALVES

Treatment of Diarrhea
- noncephalosporin beta-lactams, cephalosporins, "other" or unknown

Treatment of Respiratory Disease
- Macrolides, Florfenicol, Flouroquinolones

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ANTIBIOTICS AND SCOURS

- Previous studies - lack of efficacy data in decreasing incidence of scours
- Some drugs (neomycin) increase rates of diarrhea
- Recent studes showed increase in incidence (31%) of diarrhea in calves fed medicated milk replacer vs non medicated

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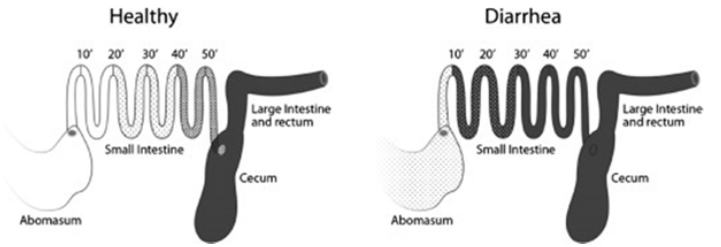

Adapted from Smith GW. Antimicrobial Decision Making for Enteric Diseases of Cattle. Vet Clin North America: Food Animal Practice. 31(1) 47-60

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NAHMS dairy – 2011

MOST COMMONLY USED – WEANED CALVES

Treatment of Diarrhea
- noncephalosporin beta-lactams, sulfonamides, florfenicol, "other" or unknown

Treatment of Respiratory Disease
- Macrolides, Florfenicol, Flouroquinolones

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Medicated Feed

- **Definition:** Any **feed** which contains drug ingredients intended or presented for the cure, mitigation, treatment, or prevention of disease of animals other than man or which contains drug ingredients intended to affect the structure or any function of the body of animals other than man
- **Definition of Feed:** Includes milk replacer and milk from cows

"Waste" Milk

Feed contaminant: means any biological, chemical (including radiological), or physical agent that if present in feed has the potential to cause illness or injury to animals or humans.

Waste Milk: Considered a 'Medicated feed'

- **Any extra label use of a medicated feed is illegal in major food producing species.**

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Why is Waste Milk an Issue?

- **Intramammary Antibiotics**
  - Bioavailability: extent and rate a drug is absorbed into systemic circulation
  - More bioavailable, more likely to enter circulation = higher likelihood for residues
  - Pasteurization does not change drug concentration significantly
- **Extra Label Drug Administration to Lactating Dairy Cattle**
  - Florfenicol
  - Tulathromycin

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Antimicrobial Decision Making in Different Age Calves

- **Diarrhea and respiratory disease is the leading cause of calf mortality**
- **Designing rational and efficacious protocols for both prevention and treatment common pathogens is critical**
- **Considerations of Age and Disease in determining which antimicrobial to use**

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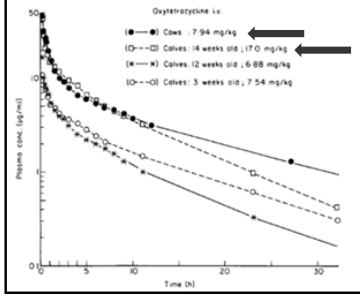
Tetracyclines

- **Age: Rate of drug elimination in young animals is much slower**
  - Combination of decreased clearance mechanisms and increased volumes of distributions



- Suggests in order to obtain equal pharmacokinetics in adult cattle and preruminant calves, the calves may require twice the dose of cattle of oxytetracycline IM or IV.
- This however, is just plasma concentrations – may be different from a tissue and residue avoidance point of view

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Cephalosporins

- **Prohibition of the extra label use of cephalosporins in major food-produ animals was enacted by the FDA in April 2012.**
  - One exception: drugs may be used for an extra label disease indication (something on the approved label), as long as the use of the drug adheres to a labeled dosage regimen (i.e., dose, route, frequency, and duration of administration) approved for tl particular species and production class.
- **Formulations are different in calves**
  - Pharmacokinetics of different formulations of cephalosporins in neonatal calves showed longer terminal half-lives in plasma as compared to adult cattle and these varied between formulations
    - Clearance of ceftiofur (sodium) in calves of different ages found that neonatal calves had a plasma elimination half-life of almost **3 times greater than that of older calves.**
    - Suggests that neonatal calves may need higher dosages to reach efficacious doses (however, this is illegal)

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Fluoroquinolones

- **The extra label use of fluoroquinolones in food-producing animals was prohibited by the FDA in 1997**
  - two approved fluoroquinolones approved for use in cattle including danofloxacin and enrofloxacin
  - Neither of these drugs are approved by the FDA for use in veal calves and are als prohibited from extra label use
- **Recent study on age impacts of distribution of danofloxacin**
  - Demonstrated similar PK parameters between 3 week old and 6 month old
  - Differences noted in distribution, but not plasma pharmacokinetics
- **LEGAL ISSUE**
  - **Enrofloxacin:** Allowed in young calves (and calves intended for dairy production)
  - **Danofloxacin**: NOT allowed in preruminant calves intended for dairy production (states on the label)

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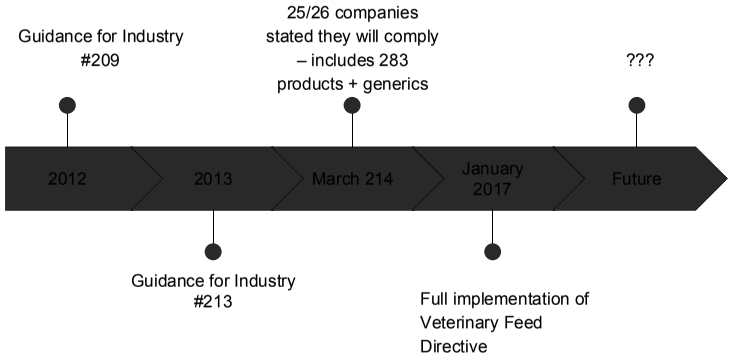

VFD for Calf Raisers

Veterinary Oversight	Drugs NOT under VFD	ELDU = Illegal
Requires veterinary authorization, VCPR for distribution, and use of VFD drugs in animal feed Medicated Milk Replacers – oxytetratcycline, neomycin	Coccidiostats in milk replacers (Monensin) – unless formulated with medically importnant antibiotics	Production purposes Must follow label – no changes in concentration/dose allowed

Next Steps to Prepare for VFD

- Valid Veterinary – Client –Patient Relationship
- Re-examine and establish protocols for use of medicated feeds
- Discuss needs with veterinarian and nutritionist

Concluding Comments

1. Antibiotic use plays an important role in dairy calf health and welfare
   - Age and disease need to be considered when choosing antibiotics for use in calves
2. Industry is progressing – waste milk/Medicated feed
3. Change is coming – Be prepared!

NC STATE
Veterinary Medicine
Population Health
and Pathobiology

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LifeStart: The Science Behind the Program

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Shur-Gain USA, a Nutreco Company

Michael E. Van Amburgh, PhD

Cornell University

LifeStart is an innovative calf nutrition program designed to bring science-based and sustainable practices to the dairy industry for the optimization of dairy performance. So, what is the science that initiated the concept and what are the expected outcomes?

In the pursuit of improved milk yield and production efficiencies, the question has long been asked, when can we best influence a cow's milk production? For years, the focus has been during the lactation itself, shifting over time to the importance of the transition period. More recently, the importance of early life development has come to the attention of researchers and producers alike.

A lactation begins at parturition, but before a lactation can begin, development of the mammary gland must occur, and this development begins far before the pregnancy that is the initial cause of the lactation. The development of the mammary gland is not the only factor affecting milk production; rather, feed efficiency and hormonal regulation among other metabolic influences also modulate milk production. Just as mammary gland development begins in early life, feed efficiency and hormonal regulation also are being programmed from as early as within the womb. As dairy producers, we have a window of opportunity to influence this early life development towards positive lifetime performance.

In a retrospective study that evaluated early life events on first lactation performance of over 1200 heifers, ADG pre-weaning revealed a strong positive correlation with milk yield in the order of 888 lb of milk for every additional 1 lb of Average Daily Gain (ADG) (Soberon, et al. 2013). The differences in ADG in this data set were mainly derived from changes in maintenance requirements due to weather changes during the pre-weaning period. Therefore, when analyzed by the correlation of energy intake available for growth, there was a positive significant correlation such that for every additional Mcal of energy intake above maintenance, heifers produced 518 lb more milk during first lactation. Results from this analysis revealed that the effects of early life management and nutrition accounted for 22% of the variation in milk production. This implies that early life nutrition was responsible for 4 to 8 times the effect on milk production that could be expected by genetic selection.

Studying the effects of liquid feed intake during the first 60 days of life revealed an allometric growth of the liver and the mammary gland, but especially of the mammary parenchymal tissue. At the time of weaning, the mammary parenchymal tissue weight of calves fed increased levels of milk replacer was 6 times greater than that of calves that were restricted in milk intake. This indicates a direct effect of nutrient intake with parenchymal proliferation in

the first months of life. This additional growth is only relevant if it turns into increased milk production later in life. Thus, a meta-analysis of all the available studies evaluating the effects of early life nutrition on first lactation milk yield was conducted. The meta-analysis resulted in an estimate that calves that received more nutrients pre-weaning produced on average 960 lb more milk during their first lactation. When pre-weaning ADG was included in the analysis, for every additional 1 lb of ADG pre-weaning, heifers produced 1,540.7 lb more milk in first lactation (Soberon and Van Amburgh, 2013).

The effect of early life nutrition on development is not unique to the dairy cow. The implications of early life nutrition have been described in bees, humans, dogs, sheep and swine among other species. In swine, Bartol et al. (2008) described the lactocrine effect, which refers to the transfer of bioactive ingredients from the sow's colostrum to the newborn piglet. The lactocrine hypothesis has been linked to the effects of relaxin from milk on the development of the uterus in the newborn sow (Bartol et al., 2008) as well as improved gastrointestinal development (Thivend et al., 1980), jejunal protein synthesis (Burrin et al., 1992; 1995) and skeletal muscle synthesis (Burrin et al., 1995).

In cattle, colostrum has been traditionally given to the calf for the transfer of IgG in order to aid the immature immune system. However, the benefits of feeding colostrum to young calves surpass that which can be attributed solely to IgG transfer. Positive long-term effects include increased average daily gain to 180 days (Robison et al., 1988), increased milk yield and fat production during first lactation (DeNise et al., 1989; Faber et al., 2005), reduced time to first calving (Waltner-Toews et al.,1986), increased average daily gain pre-weaning (Osorio and Drackley, 2005; Soberon and Van Amburgh, 2011), increased feed efficiency (Jones et al., 2004), and increased DMI post-weaning (Soberon and Van Amburgh, 2011). For example, Faber et al, (2005) used Brown Swiss cattle and offered different levels of colostrum during the first days of life, after which all calves were treated the same. Even though calves that received more colostrum had higher ADG early in life, by the time they calved, calving weights did not differ among treatments. Cows that received more colostrum at birth had a 12% increase in survival to the end of second lactation and they also produced 2,265 lb more milk during 2 lactations. These long-lasting effects are most likely not related to IgG but rather to the array of other growth factors and hormones present in great concentrations in bovine colostrum, such as IGF-I, EGF, lactoferrin, prolactin, insulin, leptin, relaxin, TGF α and TGF β. Current research is now trying to identify the effect of some of these other factors in the development of the calf.

LifeStart sets life performance, through colostrum administration and liquid feed supply during the first two months of life, so that the milk production potential of a calf can be increased by 2,000 to 3,000 lb of milk per lactation. However, to properly harvest these benefits, calves most be properly cared for during the rest of the rearing period. When a calf is receiving 8 to 12 liters of milk or milk replacer per day, the weaning process requires more attention. It is possible to properly develop the rumen of these young animals and ensure a proper transition but it is highly recommended to use a step-down method for 2 weeks (Khan et al., 2007; Miller-Cushon et al., 2013). Once the calves are weaned, it is important to provide a proper nutrition that would allow the calf to maintain protein synthesis. In a study designed to evaluate the interaction

between pre-weaning nutrition and post-weaning dietary protein levels, Moallem et al. (2010) observed that the gains achieved through proper nutrition pre-weaning could be lost if proper levels of protein were not offered pre-breeding. In his study, calves offered whole milk pre-weaning produced more fat corrected milk than calves fed a low protein milk replacer; however, the calves that were supplemented with an additional 2% of protein from 150 to 350 days produced 4.4 lb/d more fat corrected milk than the calves that had been fed the same whole milk but were not supplemented with protein pre-puberty. This study supports the theory that gains can only be achieved at certain developmental stages, but these gains can be lost later in life through improper environmental conditions including nutrition.

Calves raised under this management model will achieve proper breeding weights and heights earlier. It is important to recognize that the proper time to breed a dairy heifer for the first time is when she reaches 55% of her mature body weight and it is not directly correlated to her age. The optimum age at first calving for Fresian-Holsteins when grown under this program is between 21 and 23 months; smaller breeds can successfully calve by 19 months. This was confirmed by analyzing first lactation production of over 10,500 heifers in New York State. Age at first calving ranged from 19 months to 33 months. The analysis revealed that for every month that heifers calved after 23 months, they produced 604 lb. less milk during their first lactation.

Biology and epigenetics are not the only factors that have to be considered when determining the best rearing system for dairy calves. Economics and welfare are another two important considerations in the decision. Dr. Michael Overton from the University of Georgia made an economic comparison of a traditional rearing system to a LifeStart approved system. Dr. Overton used USA values including interest rates, milk price, veterinary costs, and cull values but his equations can be extrapolated to dairies in any country. In his analysis, calves reared under an intensive rearing system cost more per day to feed than traditional calves. However, given that these calves calved 3 months earlier, the total cost of raising calves under a full potential program was the same as the cost of raising heifers under a traditional system. This was before accounting for the additional milk produced by the intensified calves. When the additional milk is considered, the cost of raising calves under an intensified or full potential program is 10% less than the cost of raising them under a traditional system.

In conclusion, the first hours and weeks of a calf's life are a prime time to influence life-time performance. Colostrum is an important source of IgG that provides the calf with much-needed passive immunity, but beyond that, colostrum contains many growth factors that are beneficial for the life performance of calves. Nutrient intake from milk or milk replacer have a positive influence on milk yield later in life. There is no compensatory mechanisms for these effects; if the window of opportunity is missed, the chances to optimize her performance are gone.

Remember: The most effective way to properly influence the future performance of a calf is to: **1. – Colostrum**, 3 L at birth, 2 L 6 hours later and an additional 2 L 12 h from birth. **2. – Calories**, provide sufficient, good quality milk or milk replacer so calves can at minimum double their birth weight by 56 days. After weaning, properly balanced diets should allowed breeding calves at 13 to 14 months of age once they have reached 55% of their mature body weight to

achieve an age at first calving between 21 and 23 months.**3. – Consistency,** deliver milk or milk replacer that is completely mix at the same percentage of solids every time, at the right temperature, 3 times a day. **4. – Comfort**, provide the calves with sufficient space and bedding so she grows in a well ventilated, dry environment, during winter she needs to be able to nest in the bedding to keep warm. **5. – Cleanliness**, the best colostrum and facilities would be compromised if the calf, the feeding equipment, the facilities are not properly and consistently cleaned to reduce the calves' exposure to pathogens. Cleanliness begins with the calving pen and the mothers' udder before collecting colostrum but it is required throughout her life.

Weaning and Post-weaning Management of Calves and Heifers for Optimizing Long-term Productivity

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Overview of today's discussion

- Introduction
- Focus on weaning and starter intake and composition
- Nutrition formulation and benchmarking related to stage of growth and mature size – still a big problem
- Summary

Herd Replacement Objectives

- Focus on return on investment – over their productive life
- Minimize non-completion (animals that are born and either never milk or finish a lactation)
- Optimize the productivity of the animal (manage them for their genetic potential starting at birth)

Snapshot Evaluation of the Potential Quality of The Replacement

- 1st Calf Heifers "Treated" as Calf/Heifer* ≤30%
  24 hrs. → 3 mos. ____, 4 mos. → fresh ____
- DOAs in first calf heifers ≤7%
  Male DOAs. ____, Female DOAs ____
- 1st Calf avg. peak ≥80% of Mature
  1st Calf lactation total yield ≥80% of Mature
- 1st Calf Culls ≤ 60 Days in Milk ≤5%
- 1st Calf ME's ≥Mature
- 1st Calf "Treated" in Lactation* ≤15%
- 85% retention (any herd) to 2nd lactation ≥85%
- Lower #1 reason for 1st lact. culls(continuous improvement)

Weaning and Dry Matter Intake of Starter

- Behavior is most likely the primary factor affecting a majority of the studies that have evaluated calf starter intake and preferences.
- A calf under natural conditions would learn to consume feed from the dam and be encouraged and taught to do so as it developed and became physiologically ready for that type of diet.
- Several studies have been conducted on feeding behavior of grazing animals and it is clear that the dam teaches the calf what to eat and how to eat under those management conditions (Howery, L. D., et al. 1998; Provenza, 2005).
- Under most of the conditions we offer calves starter grain, there are barriers to learning that affect the how the calf views and accepts the starter grain as a food source.

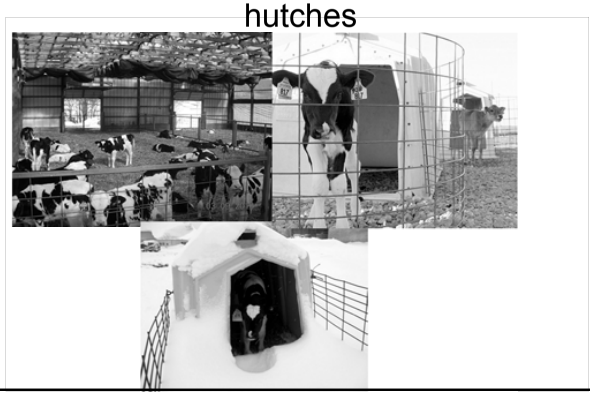
Weaning and Dry Matter Intake of Starter

- Our way of managing that learning has been to limit the nutrients from milk or milk replacer in an effort to enhance hunger so they are encouraged to consume nutrients from other sources.
- Having calves of somewhat varying ages in group housed conditions helps with the learning process because the older calves provide lessons in eating behavior for the calves not yet experienced enough to understand where and what the starter grain might be.
- Creating an environment that allows calves to teach each other about starter grain intake is essential to enhance nutrient delivery and weaning efficiency in dairy calves and help avoid any post-weaning energy balance problems.

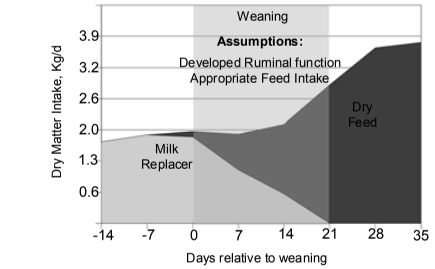
Weaning and Dry Matter Intake of Starter

- Adding flavors and odors to starter grain helps this process, especially for calves fed grain in situations where they receive no visual feedback about what other calves are doing.
- Making sure all nutrient requirements are met by the starter is also important – industry not willing to pay for that yet
- Other options are enzymes that enhance digestibility and reduce digestive stress

Group behavior vs isolated hutches



Starter Intake, Nutrient Balance and Weaning Efficiency



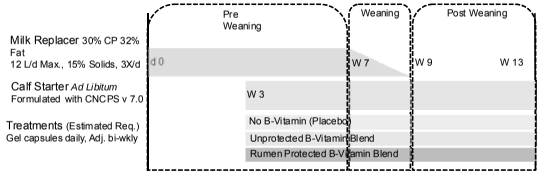
Adapted from Smith and Van Amburgh, 2000

Rodrigo's calf starter			
Pellet ingredients	**Amount, kg**	**% of DM**	**DM kg**
Wheat midds	0.6	0.199	397.09
Soyplus	0.6	0.199	397.09
Canola meal	0.2	0.066	132.36
Sugar	0.1	0.033	66.18
Dried whey	0.18	0.060	119.13
Blood meal	0.12	0.040	79.42
Metasmart dry	0.022	0.007	14.56
Minerals	0.02	0.007	13.24
Vitamins ADE	0.01	0.003	6.62
Rumensin premix	0.01	0.003	6.62
Flavor enhancer	0.01	0.003	6.62
Molasses	0.1	0.033	66.18
Fat	0.02	0.007	13.24
Yeast cell wall	0.02	0.007	13.24
External ingredients			
Beet pulp shreds	0.4	0.132	264.73
Flaked corn	0.61	0.202	403.71

Starter Nutrient Content

	% Dry Matter
CP	24.8
Sol CP	6.2 (24.9)
aNDFom	21.0
ADF	10.0
Starch	21.2
Sugar	14.9
Soluble fiber	4.9
Ether extract	4.4
ME allowable gain, kg/d	1.16
MP allowable gain, kg/d	1.13

Experimental Periods



Results

	RPBV	UPBV	CTRL
Pre-weaning			
(Wk 7) Wt, kg	84.57	83.55	85.94
ADG, kg/d	0.89	0.86	0.9
MR intake, kg/d	1.22	1.2	1.24
Grain Intake, kg/d	0.06	0.06	0.07
DMI, Kg/d	1.28	1.26	1.32
Feed Efficiency*	0.67	0.65	0.68
Weaning			
(Wk 9) Wt, kg	95.6	94.59	96.8
ADG, kg/d	0.79	0.79	0.78
MR intake, kg/d	0.8	0.84	0.82
Grain Intake, kg/d	0.73	0.65	0.77
DMI, kg/d	1.54	1.5	1.59
Feed Efficiency*	0.51	0.52	0.47

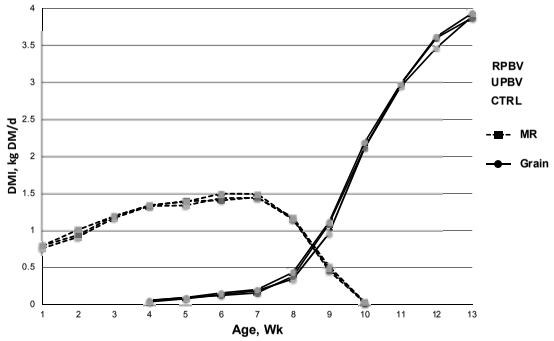
*Kg ADG/Kg DMI

Results

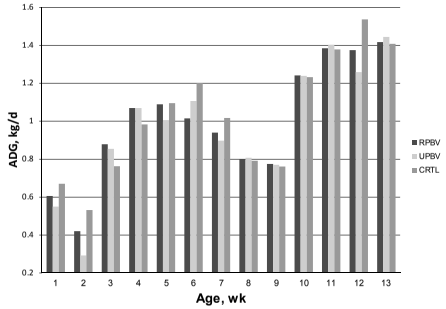
	RPBV	UPBV	CTRL
Post-weaning			
(Wk 13) wt, Kg	133.51	131.99	135.61
ADG, kg/d	1.35	1.33	1.40
Grain Intake, kg/d	3.15	3.1	3.18
Feed Efficiency*	0.43	0.43	0.44
Overall			
ADG, kg/d	1	0.98	1.02
DMI, kg/d	1.89	1.87	1.94
Feed Efficiency*	0.53	0.52	0.53

*Kg ADG/Kg DMI

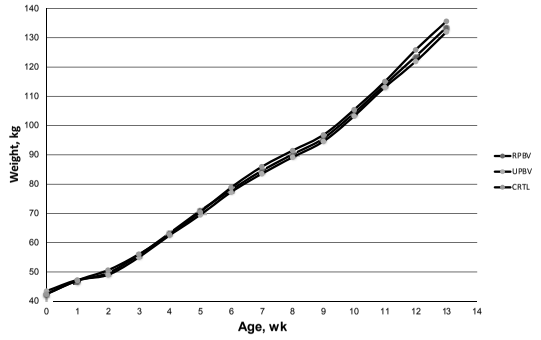
Results
Dry Matter Intake



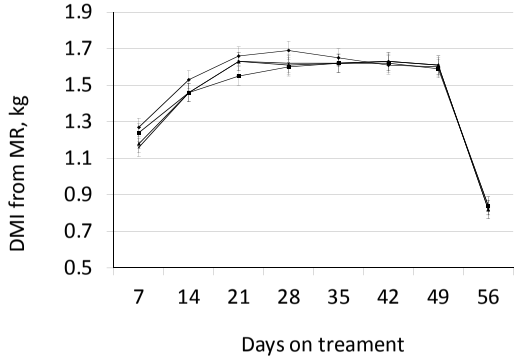
Results
ADG



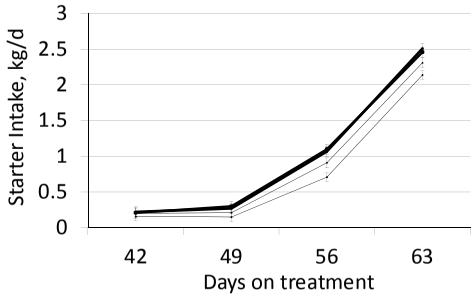
Results
Body weight



Milk replacer intake per day

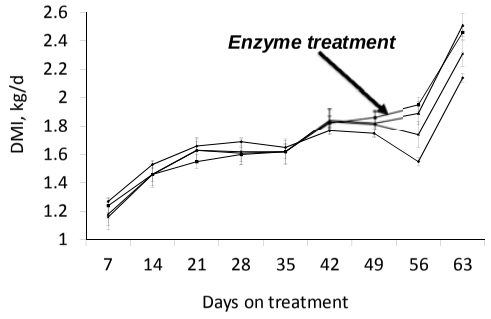


Starter intake – using an β-mannase enzyme for the starter

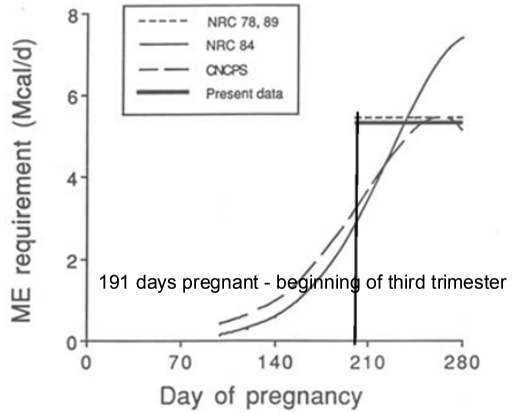


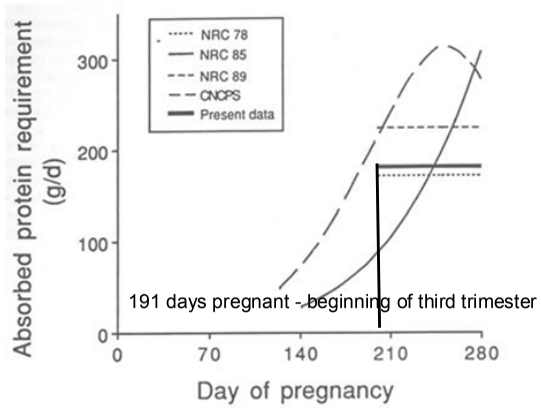
Effect of days on treatment and treatment on DMI from starter for calves fed either whey protein based MR or soy protein based MR with or without added enzymes for 9 weeks. Treatment A (all whey protein MR, ♦), treatment B (soy protein based MR, enzyme A added, ■), treatment C (▲soy protein based MR, enzyme B added), treatment D (×, soy protein based MR, no enzyme, salt added).

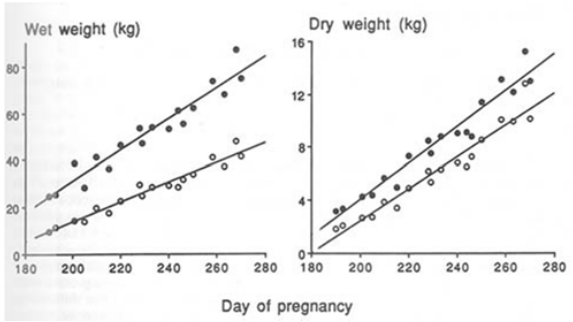
Total dry matter intake from milk replacer and starter



Fetal growth rate and requirements and mammogenesis







Fetal growth in multiparous Holstein cows (Bell et al., 1995)

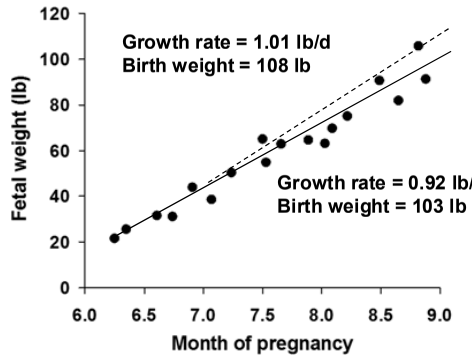


Table 1. Total uterine and fetal rates of wet and dry growth, and accretion of chemical constituents during late pregnancy*

Constituent	Total Uterus	Fetus
Tissue weight (g/d)		
Wet	664	418
Dry	138	121
Energy (kcal/d)	691	605
Crude protein (g/d)	90	74
Fat (g/d)	13	12
Ash (g/d)	23	22
Macrominerals (g/d)		
Ca	5.6	2.2-9.3
P	3.7	1.5-6.3
Mg	0.18	0.15
Na	1.3	0.83
K	1.0	0.83
Trace elements (mg/d)		
Fe	18	17
Zn	12	10
Cu	1.6	1.4
Mn	0.30	0.28

*Estimated from regressions of weight or energy content on day of pregnancy (see text).

Requirements of ME and MP for pregnancy

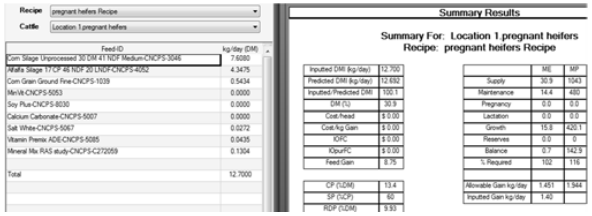
- Calculated based upon expected birth weight of calf and day of gestation
- Become meaningful beginning on day 191 of pregnancy
- Efficiency of ME use for pregnancy is 14%
- Efficiency of MP use for pregnancy is 33%

Mammogenesis

- Based upon Bell et al. (2000) and VandeHaar and Donkin (1999)
- “Switch” is turned on from 259 days of pregnancy until 21 days of lactation
- Assumes 80 grams of NP deposition in mammary gland and efficiency of use of 29%
- ME requirements calculated based upon requirements to support 80 g/d of protein deposition
- Result for MP is additional requirement of 277 g/d

Pregnant heifers – 1,212 lb, 1,770 lb mature BW

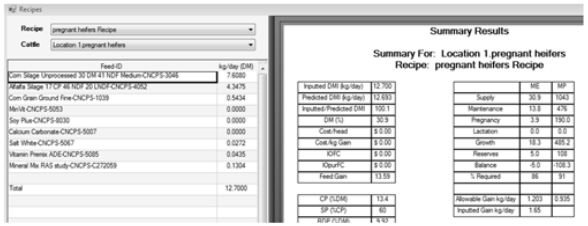
180 days pregnant – at the end of the 2nd trimester



Target gain: 3.15 lb/d
ME allowable: 3.2 lb/d
MP allowable: 4.3 lb/d

Pregnant heifers – 1,278 lb; 1,770 lb mature BW

200 days pregnant – into the 3rd trimester



Target gain: 3.63 lb/d
ME allowable: 2.65 lb/d
MP allowable: 2.06 lb/d

The Need and Importance for Monitoring
Body Weight Gain
and Age at First Calving and Productivity

Growth Benchmarks to Optimize First and Subsequent Lactation Milk Yield

Birth to weaning: double body weight

Puberty: 45% mature weight

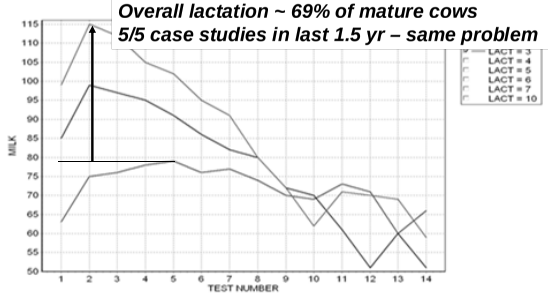
Breeding and Pregnancy: 55-60% mature weight

First lact. post-calving BW: 82 to 85% mature weight
Goal is to achieve 82% of mature size to achieve 80% of mature cow milk yield

Mature weight determined at middle of 3rd and 4th lactation – 80 to 200 days in milk on healthy cows, not cull cows

PLOT MILK BY LACT

Peak ~ 69% mature cows
Overall lactation ~ 69% of mature cows
5/5 case studies in last 1.5 yr – same problem



Discussion Group Heifer Project

Question from group: How do we optimize first lactation milk yield and the quality of the heifer as she arrives at lactation?

Herd	% Mature Peak
1	68
2	85
3	75
4	82
5	79
6	79
7	76
8	77
9	70
10	76
11	75
12	72

Location

- **Pen study ---16 cows in 12 pens (192 total)**
  - **Random allocation of cow to pen, pen to diet**
  - **12 multiparous, 4 primiparous animals per pen**

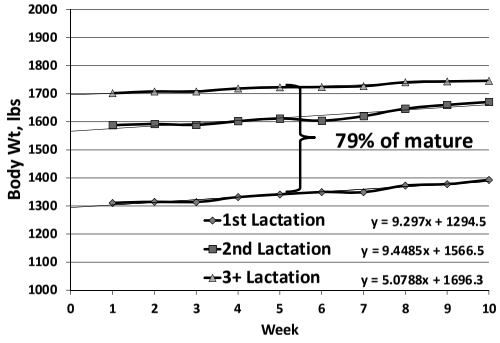
Photo: S. Fessenden

Body weight and BCS

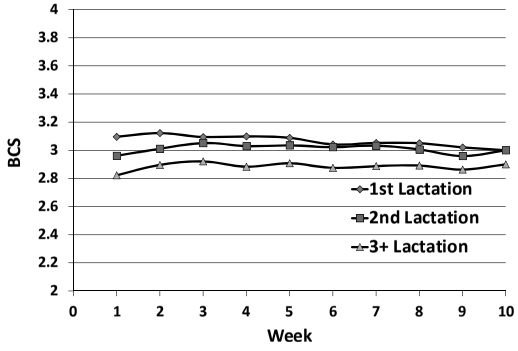
Item	Mean	Range
Lactation	2.4	1-6
DIM at trial start	115	50-180
Mature weight, lbs	1710	1350-2200
2+ lactation		
Body weight, lbs	1675	1320-2200
BCS	2.95	2.2-3.6
1st lactation		
Body weight, lbs	1350	1050-1575
BCS	3.1	2.87-3.5

Cattle characterization

Body weight by week



BCS by week



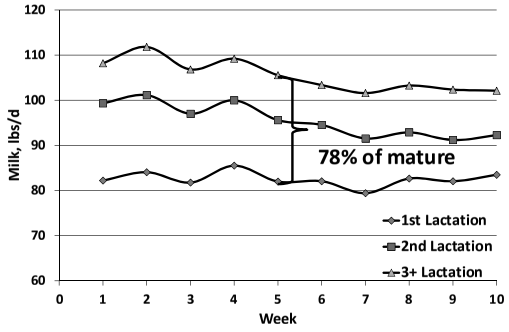
Cattle inputs

	1st Lactation	Mature Cows	All cows
Recipe	Diet B	Diet B	Diet B
Animal Type	Lactating Dairy Cow	Lactating Dairy Cow	Lactating Dairy Cow
Number of Animals	64	64	64
Days In Cycle	365	365	365
Age (months)	27.00	53.00	40.00
Days Pregnant	60	60	60
Days Since Calving	150	150	150
Calving Interval	13.00	13.00	13.00
Lactation Number	1	3	2
Calf Birth Weight (lbs)	93	93	93
Age of First Calving (months)	22.00	22.00	22.00
Milk Production (lbs/day)	**83.0**	**105.0**	**98.0**
Milk Fat	**3.75**	**3.72**	**3.73**
Milk True Protein	**3.16**	**3.17**	**3.17**
Milk Crude Protein	3.40	3.41	3.41
Milk Lactose	4.78	4.78	4.78
BCS (1-5)	3.00	2.90	2.90
Target BCS (1-5)	3.00	3.00	3.00
Days To Reach Target BCS	100	100	100
Scale Weight?	True	True	True
How To Compute Gain?	Use Target SWG	Use Target SWG	Use Target SWG
Mean FBW (lbs)	**1,350.000**	**1,710.000**	**1,610.000**
Mature FBW (lbs)	1,710	1,710	1,710
ADG (lbs/day)	0.882	0.000	0.125

Milk production

Item	Predicted	Observed
DMI, lb/d	60.5	62.4
ECM, lb/d		99.8
ME predicted milk	110.4	
MP predicted milk	100.1	
Milk fat, %		3.73
Milk fat, lb/d		3.61
Milk protein, %		3.17
Milk protein, lb/d		3.04
MUN, mg/dL		6.7

Milk production



Target weights

		Mature weight, lb		
		900	1,300	1,760
	% mature wt.	Target weight, lb		
pregnancy	55%	495	715	968
1st lact. fresh	82%	765	1,105	1,496
2nd lact. fresh	92%	828	1,196	1,619
3rd lact. fresh	96%	864	1,248	1,690

Input AFC – sets breeding age for you and breeding weight is a function of the mature size. Requirements are then calculated to meet the targets.

How Early Should Heifers Calve to Optimize Lifetime Productivity?

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

- Lactation records from
  - 2,519,232 first lactation cows
  - 937 herds in the Northeast and California
- Within herd analysis
  - Accounts for management, environment, and genetic differences among farms

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

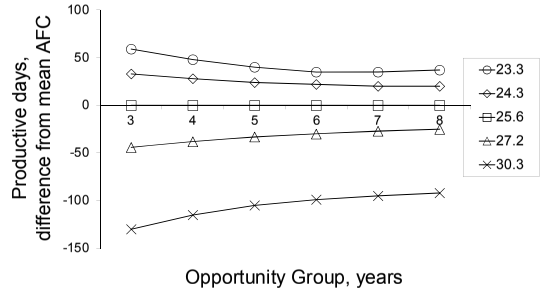
- Retrospective assignment to AFC treatment groups
  - Herd avg. AFC was calculated each year
  - Heifers were assigned to one of 5 AFC age groups:
    1) Less than -63 days from herd avg. AFC
    2) -22 to -63 days from herd avg. AFC
    3) -21 to 21 days from herd avg. AFC
    4) 22 to 63 days from herd avg. AFC
    5) Greater than 63 days from herd avg. AFC

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

- Retrospective assignment to AFC treatment groups
  - Herd avg. AFC was calculated each year
  - Heifers were assigned to one of 5 AFC age groups:
    1) 23.3 months AFC
    2) 24.3 months AFC
    3) 25.6 months AFC
    4) 27.2 months AFC
    5) 30.3 months AFC

Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 1. Average number of productive days, difference from study herd mean AFC (25.6 month)

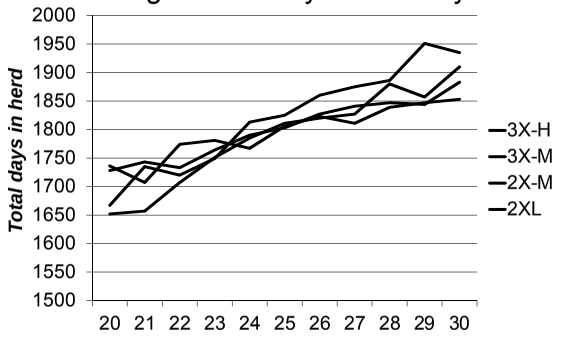


Within Herd Analysis of AFC on Productive Days, Milk Yield, Longevity

Figure 2. Average total milk production, lbs, difference from herd mean AFC (25.6 month)

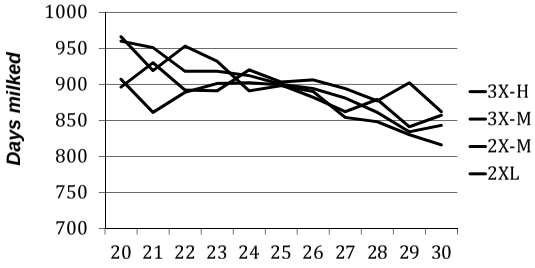
Opportunity Group, years

Exit age (total days) by AFC and 2x or 3x milking stratified by herd milk yield



Age at calving (mo) Curran et al., 2013

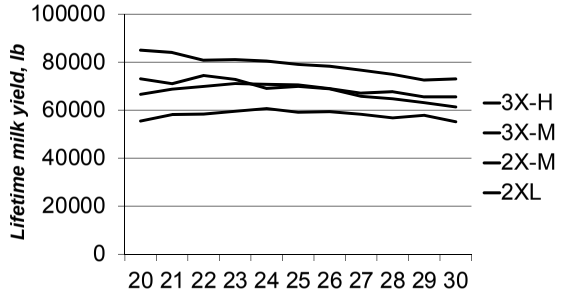
Herd life (days milked) by AFC and 2x or 3x milking stratified by herd milk yield



Age at calving (mo)

Curran et al., 2013

Lifetime milk (lb) by AFC and 2x or 3x milking stratified by herd milk yield



Age at calving (mo)

Curran et al., 2013

Evaluation of Heifer Replacement Costs by Survivability at Age at First Calving

AFC	# into herd	Animals culled Before Lactation Completion		Heifer Raising Cost	Actual Milk Production	Cost in Lactation 1	Milk Receipts	TOTAL Net Margin$_1$	Net Margin Per Heifer Completing
mo		≤ 60DIM	mid-lact	$	pounds	$	$	$	$
20	0	0	0	1,822	20,437	2,029	4,224	0	0
21	13	0	2	1,913	21,293	2,114	4,401	5,132	467
22	159	5	21	2,004	23,474	2,330	4,852	71,267	536
23	256	13	32	2,095	21,468	2,131	4,438	28,177	134
24	148	6	11	2,186	22,094	2,193	4,567	14,742	113
25	64	1	6	2,277	23,309	2,314	4,818	12,492	219
26	58	1	2	2,368	22,431	2,226	4,636	216	4
27	25	0	0	2,459	22,825	2,266	4,718	170	7

Summary

- Productive days and milk is greater for heifers with lower AFC
- Economic analysis indicates that lower AFC is more advantageous
- Lower AFC requires fewer replacements per year to maintain herd size and this inventory reduction has significant financial implications

Thank you for your attention.

Rescuing Calves from Poor Sanitation: Biofilm Basics

Calf and Heifer Congress, 2016

Where are We Going?

- Consequences of biofilms (poor sanitation)
- What are they?
- How do they develop or grow?
- How do we identify them?
- How does good sanitation slow their growth?
- How do we remove them?
- How do we monitor sanitation protocol compliance?

Neglected Hygiene = Biofilms

- **Biofilms = bacterial contamination of colostrum and milk**
- **Biofilms = elevated scours treatment rates**
- **Biofilms = extended treatment days for scours**
- **Biofilms = higher risk of pneumonia due to immunosuppression related to diarrhea**

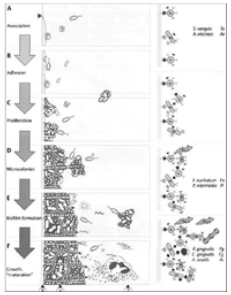
Is This Your Image of "Biofilm?"

Or, How about this? Can you think of other examples? (water trough, rumen particles, creek)

Phases of Biofilm Formation

1. **Asssociation** (weak bonds to surface, invisible)
2. **Adhesion** (bonding is stronger, invisible)
3. **Proliferation** (strong bonds, can see or feel if accompanied by mineral deposits)
4. **Microcolonies** (beginning to form a matrix, quorum signalling)
5. **Biofilm formation** (extracellular polymeric substance – may feel like "goo" or "slime")
6. **Growth "Maturation"** (shedding common)

Let's look at a growth diagram



Factors that favor biofilm formation

Organic material essential for:

1. Bacterial exposure
2. Nutrient availability
3. Water

Longer contact times favor formation.

Any practice that creates "sticky" proteins – like excessively hot rinse water denaturing whey proteins

The dairy needs a manual washing protocol

1. Protocol based on milk chemistry
2. KISS – keep protocol simple
3. Must be possible – hot water, sink, chemicals, equipment, some way to air dry equipment

WASHING MILK CONTAINERS

1. RINSE
Use lukewarm water. DO NOT rinse with hot water. Rinse off dirt and milk residue.

2.WASH
Use hot water. Add liquid detergent and bleach or a dry chlorinated detergent. Brush all surfaces. Scrub off remaining milk residue. Keep water above 120° (49C) at all times.

3.RINSE
Use warm water. Add acid. Rinse containers. Do not rinse off the acid solution. Leave it on the bottles and pails while they dry. [May use an acid-sanitizer, also.]

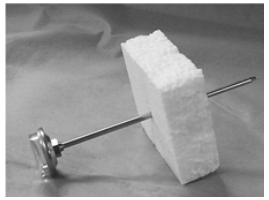
4.DRY
Allow the bottles and pails to drain and dry. Do not stack pails inside each other. Do not sit pails upside down on a concrete floor.

RINSE

1. Carry away nutrients needed for biofilm growth.
2. Carry away bacteria needed for biofilm growth.
3. High temperatures may denature whey proteins [70°C/158°F].
4. Denaturing whey proteins increases strength of bonds in "Association" phase in biofilm development

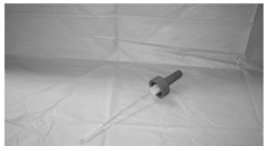
Monitor wash temperature
Never below 49°C (120°F)

Simple technology



High tech – battery required

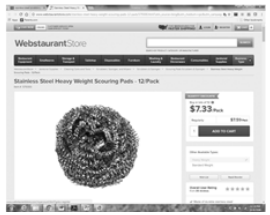
BRUSH, BRUSH, BRUSH
Capitalize on weak bonds early in "Association" & "Adhesion" phases



These will remove biofilm but can create deep scratches!

Light application of these may help but require frequent cleaning

These are a disaster for plastic – deep, deep scratches!



Plan to Observe

Try reviewing the eleven-point checklist

Monitoring Sanitation Procedures
A Checklist

Have you selected the most appropriate measures for monitoring sanitation procedures? Do these measures provide feedback for employees? Do these measures provide information for regular protocol evaluation and revision?

Let's consider how you monitor sanitation procedures. Compare your actions with the standards in this checklist. When the items below refer to "I," this is equivalent to an experienced supervisor. When making this evaluation, I like to use these scores: 1=never, 2=seldom, 3=often, 4=usually, and 5=almost always.

____ 1. **Before** I observe actual employee behavior, I go to the work site and determine that it is possible to perform the task correctly in that setting and with the tools and materials available.

____ 2. I observe actual employee behavior. (This is in contrast to just talking about doing the job.)

____ 3. I compare observed behavior to the training standards (these may be incorporated in the protocol). For example, maintains wash solution above 120°F.

____ 4. When I see the employee not following the protocol, I review these deviations privately with the employee. (This is in contrast to "chewing out" the employee in front of her/his peers.)

____ 5. When I see the employee not following the protocol, I provide a training opportunity for the employee.

Where have we been?

- Consequences of biofilms – **for us, negative.**
- What are they? **Layers on layers.**
- How do they develop or grow? **Accumulation.**
- How do we identify them? **Look and touch.**
- How does good hygiene slow their growth? **Promptly eliminate bacteria and nutrients.**
- How do we remove them? **Elbow grease.**
- How do we monitor hygiene protocol compliance? **Watch, watch, watch.**

Dr. Sam Leadley
Attica Veterinary Associates, P.C.

- Specializing in dairy calf rearing since 1988
- **Calves with Sam** blog at dairycalfcare.blogspot.com
- Monthly calf management letter for calf rearers via Internet. Send e-mail with subscribe in subject to calvingease@rochester.rr.com
- Websites are **calffacts.com** & **atticacows.com**
- E-mail: smleadley@yahoo.com
- Text 585-356-0769

Monitoring Sanitation Procedures
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_____ 6. When task performance results in an objective measurable outcome, I provide resources for collecting information to provide employee feedback. For example, I provide the equipment to collect rinse samples from clean tube feeders that can be cultured to show the feeders were cleaned properly.

_____ 7. Employee feedback is related directly to the protocol. For example, if the employee allows the wash water to fall below 120°F, I go back to the wash protocol to emphasize washing equipment in the proper temperature water.

_____ 8. Employee feedback is given in straightforward, understandable terms. For example, I show the employee how to use a rapid read thermometer to monitor wash water temperature.

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_____ 9. I actively solicit employee reactions to their evaluations, using this information to revise protocols when needed. For example, if the employee tells me that stacking pails upside down takes less time than using racks we consider changing the protocol.

_____ 10. Where outcomes are the result of more than one employee's work, I involve all employees in evaluation, retraining and/or protocol revision. For example, when employees on two different shifts are responsible for cleaning equipment the workers from both shifts are included.

_____ 11. I communicate with employees (evaluation, feedback, and training) in a language they understand.

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WASHING MILK CONTAINERS

1. RINSE

Use lukewarm water. DO NOT rinse with hot water. Rinse off dirt and milk residue.

2.WASH

Use hot water. Add liquid detergent and bleach or a dry chlorinated detergent. Brush all surfaces. Scrub off remaining milk residue. Keep water above 120° (49C) at all times.

3.RINSE

Use warm water. Add acid. Rinse containers. Do not rinse off the acid solution. Leave it on the bottles and pails while they dry. [May use an acid-sanitizer, also.]

4.DRY

Allow the bottles and pails to drain and dry. Do not stack pails inside each other. Do not sit pails upside down on a concrete floor.

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Auto Feeder Key Points for Success

Sue Puffenbarger
National Account Manager
Land O'Lakes Animal Milk Products
smpuffenbarger@landolakes.com

As more and more farms look for ways to manage with reduced labor and at the same time improve calf and heifer gains, auto feeders are gaining significant ground. In addition to shifting labor resources from being 'housekeepers' to 'calf managers' we are seeing a significant improvement in the nutrition being offered to young animals.

There are some challenges though. Unfortunately, it is not as easy as putting a unit in and 'visiting' the calves once a day. Miracles also don't happen by using large quantities of a good milk replacer or pasteurized milk product. Our biggest hurdle is still cleanliness and maintenance with these units.

The below set of guidelines are what I consider 'must do' to maximize your rate of gain and maintain health in calves fed with an auto feeder. These guidelines are geared toward the Forster Technic units, but can be extrapolated to a variety of systems. The basic principles are the same.

Auto Feeder Tasks

Sue Puffenbarger
Land O'Lakes Animal Milk Products
smpuffenbarger@landolakes.com

Use a detergent that is made for low temperature cleaning.

DAILY:

1. Replace and clean nipples with soap/water and a nipple brush.
2. Using a brush, clean entire nipple unit including drain area.
3. Using a brush, clean out mixer. Make sure the sensor in the mixer is clean.
4. Make sure milk replacer hopper outlet is clean. If there is residue: unscrew the black knob, pull the metal lip off and clean with a brush, soap, and water. Dry the metal piece completely, then reinstall.
5. Make sure water outlet is clean and free from residue.
6. Do a circuit cleaning.
7. Do a sponge cleaning.

WEEKLY:

1. Replace and discard hoses from unit to nipples.

QUARTERLY or when new pallet of milk replacer arrives:

1. Calibrate.

SEMI-ANNUALLY:

2. Replace drain hose that comes out of the mixer.

STANDARD SETTINGS:

1. Feed temperature for mixing: 42°C
2. Mixer cleaning: 3 to 4 times per day (make sure this doesn't occur during peak feeding times)
3. Mixer emptying: 5 minutes
4. Mixer off delay: 6 seconds
5. Draining time, feed station: 60 seconds
6. Cleaning temperature: Set to product recommendations.

5 Tips for Inspiring Your Team

Moderator

Laura Daniels, Heartwood Farm & Dairy Girl Network, Cobb, WI

lauradaniels@uwalumni.com

Laura is in charge of the day-to-day operation of the 300 Jersey cow farm that she and her husband Jarred own together. Laura also does consulting on team building and employee motivation for Star Blends Feed. She recently founded the Dairy Girl Network, and also hits the road to deliver pro-ag and motivational speeches across the country, inspiring many to find their passion, build their skills and have confidence to tell their story.

Panelists

Meghan Hauser – Table Rock Farm, Castile, NY

meghan@insitearch.com

Meghan works with her family and 30 full and part time employees to operate this 4th generation, 1,100 cow dairy. Meghan shares general management responsibilities of the farm with her dad and has a special focus on employee development and community outreach. Calves are raised in hutches on pasteurized milk and have been managed by Suzanne De Groff for 31 years.

Paul Molesky – Allenwaite Farm, Schaghticoke, NY

pmolesky18@gmail.com

Paul has worked as herd manager at Allenwaite Farm for nearly 6 years. His experience in LEAD NY helped bring about a shift in his perspective and focus of farm management from managing cows to leading people. Paul oversees around 20 employees, local and Hispanic. They milk 2,300 cows on two sites, in a rotary parlor and a double 13. Calves are raised on auto feeders and in hutches and are fed pasteurized milk and replacer.

Paul Tillotson – Cottonwood Farms, Pavilion, NY

petdlt@frontiernet.net

Paul and his son Jason operate a 300-cow organic dairy on the same location where the family started farming in 1880. They operate the farm with the help of 4 local employees. Since 2011 they have group housed their calves and feed them UV pasteurized milk with a robotic feeder. In 2013 they installed robotic milkers and feed pushers, which they've successfully integrated into their intensive grazing program. Paul is stepping back to allow his son to manage more of the day-to-day tasks. He helps out where needed, makes suggestions, and does repair work and financial planning.

LEADING BY EXAMPLE: A VIRTUAL TOUR OF WELL-MANAGED CALF AND HEIFER OPERATIONS

Inspired Finale to the 2016 Calf and Heifer Congress

C. Rossiter-Burhans
Poulin Grain, Inc.
Newport, Vermont

Things that make it worthwhile to attend a meeting are talking with other people in businesses like or related to yours, and the expectation you be inspired and take home something new, to try or consider, on your farm. For agri- business supporters, it is to have new ideas to share with clients and customers. The last session of the NWNY Dairy, Livestock, Field Crops Team, 2016 Calf and Heifer Congress, “Laying the Foundation for Top Herd Performance” is intended to finish on a practical and inspiring note. This is virtual tour highlighting well executed management areas in several dairy operations that rewards these farms with healthy well grown calves and heifers, raised easier, more efficiently, cost effectively, and or more enjoyably. These operations illustrate the application of some of the topics discussed in the 2016 Calf and Heifer Congress.

Dairy farms sharing these virtual tours and their calf / heifer tour theme:

Breezy Hill Dairy – laser focus on the newborn calf
The Almeter Family
Strykersville, NY

Woodsway Farm – Impeccable successful calf and hutch management
Jim and Sally Woods
Attica, NY

Champion Farms LLC – Planning and Design Highlights – New Automatic Calf Feeder barn
The Champion Family
Clinton, NY

Green Mountain Dairy – spacious group housing barn –3x milk feeding by Milk Bar
The Rowell Family
Sheldon, Vermont

Vorsteveld Farm – a barn dedicated to a smooth transition and the weaned calf rumen
Vorsteveld Brothers
Vergennes, Vermont

Moserdale Farm – ad lib acidified milk barn, system and calves supreme
Andrew, Doug and Patty Moser
Copenhagen, NY

Taft Acres – unique ad lib acidified milk replacer system making great calves since 2007
Taft Family
Island Pond, Vermont

3 On-farm Heifer Weighing Systems and the management decisions they help make:

University of Wisconsin Marshfield Heifer Research Station
Stratford, Wisconsin

Maple Row Dairy
Tim Montgomery, DVM
Saranac, MI

Summit Dairy
Kevin McSweeney DVM, Intnl Bovine Training Solutions
Loveland, CO

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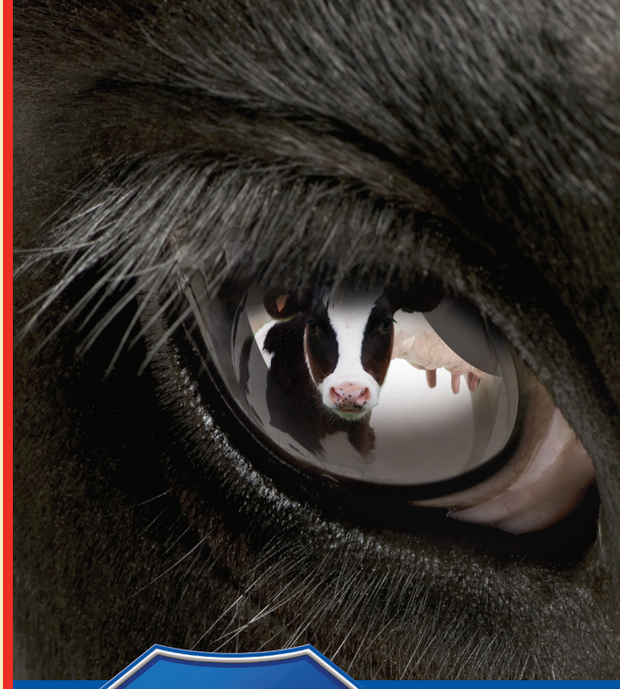

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