

SKY'S THE LIMIT

2017

DCHA ANNUAL CONFERENCE APRIL 11-13 | MADISON, WI



LAND O LAKES° ANIMAL MILK PRODUCTS CO.

CALF CARE PRODUCTS



BEAT THE HEAT
THIS SUMMER WITH
THE LAND O LAKES®
ELECTROLYTE SYSTEM.

The LAND O LAKES® Electrolyte System is a two-part system designed to address electrolyte loss, nutrition and dehydration.

EARLY INTERVENTION

- Heat stress
- First signs of scours
- Shipping and receiving protocol

TREATMENT

- Severe scours
- Visible dehydration



Once mixed, stays in suspension.

FOR MORE INFORMATION VISIT LOLMILKREPLACER.COM

TABLE OF CONTENTS

SKY'S THE LIMIT

GENERAL INFORMATION3
CONFERENCE SPEAKERS5
CHEDULE AT A GLANCE7
017 EXHIBITORS9-15
CONFERENCE MAPS17
CONFERENCE AGENDA18–23
OUR SUMMARIES25-28
ROCEEDINGS30-68
OARD OF DIRECTORS COMMITTEEInside Back Cover
PONSORSBack Cover



LET US KNOW YOU'RE HERE!

Tweet it, post it and tag it with #DCHA2017. One lucky social media follower will be randomly chosen to win a complimentary 2018 conference registration!

#DCHA2017

Like us



facebook.com/calfandheifer

Follow us



twitter.com/calfandheifer

www.calfandheifer.org | (855) 400-DCHA (3242) info@calfandheifer.org



Acti**Saf**

SafMannan Procreatin 7

SelSaf

NOTHING IS MORE PRECIOUS THAN LIFE, AND THAT'S THE PHILOSOPHY THAT DRIVES PHILEO.

As global population continues to increase, the world faces a growing demand for food and greater sustainability challenges. Working at the crossroads of nutrition and health, we are committed to delivering future evidence-based solutions that enhance ruminant health and performance. In each and every country, our team's progress is led by the most advanced scientific outcomes as well as the field input of experience farmers.



www.phileo-lesaffre.com

Rick Kreykes Regional Sales Manager Ruminants Mobile: 1-936-371-0315 r.kreykes@phileo.lesaffre.com

North American Headquarters 7475 West Main Street Milwaukee, WI 53214, USA Ph: 1-877-677-7000 info@phileo.lesaffre.com



REGISTRATION

TUESDAY, APRIL 11 9:00 am - 6:00 pm

WEDNESDAY, APRIL 12 6:00 am - 6:00 pm

THURSDAY, APRIL 13 7:00 am - 3:00 pm

TRADE SHOW

The conference trade show will kick off with a reception Tuesday evening and remain open throughout the entire conference. Listed below are the specific trade show activities and breaks.

TUESDAY, APRIL 11

6:30 - 7:30 pm Trade Show Reception

WEDNESDAY, APRIL 12

7:15 - 8:15 am Breakfast & Welcome

12:00 - 1:30 pm Lunch 4:00 - 6:00 pm Mixer

THURSDAY, APRIL 13

Breakfast 7:00 - 7:45 am

9:00 - 9:45 am Break

12:30 - 1:30 pm Lunch





Animals speak louder than words. And a calf on the Purina® AMPLI-CALF® three-step program delivers 2,740 more pounds¹ of first lactation milk. Which says it all.

Your local Purina representative can tell you more about Cow's Match® Milk Replacer, AMPLI-CALF® Starter and AMPLI-CALF® Grower than this ad ever could. **Or visit amplicalf.com**





MICHAEL BALLOU Texas Tech University



MICHAEL BOLTON Merck Animal Health



JOSEPH DALTON University of Idaho



STAN ERWINE Dairy Management, Inc.



KATIE GRINSTEAD Vir-Clar Farm



NOAH LITHERLAND Vita Plus



RUBY NEWELL-LEGNER 7 Star Service



TERRI OLLIVETT UW School of Veterinary Medicine



KATIE DOTTERER-PYLE Cow Comfort Inn Dairy



EMILY YEISER STEPP National Milk Producers Federation



DENISE SKIDMORE Hilmar Cheese Company



DON SOCKETT Wisconsin Veterinary Diagnostic Lab



MARINA VON KEYSERLINGK University of British Columbia



MIKE VAN AMBURGH **Cornell University**



CHOOSE A HEALTHIER, MORE PROFITABLE HERD

YOUR HEIFER CALVES ARE YOUR LEGACY.
PREDICT HOW HEALTHY THEY WILL BE AS COWS BY
PROACTIVELY TESTING THEM WITH CLARIFIDE® PLUS.

CLARIFIDE® Plus provides unique genomic predictions for mastitis, lameness, metritis, retained placenta, displaced abomasum and ketosis. And with a powerful new economic index—the Dairy Wellness Profit Index™ (DWP\$™)—producers have the unprecedented ability to choose and plan for a healthier and more profitable herd.

To learn how CLARIFIDE Plus can help make your life easier by selecting heifers to help build a healthier herd, contact your Zoetis representative or visit clarifideplus.com.





SCHEDULE AT A GLANCE

TUESDAY, APRIL 11				
9:00 am - 6:00 pm	Registration Open	Registration Desk		
10:00 – 11:30 am	Pre-Conference Seminars	Salon FGH/Salon ABC		
11:00 am - 12:00 pm	Lunch	Convention Center Lobby		
12:00 – 5:00 pm	Farm Tours & Demonstrations	Endres Jazzy Jerseys & Ziegler Dairy Farm		
6:30 - 7:15 pm	How the Dairy Industry is Taking the Microphone Back to Define Our Values, Practices and Products	Trade Show Hall		
	WEDNESDAY, APRIL 1	2		
7:15 – 8:15 am	Breakfast & Welcome	Trade Show Hall		
8:30 - 9:30 am	7 Star Leadership: Turn Every Employee into a Fan	Salon DE		
9:45 - 10:45 am	Nutritional Strategies to Improve the Health of Pre-Weaned Calves and Growing Heifers	Salon DE		
11:00 am - 12:00 pm	Classroom Sessions	Salon ABC, Salon FGH, Green Bay-Milwaukee-LaCrosse		
12:00 – 1:30 pm	Lunch	Trade Show Hall		
1:00 – 1:30 pm	DCHA Annual Business Meeting	Salon DE		
1:45 – 2:45 pm	Classroom Sessions	Salon ABC, Salon FGH, Green Bay-Milwaukee-LaCrosse		
3:00 – 4:00 pm	Classroom Sessions	Salon DE		
4:00 – 6:00 pm	Mixer	Trade Show Hall		
	THURSDAY, APRIL 13			
7:00 - 7:45 am	Breakfast	Trade Show Hall		
8:00 - 9:00 am	Animal Welfare Issues: Present and Future	Salon DE		
9:00 - 9:45 am	Break	Trade Show Hall		
10:00 – 12:15 pm	Classroom Sessions	Salon ABC, Salon FGH, Green Bay-Milwaukee-LaCrosse		
12:30 – 1:30 pm	Lunch	Trade Show Hall		
1:30 – 3:00 pm	Calves, Consumer and Communication: Perspectives from Across North America	Salon DE		
3:15 – 6:00 pm	Post-Conference Wet Lab Demonstrations	Green Bay, Milwaukee, LaCrosse		



Association 2017 Annual Conference.

merck-animal-health-usa.com • 800.521-5767

Copyright ©2016 Intervet, Inc., doing business as Merck Animal Health, a subsidiary of Merck & Co., Inc. All rights reserved 55154 6/16 53715

IMPORTANT SAFETY INFORMATION

FOR USE IN ANIMALS ONLY, NOT FOR HUMAN USE, KEEP OUT OF REACH OF CHILDREN. TO AVOID ACCIDENTAL INJECTION, DO NOT USE IN AUTOMATICALLY POWERED SYRINGES WHICH HAVE NO ADDITIONAL PROTECTION SYSTEM. IN CASE OF HUMAN INJECTION, SEEK MEDICAL ADVICE IMMEDIATELY AND SHOW THE PACKAGE INSERT OR LABEL TO THE PHYSICIAN. DO NOT USE Zuprevo® 18% IN SWINE. Fatal adverse events have been reported following the use of tildipirosin in swine. NOT FOR USE IN CHICKENS OR TURKEYS. Cattle intended for human consumption must not be slaughtered within 21 days of the last treatment. Do not use in female dairy cattle 20

months of age or older. Use of this drug product in these cattle may cause milk residues. A withdrawal period has not been established in pre-ruminating calves. Do not use in calves to be processed for yeal. The effects of Zuprevo® 18% on bovine reproductive performance, pregnancy and lactation have not been determined. Swelling and inflammation, which may be severe, may be seen at the injection site after administration. Subcutaneous injection may result in local tissue reactions which persist beyond slaughter withdrawal period. This may result in trim loss of edible tissue at slaughter. Brief summary available on adjacent page.



2017 TRADE SHOW EXHIBITORS

PRODUCT INFORMATION NADA 141-334 Approved by FDA

048539 R10

Injectable Solution for Cattle

ANTIMICROBIAL DRUG

180 mg of tildipirosin/mL For subcutaneous injection in beef and non-lactating dairy cattle

Not for use in female dairy cattle 20 months of age or older or in calves to be processed for yeal.

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed

RRIFF SHMMARY for full prescribing information use package insert.

INDICATIONS: Zuprevo® 18% is indicated for the treatment of bovine respiratory disease (BRD) associated with Mannheimia haemolytica, Pasteurella multocida, and Histophilus somni in beef and non-lactating dairy cattle, and for the control of respiratory disease in beef and non-lactating dairy cattle at high risk of developing BRD associated with M. haemolytica, P. multocida, and H. somni.

WARNINGS: FOR USE IN ANIMALS ONLY. NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN. TO AVOID ACCIDENTAL INJECTION DO NOT USE IN AUTOMATICALLY POWERED SYRINGES WHICH HAVE NO ADDITIONAL PROTECTION SYSTEM. IN CASE OF HUMAN INJECTION SEEK MEDICAL ADVICE IMMEDIATELY AND SHOW THE PACKAGE INSERT OR LABEL TO THE PHYSICIAN

Avoid direct contact with skin and eyes. If accidental eye exposure occurs, rinse eyes with clean water. If accidental skin exposure occurs, wash the skin immediately with soap and water. Tildipirosin may cause sensitization by skin contact.

For technical assistance or to report a suspected adverse reaction, call: 1-800-219-9286.

For customer service or to request a Material Safety Data Sheet (MSDS), call: 1-800-211-3573. For additional Zuprevo 18% information go to www.zuprevo.com.

For a complete listing of adverse reactions for Zuprevo 18% reported to CVM see: http://www.fda.gov/AnimalVeterinary/ SafetyHealth

DO NOT USE ZUPREVO 18% IN SWINE.

Fatal adverse events have been reported following the use of tildipirosin in swine. NOT FOR USE IN CHICKENS OR TURKEYS.

RESIDUE WARNING: Cattle intended for human consumption must not be slaughtered within 21 days of the last treatment. Do not use in female dairy cattle 20 months of age or older. Use of this drug product in these cattle may cause milk residues. A withdrawal period has not been established in preruminating calves. Do not use in calves to be processed for yeal.

PRECAUTIONS: The effects of Zunrevo 18% on havine reproductive performance, pregnancy and lactation have not been determined. Swelling and inflammation, which may be severe, may be seen at the injection site after administration. Subcutaneous injection may result in local tissue reactions which persist beyond the slaughter withdrawal period. This may result in trim loss of edible tissue at slaughter.

Made in Germany Distributed by: Intervet Inc d/b/a Merck Animal Health, Summit NJ 07901 Copyright © 2011, Intervet Inc., a subsidiary of Merck & Co. All rights reserved.

Accelerated Genetics

BOOTH #64

E10890 Penny Lane Baraboo, WI 53913

608-355-5422 kstanek@accelgen.com

www.accelgen.com

Animal genetics, Calf/heifer housing & supplies, Feed & feed additives

Acepsis, LLC

BOOTH #4

9534 Blue Heron Drive Middleton, WI 53562

608-203-5535 mpawlak@acepsis.com

www.acepsis.com

Sanitation equipment & supplies

ADA Enterprises, Inc.

BOOTH #2

305 Enterprise Drive Northwood, IA 50459

641-324-1093 jacob@adaent.net

www.adaent.net

Calf/heifer housing & supplies

Agri-Plastics

BOOTH #45/46

7793 Young St. Grassie, ON LOR 1M0

905-643-6278

kristin@agri-plastics.net www.agri-plastics.net

Calf/heifer housing & supplies

Alltech

BOOTH #21

331 W Kindt St Juneau, WI 53093

920-386-9651 ahoeft@alltech.com www.alltech.com

Feed & feed additives

American Dairymen

BOOTH HALLWAY

4685 Merle Hay Road, Suite 200 Des Moines, IA 50322

515-330-2144 dustin@livestockmediagroup.com www.americandairymen.com

Communications & media

American Wood Fibers

BOOTH #8

100 Alderson Street Scholfield, WI 54476

715-359-1343 dzemke@awf.com www.awf.com

Feed & feed additives, Livestock supplies & services

ANIMART

BOOTH #63

1240 Green Valley Rd. Beaver Dam, WI 53916

920-319-4366 katieh@animart.com

www.animart.com

Animal health/pharmaceuticals, Calf/heifer housing & supplies, Livestock supplies & services

Arm & Hammer Animal Nutrition

BOOTH #36

1912 Kings Pass Heath, TX 75032

559-786-4235

gene.boomer@churchdwight.com

www.ahanimalnutrition.com

Feed & feed additives



Animal Nutrition

Art's Way Scientific, Inc.

BOOTH #61

P.O. Box 217 1600 Hwy 9 Decorah, IA 52101

karend@buildingsforscience.com www.buildingsforscience.com

Building & supplies, Calf/heifer housing & supplies, Farm implements & equipment

Bayer Animal Health

BOOTH #40 & 42

P.O. Box 390 Shawnee, KS 66201

913-268-2491 dean.cost@bayer.com www.BayerLivestock.com

Animal health/pharmaceuticals

Bayland Buildings, Inc.

BOOTH #32

P.O. Box 13571 Green Bay, WI 54307

920-498-9300 arambrosius@baylandbuildings.com

www.BaylandBuildings.com

Building & supplies, Calf/heifer housing & supplies, Facility expansion/consulting

Bio-Vet Inc.

BOOTH #71

300 Ernie Dr. Barneveld, WI 53507

608-924-7001

heidi.jones@bio-vet.com

www.bio-vet.com

Feed & feed additives

BioZyme, Inc

BOOTH #72

6010 Stockyards Expressway Saint Joseph, MO 64504

816-344-5755

jpurvis@biozymeinc.com

www.biozymeinc.com

Livestock nutrition, prebiotic additive

BMO Harris Bank

BOOTH #51

205 South Main St. Seymour, WI 54165

920-993-5343

kevin.coffeen@bmo.com rick.puls@bmo.com

www.bmoharris.com

Financial services

Calf Star

BOOTH **#56 & 58**

4324 North County Road P New Franken, WI 54229

920-866-2485 info@calfstar.com

www.calfstar.com

Calf/heifer housing & supplies - Other: pasteurizers/automatic calf feeders

CalfCare

BOOTH #74

11937 North State Road 13 North Manchester, IN 46962

260-982-7596 jan@calfcarevet.com www.calfcarevet.com

Animal health/pharmaceuticals, Livestock supplies & services - Other: veterinarian, milk replacer distributor

Calf Solutions

BOOTH #55

435 E Main St. Chilton, WI 53014

920-849-1158

BLBrantmeier@milkproductsinc.com

www.calfsolutions.com

Feed & feed additives

Calf-Tel

BOOTH #75 & 77

W194 N11551 McCormick Dr. Germantown, WI 53022

262-532-9094 ashleysmith@hampelcorp.com www.Calf-Tel.com

Calf/heifer housing & supplies

Central Life Sciences

BOOTH #18

W5123 E Bush Road Pardeeville, WI 53954

608-259-6871 skohl@central.com

www.centrallifesciences.com

Animal health/pharmaceuticals, Feed & feed additives

Cerdos, LLC

BOOTH #33

407 Allen St. Clinton, WI 53525

608-436-0217 darin@cerdosllc.com

www.cerdosllc.com

Calf/heifer housing & supplies, Livestock supplies & services

Chr. Hansen, Inc.

BOOTH #48

9015 W Maple St. Milwaukee, WI 53214

414-607-5720 uskaha@chr-hansen.com

www.chr-hansen.com

Animal Health / Probiotics and Silage Inoculants

Crystal Creek Natural, LLC

BOOTH #22

1600 Roundhouse Road Spooner, WI 54801

715-635-4321 jan@crystalcreeknatural.com

www.crystalcreeknatural.com

Facility expansion/consulting, Feed & feed additives - Other: Calf Barn Ventilation

Dairy Herd Management

BOOTH #HALLWAY

10901 W 84th Terr #300 Lenexa, KS 66214

913-669-0295

rrei@farmjournal.com www.dairyherdmanagement.com

Communications & media

Dairy Tech Inc.

BOOTH #35

P.O. Box 250 Severance, CO 80546

970-674-1888

dennis@dairytechinc.com

www.dairytechinc.com

Animal health/pharmaceuticals, Livestock supplies & services - Other: Colostrum & Milk Pasteurization

DBC Ag Products

BOOTH #52

1383 Arcadia Road, Suite 102 Lancaster, PA 17601

717-951-8520

dlmathes@danielbaumco.com

www.dbcagproducts.com

Animal health/pharmaceuticals

Elanco Animal Health

BOOTH #26

2500 Innovation Way Greenfield, IN 46140

317-315-6059

edepompei@elanco.com

www.elanco.us

Animal health/pharmaceuticals, Feed & feed additives

Euroduna Americas, Inc.

BOOTH #53

E7465 640th Ave. Elk Mound, WI 54739

715-440-5410

mccallajeff@gmail.com

www.euroduna-americas.com

Feed & feed additives - Other: Specialty calf products

Fever Tags LLC

BOOTH #82

3846 Business Park Dr. Amarillo, TX 79110

806-353-8247

info@fevertags.com

www.fevertags.com

Computer & computer software, Livestock supplies & services - Other: Health intervention technology

First Pioneer Insurance Agency

BOOTH #5

409 Johnson St. Aberdeen, NC 28315

800-547-1495

agency@pioneerinsurance.com

www.pioneerinsurance.com/dcha

Agricultural Workers Compensation Insurance

Förster Technik

BOOTH #1

56 Yates Ave. Cambridge, ON N1P 0A3

519-239-9756

jan.ziemerink@foerster-technik.com

www.foerster-technik.com

Computer & computer software, Feed & feed additives, Milk handling equipment

FutureCow

BOOTH #44

1335 Bennett Dr., Suite 173 Longwood, FL 32750

855-388-7269

nina@futurecow.com

www.futurecow.com

Animal Comfort/Husbandry

Golden Calf Company

BOOTH #34

21677 27th St. Bloomer, WI 54724

715-944-9609

dagmar@goldencalfcompany.com

www.goldencalfcompany.com

Calf/heifer housing & supplies, Colostrum Management

Good Day's Work

BOOTH #30

250 Main St., Suite 540 Lafayette, Indiana 47901

765-490-0353 don@gooddayswork.ag www.gooddayswork.ag

Ag Specific Safety Training

Greenhouse Supply, Inc

BOOTH #38

P.O. Box 3038 Brewer, Maine 4412

207 989-1585

greenhse@agrotech.com

Agrotech.com

Building & supplies, Calf/heifer housing & supplies, Facility expansion/consulting

GreenStone Farm Credit Services

BOOTH #69

3030 Park Dr., Ste B Sturgeon Bay, WI 54235

920-743-8150

Thomas. Wilson@greenstonefcs.com

www.greenstonefcs.com

Financial services

Grober Nutrition

BOOTH #41

20 Eagle Dr. Auburn, NY 13021

800-265-7863

marketing@grober.com

www. Grober Nutrition.com

Calf/heifer housing & supplies, Feed & feed additives

Hawkins Inc.

BOOTH #19

2381 Rosegate Roseville, MN 55113

612-617-8621

laura.eilek@hawkinsinc.com

www.hawkinsinc.com

Water Treatment

Hoard's Dairyman

BOOTH #HALLWAY

P.O. Box 801

Fort Atkinson, WI 53538

920-563-5551

hoards@hoards.com

www.hoards.com

Communications & media

ImmuCell Corporation

BOOTH #50

56 Evergreen Dr. Portland, ME 4103

800-466-8235

kbecher@immucell.com

www.firstdefensecalfhealth.com

Animal health/pharmaceuticals, Livestock supplies & services

IMMVAC (Makers of Endovac)

BOOTH #79

6080 Bass Lane Columbia, MO 65201

217-617-9004

jscott@immvac.com

www.EndovacDairy.com

Animal health/pharmaceuticals

Imu-Tek Animal Health, Inc.

BOOTH #17

3541 East Vine Dr. Fort Collins, CO 80524

970-493-7033

susan@imutek.com

www.imutek.com

Animal health/pharmaceuticals -Other: Colostrum supplies

KeyAg Distributors

BOOTH #14

P.O. Box 150

Murtaugh, ID 83344

208-432-6602

matt.jones@keyag.com

www.keyag.com

Animal health/pharmaceuticals, Livestock supplies & services, Sanitation equipment & supplies

Kunafin "The Insectary"

BOOTH #39

13955 N Hwy 277 Quemado, TX 78877

830-757-1181

office@kunafin.com

www.kunafin.com

Livestock supplies & services

Laird Mfg. LLC

BOOTH #54

531 South Hwy 59 Merced, CA 95341

209-722-4145 david@lairdmfg.com www.lairdmfg.com

Feed & manure equipment -Other: Cattle Feeding Equipment

Lallemand Animal Nutrition

BOOTH #25

6120 W. Douglas Ave. Milwaukee, WI 53218

414-393-4030 ECarter@lallemand.com

www.LallemandAnimalNutrition.com

Feed & feed additives

Life Products Inc.

BOOTH #3

7690 South Prairie Road Tillamook, OR 97141

402 860 - 8871

kevin@lifeproductsinc.com

www.lifeproductsinc.com

Animal health/pharmaceuticals, Feed & feed additives

Merck Animal Health

BOOTH #23 & 24

35500 West 91st St. DeSoto, KS 66018

802-309-4226

rick.jackson@merck.com

www.dairycare365.com

Animal health/pharmaceuticals

Merial

BOOTH #6 & 7

2000 Central Kansas City, MO 64108

816-283-4795

andrew.posch@shscom.com

www.merial.com

Animal health/pharmaceuticals

Micro Technologies

BOOTH #73

3041 W. Pasadena Dr. Bosie, ID 83705

208-955-9424 ajohnson@mwivet.com

www.microtechnologies.com

Animal health/pharmaceuticals, Computer & computer software

MicroBasics

BOOTH #57

11590 W. Bernardo Ct., Ste. 110 San Diego, CA 92127

858-756-9447

markkb@microbasics.com

www.microbasics.com

Animal health/pharmaceuticals, Feed & feed additives

Midwest Milk Products

BOOTH #78

15 Stone Hill Road Oswego, FL 60543

630-564-0415

bernie@midwestmilk.com

Feed & feed additives

Multimin USA, Inc.

BOOTH #81

2809 East Harmony #190 Fort Collins, CO 80528

970-372-2302

kimber@multiminusa.com

www.multiminusa.com

Animal health/pharmaceuticals

Norbrook Inc

BOOTH #16

9401 Indian Creek Parkway 680 Overland Park, KS 66210

913-599-5777

aford@norbrookinc.com

www.norbrook.com

Animal health/pharmaceuticals

NovaVive Inc.

BOOTH #60

19 Newberry Street, Unit A Belleville, ON K8N 3N2

613-771-1146

Graeme.McRae@NovaVive.ca

www.NovaVive.ca

Animal health/pharmaceuticals

NRV Inc

BOOTH #80

N8155 American St. Ixonia, WI 53036

800-558-0002 dkleve@nutramelk.com

www.nrvmilk.com

Calf/heifer housing & supplies, Feed & feed additives

Organix Recycling, LLC

BOOTH #20

19065 Hickory Dr., Suite #240 Mokena, IL 60448

970-768-0021

rickw@organixrecycling.com

www.organixrecycling.com

Feed & feed additives

Peach Teats (JDJ Solutions)

BOOTH #28

5983 US - 11 Homer, NY 13077

800-680-3167 tduff@jdjsolutions.com

www.jdjsolutions.com

Animal health/pharmaceuticals, Calf/heifer housing & supplies, Livestock supplies & services

Phileo Lesaffre Animal Care

BOOTH #65

1476 3rd Ave. SE Sioux Center, IA 51250

712-308-4728

r.kreykes@phileo.lesaffre.com

www.phileo-lesaffre.com

Animal health/pharmaceuticals, Feed & feed additives



PortaCheck, Inc.

BOOTH #31

1 Whittendale Dr., Suite E Moorestown, NJ 08057

856-231-8894

thopkins@portacheck.com

www.portacheck.com

Animal health/pharmaceuticals

ProfitSource

BOOTH #43

611 Elm St. Merrill, WI 54452

715-536-7159

lee@goprofitsource.com

www.goprofitsource.com

Computer & computer software

Purina Animal Nutrition

BOOTH #47 & 49

1080 County Rd F West MS 5350 Shoreview, MN 55126

651-375-6379

amirabal@landolakes.com

www.purinamills.com/dairy-feed

Feed & feed additives

Roto-Mix LLC

BOOTH #15

2205 E. Wyatt Earp Blvd Dodge City, KS 67801

620-225-1142 info@rotomix.com

www.rotomix.com

Farm implements & equipment, Feed & manure equipment

SCR Dairy, Inc./Allflex

BOOTH #68

2013 S. Stoughton Road Madison, WI 53716

608-237-3170

pgoecks@scrdairy.com

www.scrdairy.com

Computer & computer software, Livestock supplies & services - Other: animal monitoring

STGenetics

BOOTH #70

6938 Hickory Lane Deforest, WI 53532

920-517-8629

jhippen@stgen.com

www.stgen.com

Animal genetics

Strauss Feeds

BOOTH #67

W7507 Provimi Road Watertown, WI 53098

608-963-9734

catherman@straussfeeds.com

www.straussfeeds.com

Feed & feed additives

TechMix, LLC

BOOTH #66

P.O. Box 221, 740 Bowman Street Stewart, MN 55385

(320) 562-2740

tamimerkins@techmixglobal.com

www.techmixglobal.com

Animal health/pharmaceuticals

Topcon Agriculture Americas

BOOTH #76

W5527 Hwy 106 Fort Atkinson, WI 53538

306-290-9130

jhughes@topcon.com

www.digi-star.com

Feed & manure equipment, Livestock supplies & services

Tru-Test Group

BOOTH #29

23462 Dry Sage Lane Rapid City, SC 57702

320-761-9082

wschroeder@tru-test.com

www.tru-test.com

Livestock supplies & services

Van Beek Natural Science

BOOTH #59

3689 460th St. Orange City, IA 51041

712-707-4132

katieg@vanbeeknaturalscience.com

www.vanbeeknaturalscience.com

Feed & feed additives

Y-Tex Corporation

BOOTH #27

1825 Big Horn Avenue Cody, WY 82414

307-527-6433 Rgraham@y-tex.com

www.Y-Tex.com

Animal health/pharmaceuticals, Livestock supplies & services - Other: Identification

Zoetis

BOOTH #37

10 Sylvan Way Parsippany, NJ 07054

973-443-2847

cheryl.f.marti@zoetis.com

www.dairywellness.com

Animal health/pharmaceuticals

www.nrvmilk.com We take are of asses, naturally!

Building a great dairy herd today requires a solid foundation. This begins with your calves!

NRV milk replacers and whole/waste milk balancers provide the nutritional foundation which your herd replacements require to maximize their potential and get them into the milking string sooner. All you do is add water!

It is time to contact your NRV representative to begin building the foundation of your herd for years to come!

(800) 558-0002



HOARD'S PAIRYMAN

Don't miss another information packed issue of *Hoard's Dairyman*

With information from the dairy industry's most respected specialists, researchers, veterinarians, and dairy farmers, *Hoard's Dairyman* is a source that is unparalleled in the dairy industry. Our editors travel over 100,000 miles per year to serve you with the most reliable dairy information available.

- Find the Heifer Notes Newsletter four times a year in your Hoard's Dairyman issue
- Visit our Calf and Heifer E-Source online
- For weekly updated dairy news delivered to your online inbox, subscribe to
 HOARD'S PAIRYMAN at hoards.com/intel
- Check out the Hoard's Dairyman webinar archives at hoards.com/webinars



SUBSCRIBE TODAY!

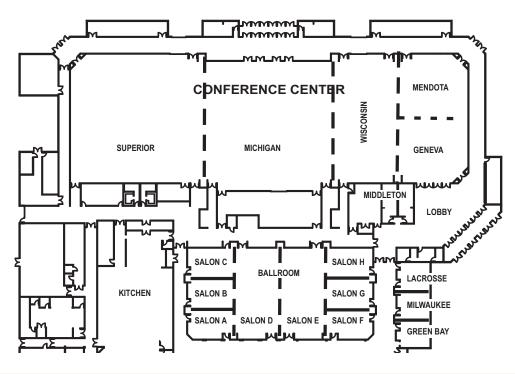


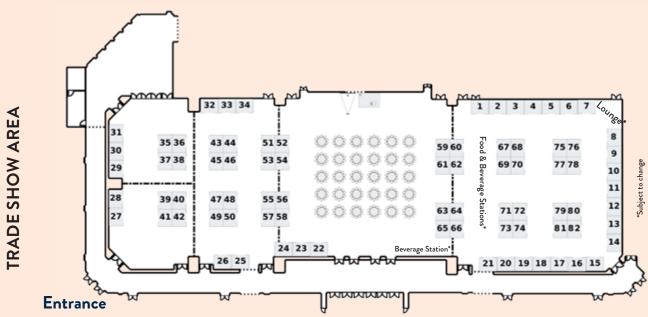




CONFERENCE MAPS

CONFERENCE MEETING ROOM AREA





CONFERENCE AGENDA

TUESDAY, APRIL 11

REGISTRATION DESK OPEN

9:00 am - 6:00 pm

Sponsored by: Merck Animal Health

SPONSORED PRE-CONFERENCE SEMINARS

10:00 - 11:30 am

What's new in genomics to improve your profit potential

Salon F, G & H

A producer panel and Cheryl Marti, MS, MBA, Associate Director Genetics & Reproduction Marketing, Zoetis

You've heard about genomics, but what are some new learnings and tools to help you be more profitable? For instance, how can new wellness traits help improve dairy wellness and reduce residue risk? How might genomics and the environment play out in higher stress situations? Are you waiting for a certain size to determine breeding versus age? Come listen, learn and ask questions to fellow producers and Cheryl Marti, MS, MBA, associate director, Genetics & Reproduction Marketing for Zoetis, about using CLARIFIDE®. Hear about what we've learned, the profit potential of using genomics and what we're seeing on operations coast to coast.

Sponsored by: Zoetis

Past, Present and Future of Sexed Semen in the Dairy Industry

Salon A, B & C

Jack Hippen from STgenetics

Sexed semen has become an established tool in the industry. Dairy industry veteran Jack Hippen is STgenetics North American and EU Sales Director. Jack will be sharing how fertility has changed for the positive. The opportunities for genetic improvements and potential profit gains through the advancements in sexed semen technology will also be evaluated.

Sponsored by: STgenetics

LUNCH (for Farm Tour registrants)

11:00 am - 12:00 pm

FARM TOURS & DEMONSTRATIONS

12:00 - 5:00 pm

Meet in the conference center lobby at 12:00 pm

Buses Sponsored by: Golden Calf Company

Tour Stop A: Endres Jazzy Jerseys

Attention to small details has been a key focus of Endres Jazzy Jerseys calf and heifer management. This Lodi, Wis. operation focuses on every management aspect of each life stage to keep their Jersey calves at peak health. Features of the farm tour will include prefresh pen management, colostrum and vaccination administration, calf nutrition, calf barn design and sanitation. Tour participants will learn about their unique market for Jersey bull calves.

On-Farm Demonstration: A Closer Look at the DCHA Gold Standards

Tour Stop B: Ziegler Dairy Farm

Focusing on calf and heifer transitions is a key management strategy at Ziegler Dairy Farm in Middleton, Wis. Calves are group housed and fed pasteurized whole milk where focus is on consistent calf care protocols of the individual calf. This farm is run by three generations, including the third generation of five "millennial" brothers, where they milk 1,200 cows located in the shadow of the bustling city of Madison. The tour will also stop at their heifer facilities. From automatic calf feeders to new transition heifer barns, learn why this family farm chose to add both to their fifth-generation farm. From construction to management, this tour will showcase expansion options.

On-Farm Demonstration: How To Meet Growth Goals With Nutrition And Benchmarking Sponsored by: Purina Animal Nutrition

On-Farm Demonstration: Evaluation of Heifer Reproductive Protocols and Industry Trends

How the Dairy Industry is Taking the Microphone Back to Define Our Values, Practices and Products

6:30 – 7:15 pm | Trade Show Hall

Stan Erwine, Dairy Management, Inc.

Stan Erwine, Dairy Management, Inc., Vice President of Farmer Relations and Activation, will provide updates and results from Season 2 of Acres and Avenues. He'll also share how farmers and dairy industry stakeholders are engaging leaders and consumers in new and sometimes unexpected ways to drive discovery and proactive conversations about our values, practices and nutritious products.

WEDNESDAY, APRIL 12

BREAKFAST & WELCOME

7:15 – 8:15 am | Trade Show Hall

Join all attendees and exhibitors to kick off the day.

7 STAR LEADERSHIP: TURN EVERY EMPLOYEE INTO A FAN

8:30 - 9:30 am | Salon DE

Ruby Newell-Legner, 7 Star Service

Do you light the fire under your people – or stoke the fire within? Do you command behavior or inspire performance? Do you control your staff or foster commitment? Whether it is to improve performance or trying to get staff to follow proper protocol, motivating your staff is a key skill that every manager needs to succeed. Become the leader that keeps individuals focused on their goals and the business running smoothly. Make your job easier when employees build their skills, improve performance and independence. Ruby will review how to create a positive work environment that fosters trust and develops teamwork. You will gain insight on the best way to motivate your team and get them to want to follow the farm protocols.

Ruby Newell-Legner, is a certified speaking professional and founder of 7 Star Service. Her clients range from the world's only 7 Star Hotel in Dubai, United Arab Emirates to the National Western Stock Show in Denver, Colorado plus 29 professional sports teams and 60 sports and entertainment venues.

NUTRITIONAL STRATEGIES TO IMPROVE THE HEALTH OF PRE-WEANED CALVES AND GROWING HEIFERS

9:45 - 10:45 am | Salon DE

Dr. Michael Ballou, Texas Tech University

Dairy calves and growing heifers are extremely susceptible to both gastrointestinal and respiratory diseases. Proper nutrition is essential and can reduce the risk of both diseases. This presentation will discuss how total plane of nutrition as well as specific nutritional supplements impact the development of immunity and risk for infectious diseases.

Sponsored by: Land O' Lakes Animal Milk Products

TRACK OPTIONS - SELECT ONE

11:00 am - 12:00 pm

TRACK A: UNDERSTANDING DYNAMIC GROWTH OF REPLACEMENT HEIFERS

Salon ABC

Dr. Noah Litherland, Vita Plus

Heifer growth can be described as efficient, fast and dynamic. We grow calves from the inside out by establishing an environment for favorable bacterial growth, maturation of the digestive system, and supplying the right nutrients in the correct amounts. We will work to better understand the nursery, transition, and grower phases of growth and identify key constraints to dynamic heifer growth at each phase.

Sponsored by: Phileo Lesaffre Animal Care

TRACK B: GROUP HOUSING FOR PREWEANED DAIRY CALVES: THE DO'S AND DON'TS

Salon FGH

Dr. Donald Sockett, Wisconsin Veterinary Diagnostic Lab

There are a number of benefits to raising young calves in groups. However, there is also more opportunity for infectious disease transmission. Dr. Sockett will provide details on what to do and more importantly what not to do when raising preweaned calves in groups. You will be surprised what he has to say.

TRACK C: PRODUCER PANEL: LIGHT THE FIRE THROUGH EMPLOYEE MANAGEMENT

Green Bay, Milwaukee, LaCrosse

Moderated by: Ruby Newell-Legner, 7 Star Service

Producers from around the country will share their experience in keeping employees motivated and focused on the needs to build a successful operation.

Sponsored by: Merck Animal Health

LUNCH

12:00 – 1:30 pm | Trade Show Hall

Sponsored by: APC



PERSPECTIVE



and we understand yours

We know your approach to calf health and nutrition is different from other calf raisers. Regardless of your goals, the Calf Solutions, portfolio helps provide your calves with the right nutrition at the right time, every time.



DCHA ANNUAL BUSINESS MEETING

1:00 – 1:30 pm | Salon DE

TRACK OPTIONS - SELECT ONE (repeated)

1:45 - 2:45 PM

TRACK A: UNDERSTANDING DYNAMIC GROWTH OF REPLACEMENT HEIFERS

Salon ABC

Dr. Noah Litherland, Vita Plus

Sponsored by: Phileo Lesaffre Animal Care

TRACK B: GROUP HOUSING FOR PREWEANED DAIRY CALVES: THE DO'S AND DON'TS

Salon FGH

Dr. Donald Sockett, Wisconsin Veterinary Diagnostic Lab

TRACK C: PRODUCER PANEL: LIGHT THE FIRE THROUGH EMPLOYEE MANAGEMENT

Green Bay, Milwaukee, LaCrosse

Moderated by: Ruby Newell-Legner, 7 Star Service

Sponsored by: Merck Animal Health

RETHINKING COLOSTRUM: IT'S MORE THAN JUST IGGS

3:00 - 4:00 pm | Salon DE

Dr. Mike Van Amburgh, Cornell University

There is mounting evidence from many species that what is secreted in colostrum and milk is not just for nutrients and immune system development. For example, there are other components of colostrum that stimulate nutrient absorption, energy metabolism and nutrient utilization and this aspect has been overlooked in calves and heifers. This talk will explore some of the components and their impact on calf performance and what that means for calves and their managers.

Sponsored by: Land O' Lakes Animal Milk Products

MIXER

4:00 - 6:00 pm | Trade Show Hall

Take this opportunity to connect with industry-focused companies and allied professionals, veterinarians, student attendees and fellow producers. Enjoy light snacks and drinks to round out this evening of networking



Be sure to visit exhibitor booths for complimentary drink tickets!

THURSDAY, APRIL 13

BREAKFAST

7:00 - 7:45 am | Trade Show Hall

ANIMAL WELFARE ISSUES: PRESENT AND FUTURE

8:00 - 9:00 am | Salon DE

Dr. Marina von Keyserlingk, University of British Columbia

Concern for the welfare of farm animals is not new, but the last few years have seen increased interest in farm practices. Many consumers believe that cows spend their days grazing green pastures. This strength can also be regarded as a threat if some industry practices no longer match evolving public expectations. Every year there are fewer farms, and the ever decreasing proportion of society that works within this industry will never be able to able to 'educate' the large majority. Moreover, producers themselves are part of this rapidly evolving society, and practices that were accepted by past generations may not seem so to the next generation of producers. During this presentation, Dr. von Keyserlingk will highlight some of her most recent work on engaging dairy producers and the public as a means to help identify practices that do and do not come into harmony with public expectations.

Sponsored by: Merck Animal Health

BREAK

9:00 – 9:45 am | Trade Show Hall

Sponsored by: Nutriad

TRACK OPTIONS - SELECT ONE

10:00 - 11:00 am

TRACK A: NEW REPRODUCTIVE STRATEGIES AND ECONOMIC OUTCOMES FOR DAIRY HEIFERS

Salon ABC

Dr. Joe Dalton, University of Idaho

New reproductive strategies are available to efficiently generate pregnancies shortly after AI breeding eligibility. Economic analyses provide evidence that implementation of these strategies may decrease 1) cost per pregnancy, 2) days on feed, and 3) overall cost to raise a heifer.

TRACK B: DEFINE, DETECT AND DIAGNOSE BRD FOR GREATER PREVENTION AND TREATMENT SUCCESS

Salon FGH

Dr. Terri Ollivett, University of Wisconsin - Madison

How dairy producers and veterinarians define, detect and diagnose respiratory disease in young stock can impact our perception of the amount and severity of disease in an operation. This lecture will highlight differences between BRD definitions, detection methods, diagnostic tools, and how the 3 D's influence prevention and treatment strategies. Topics covered will include clinical scoring systems, lung ultrasonography, priorities for prevention, and optimal use of antibiotics and adjunct therapies for the treatment of respiratory disease.

Sponsored by: Merck Animal Health

TRACK C: PRODUCER PANEL: DEVELOPING PROTOCOLS FOR ANIMAL HANDLING

Green Bay, Milwaukee, LaCrosse

Moderator: Dr. Michael Bolton, Merck Animal Health

Producer panelists will discuss their experience with animal welfare concerns and provide insights to their employee policies and protocols used to remedy problems.

Sponsored by: Merck Animal Health

TRACK OPTIONS - SELECT ONE (repeated)

11:15 am - 12:15 pm

TRACK A: NEW REPRODUCTIVE STRATEGIES AND ECONOMIC OUTCOMES FOR DAIRY HEIFERS

Salon ABC

Dr. Joe Dalton, University of Idaho

TRACK B: DEFINE, DETECT, AND DIAGNOSE BRD FOR GREATER PREVENTION AND TREATMENT SUCCESS

Salon FGH

Dr. Terri Ollivett, University of Wisconsin - Madison

Sponsored by: Merck Animal Health

TRACK C: PRODUCER PANEL: DEVELOPING PROTOCOLS FOR ANIMAL HANDLING

Green Bay, Milwaukee, LaCrosse

Moderator: Dr. Michael Bolton, Merck Animal Health

Sponsored by: Merck Animal Health

LUNCH

12:30 - 1:30 pm | Trade Show Hall

CALVES, CONSUMER AND COMMUNICATION: PERSPECTIVES FROM ACROSS NORTH AMERICA

1:30 - 3:00 pm | Salon DE

Moderator: Emily Yeiser Stepp, National Milk Producers Federation Panelists: Dr. Marina von Keyserlingk, Katie Dotterer-Pyle, Denise Skidmore and Katie Grinstead

A panel of dairy stakeholders will discuss consumer confidence in calf care and areas related to calf management that may be the next 'ask' from dairy consumers and, in turn, customers.

Sponsored by: Zoetis

POST-CONFERENCE WET LAB DEMONSTRATIONS

3:00 - 6:00 pm

Dr. Don Sockett, Wisconsin Veterinary Diagnostic Lab; Dr. Terri Ollivett, UW School of Veterinary Medicine; Dr. Keith Poulsen, Wisconsin Veterinary Diagnostic Lab, Dr. Kathleen Deering, Wisconsin Veterinary Diagnostic Lab and Kristen Cooley, Wisconsin Veterinary Diagnostic Lab

Due to popular demand, watch the Madison Marriott transform into an on-site wet lab with personnel from the Wisconsin Veterinary Diagnostic Lab and University of Wisconsin – School of Veterinary Medicine. Experience hands-on learning sessions combined with classroom programming on electrolytes, IV catheters and a full necropsy.

Sponsored by: Land O'Lakes Animal Milk Products





Farm Journal's

BUSINESS CONFERENCE

November 6-8, 2017

M Resort, Las Vegas



VENUE:

The Conference will be held at the exclusive **M Resort Spa Casino**

Empowering Top-Tier Operations to be PROFITABLE, EFFICIENT AND SUSTAINABLE

The MILK Business Conference distills global economic issues down to their impact at the farm gate, giving attendees the insight to better manage their dairies and their bottom lines. Now in its 16th year, The MILK Business Conference is a mustattend event for commercial dairy farmers seeking to navigate an increasingly complex and risky business environment.

For agenda updates and registration details, visit www.MILKBusiness.com.



TOURS

ENDRES JAZZY JERSEYS	24
ZIECLED DAIDY FADAA	٦٢

ENDRES JAZZY JERSEYS | Lodi, Wis.

INFORMATION & ORIGIN:

Dave Endres started farming in 1986 milking 50 Holsteins. By 1992, he was milking an only Jersey herd of 60 and in 1994, the family moved to their current location, expanding to 250 Jerseys. Today, Jazzy Jerseys is home to 900 cows and 800 young stock. The Endres family farms about 1,200 acres and has a harvesting LLC with two other partners. They also own a farrow to finish swine operation. Fifteen full-time employees keep the farm running day to day. Dave's two sons, Vinny (26) and Mitchell (20) work full-time on the farm and daughter, Sydney (22) is currently a senior at UW-Madison with plans to return home eventually.

CALF MANAGEMENT TIMELINE:

DAY 1: Employees are well versed in newborn care at Jazzy Jerseys. Calves are born on the farm and are fed three quarts of colostrum within the first hour of life. The farm has found that wrapping newborns in blankets right away helps them dry off and warm up a lot faster. Once they are dry and fed, calves move to the calf barn where they stay for the next two months.

DAY 2: Calves receive just under two quarts of pasteurized waste milk twice a day.

DAYS 3-5: Calves are introduced to starter.

DAY 30-70: Calves are weaned around two months of age and grower feed is introduced after weaning. They stay in the barn for a little while before being moved outside to group housing in super huts.

DAY 60-365: After being housed in super huts for a two months, calves are then moved to rented facilities in the area. They are first bred at 10.5 months.

WHAT YOU'LL SEE:

- Improvements through management: Jazzy Jerseys gathers regular benchmarking data to ensure a consistent size of heifers. A whole milk pasteurizer has been a part of the farm for the last 15 years.
- Calf and heifer facilities: Designing the calf barn as an all-in, all-out facility has helped calf health by containing diseases to just one group of calves. They also choose to heat the calf barn to help the Jersey calves handle the cold better and always have access to water.
- Creativity in protocols: See what this farm does to ensure
 an extremely low death loss in Jersey calves. It all starts with
 strict pre-fresh protocols that follow all the way through
 to the calf barn. Jazzy Jerseys have also created their own
 calf mover to make processing newborn calves easier.



ZIEGLER DAIRY FARM | Middleton, Wis.

INFORMATION & ORIGIN:

Ziegler Dairy, Middleton, Wis., is a multi-generational farm that has been in operation for 155 years. Three generations work side-by-side to care for their herd consisting of 1,350 cows and 1,500 heifers. While the farm has undergone many significant changes throughout the five generations, one of the more recent updates includes the installation of three automatic calf feeders in 2011. Each feeder can handle 60 calves and has shown great results with an increase in calf intake and growth, and labor reduction. Another recent update is the addition of two new heifer barns in 2013. Prior to the new barns, youngstock left the farm at 3.5 months of age. Now at 8 weeks, heifers transition to the new barns, where they stay until 11 months of age. The Ziegler family has found this new transition helps with additional management of heifers, especially if one gets off to a rough start.

CALF MANAGEMENT TIMELINE:

DAY 1: The management team at Ziegler Dairy keeps a keen eye on all close-up cows. Once a calf is born, their naval is immediately dipped with 7 percent iodine, they are dehorned, tagged, fed colostrum and dried off.

DAYS 1-4: Calves are housed in individual pens while being trained on a nipple. Calves begin a milk replacer only diet.

DAY 5: Calves are introduced to starter and moved into group housing where they start being trained to use the automatic calf feeders.

DAY 10: Moving into a larger group of calves, they continue with starter and milk replacer diet.

DAYS 56–60: Calves are weaned no sooner than day 56, perhaps later depending on calf barn population.

DAY 20–105: Calves' diet transitions from a full milk replacer diet to 70 percent pasteurized milk and 30 percent milk replacer until they are weaned at 2.5 months of age. The heifers are then moved into the new barns.

DAY 106: The starter in the calves' diet is transitioned to grower feed to improve growth rates.

WHAT YOU'LL SEE:

- Calf and heifer facilities: From automatic calf feeders to new transition heifer barns, learn why this family farm chose to add both to their fifth-generation farm. From construction to management, this tour will showcase expansion options.
- Standard operating procedures: When it comes to heifers, protocols are vital. Ziegler Dairy begins at an early age with strict newborn protocols. As heifers reach breeding age, they use specific vaccination and reproduction synchronization protocols to ensure heifers are healthy and calve in on time.
- Improving through opportunities: This fifth-generation family will share the story of how three generations work alongside each other focusing on both the big picture and the day to day activities. Having multiple generations working on the farm is a great learning opportunity for the farm.
- Older heifer facilities: The tour will stop at Scott and Bruce Hellenbrand's. The Hellenbrand's manage Ziegler Dairy heifers after they leave the transition barns. A focus on reproduction and the mature heifer management will be featured.



WISCONSIN VETERINARY DIAGNOSTIC LABORATORY | Madison, Wis.

INFORMATION:

Features of the lab: Being a member of the University of Wisconsin System, the Wisconsin Veterinary Diagnostic Laboratory (WVDL) has access to the phenomenal infrastructure of the world class university, helping it stay ahead of the industry's needs. The lab primarily serves the dairy and dairy genetics industries in Wisconsin and the United States. Because of this, it has developed a niche in both export and disease management testing.

What's New: WVDL boasts a new group of pathologists and exciting test development occurring in the laboratory. The lab is expanding its caseload and receiving samples from across the country.

WHAT TO EXPECT:

This year's on-site wet lab, attendees will participate in three "short-lectures" on electrolytes, fluid therapy, and pathology. Following each lecture, attendees will work hands-on utilizing and review electrolytes, management of IV catheters and participate in a full necropsy.

The segments in the lab are designed to teach attendees about the current state of practice for diagnosis and treatment of calf scours. Additionally, the importance of electrolyte usage, how to troubleshoot use of IV catheters and view tissue. For attendees who are already familiar with these topics, this will be a great opportunity to brush up on skills to train others. All attendees will also receive a copy of the pathology report following the necropsies from WVDL.

The WVDL encourages all attendees to ask questions! Participation will aid the lab in making continuing education events even better for DCHA members.

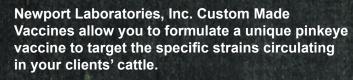
HISTORY:

In the early 1930's, the Dean of the College of Agriculture and the state Director of Agriculture made an agreement about the need for animal disease diagnostic assistance for both veterinarians and producers. This agreement was the beginning of veterinary diagnostic activities in Wisconsin. Originally, the laboratory was in Agriculture Hall at UW-Madison. In 1999, the WVDL was established by Wisconsin Act 107. Over time, the lab grew and expanded, including by playing a crucial role in the eradication of bovine brucellosis and bovine tuberculosis. With increasing demand for quality veterinary diagnostics, in 2006 construction began on the current state-of-the art facility on the UW-Madison campus.





SAYS IT ALL... ORDER YOUR PINKEYE VACCINE TODAY



USDA-licensed products subject to safety & sterility testing

DON'T WAIT, CONTACT YOUR VETERINARIAN TO ORDER YOUR CUSTOM MADE PINKEYE VACCINE TODAY!



Call us at 800-220-2522 www.newportlabs.com



® The Newport Laboratories Logo is a registered trademark of Newport Laboratories, Inc. All other mark belong to their respective owners. © 2017 Newport Laboratories, Inc., Worthington, MN. All rights reserved. NLRBU063.V1 (03/17)



PROCEEDINGS

HOW THE DAIRY INDUSTRY IS TAKING THE MICROPHONE BACK TO DEFINE OUR VALUES PRACTICES AND PRODUCTS	
7 STAR LEADERSHIP: TURN EVERY EMPLOYEE INTO A FAN	32
NUTRITIONAL STRATEGIES TO IMPROVE THE HEALTH OF PRE-WEANED CALVES AND GROWING HEIFERS	33-40
UNDERSTANDING DYNAMIC GROWTH OF REPLACEMENT HEIFERS	41-44
GROUP HOUSING FOR PREWEANED DAIRY CALVES: THE DO'S AND DON'TS	45-46
PRODUCER PANEL: LIGHT THE FIRE THROUGH EMPLOYEE MANAGEMENT	47

RETHINKING COLOSTRUM: IT'S MORE THAN JUST IGGS48-52
ANIMAL WELFARE ISSUES: PRESENT AND FUTURE53-58
NEW REPRODUCTIVE STRATEGIES AND ECONOMIC OUTCOMES FOR DAIRY HEIFERS59-64
DEFINE, DETECT, AND DIAGNOSE BRD FOR GREATER PREVENTION AND TREATMENT SUCCESS
PRODUCER PANEL: DEVELOPING PROTOCOLS FOR ANIMAL HANDLING
CALVES, CONSUMER AND COMMUNICATION: PERSPECTIVES FROM ACROSS NORTH AMERICA

HOW THE DAIRY INDUSTRY IS TAKING THE MICROPHONE BACK TO DEFINE OUR VALUES, **PRACTICES AND PRODUCTS**

Stan Erwine, Dairy Management, Inc.			

7 STAR LEADERSHIP: TURN EVERY EMPLOYEE INTO A FAN

Ruby Newell-Legner, 7 Star Service

NUTRITIONAL STRATEGIES TO IMPROVE THE HEALTH OF PRE-WEANED CALVES AND GROWING HEIFERS

Michael A. Ballou, Ph.D.1

Associate Dean for Research Associate Professor of Nutritional Immunology

Texas Tech University College of Agricultural Sciences and Natural Resources Department of Animal and Food Sciences

¹Contact at: Goddard Building, Suite 108, MS 42123, Lubbock, Texas 79409

P: 806.834.6513, F: 806.742.2836, Email: michael.ballou@ttu.edu

TAKE HOME MESSAGES

Dairy calves are highly susceptible to enteric disease during the first few weeks of life as the gastrointestinal tract matures.

Probiotics, prebiotics, and protein from either hyper-immunized egg or plasma can improve enteric health during the first few weeks of life.

Calves can digest, absorb, and utilize the additional protein and energy early in life when fed greater quantities of milk replacer.

Feeding greater quantities of milk solids early in life could improve post-weaning health.

ABSTRACT

Dairy calves are extremely susceptible to gastro-intestinal disease during the pre-weaned period. The risk for enteric disease decreases as the calf ages; therefore, it is important to break the pre-weaned period up into at least 2 distinct phases that likely need to be managed differently, early life (first couple weeks of life) and the remaining time the calf is fed milk solids. When a calf is born they have been exposed to very few if any microorganisms and some aspects of their gastrointestinal immune system are not fully developed. After birth, the calf is now in a microbial world and exposed to a greater quantity and diversity of microorganisms. This adaptation is abrupt and dramatic and is a major stressor to a newborn calf. The gastrointestinal tract of the calf is naïve and develops rapidly during the first few days to weeks of life. The cells that make up the gastro-intestinal tract are the first line of defense of the immune system; therefore, until the cells are more adult-like

the calf maybe at an increased risk for developing gastro-intestinal diseases. My laboratory recently tested the hypothesis that feeding greater quantities of milk solids during the first week of life would increase the percentage of dietary nutrients that were neither digested nor absorbed by the calf, which would increase the risk of scours. The data indicated that dairy calves during the first few weeks of life digest and absorb nutrients well, and when fed a greater plane of nutrition the additional nutrients were incorporated into tissue growth (Liang et al., 2016). Our data also indicated that calves fed greater planes of nutrition had increased fecal scores, but when the dry matter percentage was determined there were no differences. This suggests that fecal scores alone are inadequate as a measure of enteric health, especially when evaluating various planes of nutrition. Others have reported that calves fed greater quantities of milk and challenged with Cryptospporidium parvum had reduced duration of scours and improved hydration (Ollivett et al., 2012). More data are needed to further investigate the mechanisms underlying this altered response to infectious diseases and understand how early life plane of nutrition influences gastro-intestinal disease during that early life period. In addition, an interesting area of research is that the plane of nutrition of calves during the pre-weaned period improved future lactational performance, and emerging data is suggesting that it may also improve the resistance to some diseases that persists past the pre-weaned period (Ballou et al., 2016; Sharon and Ballou, unpublished). Calves that were previously fed a greater plane of milk replacer nutrition had greater leukocyte responses after they were challenged orally with Salmonella enterica Serotype Typhimurium and subsequently had reduced measures of disease (Ballou et al., 2016). Similarly, another group of calves that were previously fed a greater plane of milk replacer nutrition had reduced mortality and less clinical disease after they were challenged approximately a month after weaning with both bovine herpes virus-1 and Mannheimia haemolytica (Sharon and Ballou, unpublished). More research is needed in this area before any conclusions should be made. In addition to plane of nutrition, the primary strategy to improve the resistance to gastro-intestinal diseases during early life are focused on decreasing the interaction of potential pathogens with the cells of the calf's gastro-intestinal tract. The uses of prebiotics, probiotics, hyper-immunized egg protein, and spray-dried plasma proteins were in many cases shown to decrease the incidence of gastro-intestinal diseases and improve the growth of pre-weaned calves. In summary, nutrition influences leukocyte

responses and disease resistance of calves in many ways, both directly by supplying specific nutrients and indirectly by influencing the exposure to microorganisms. Again, I think it is important that we think about the pre-weaning period as 2 distinct phases that need to be managed differently, the first couple weeks while the gastrointestinal tract is maturing, and the remaining of time the calf is fed fluid.

Keywords: calf, health, immune, and nutrition

INTRODUCTION

It is well documented that dairy calves are extremely susceptible to enteric diseases and mortality during the first few weeks of life. The latest reports from the USDA's National Animal Health and Monitoring System (NAHMS, 1993; 1996; 2007) report that the national mortality rate of heifer calves from 48 hours of life to weaning is approximately 7.8 to 10.8%. Producer perceived records indicate that scours account for 56.5 to 60.5% of all pre-weaned deaths. Approximately ¼ of all pre-weaned calves are therapeutically treated for scours, and the major causes of death from scours are either dehydration or the pathogen gains access to the blood and causes septicemia. The high incidences of disease indicate we have much to learn about improving gastro-intestinal disease resistance among pre-weaned calves. Colostrum management, how much and the composition of fluid fed, the use of various additives such as prebiotics, probiotics, and proteins from hyper-immunized egg or plasma proteins, and housing can all influence the health of preweaned dairy calves. In addition, there are a few data that indicate that early life nutrition can have long-term impacts on leukocyte responses and disease resistance (Ballou, 2012; Ballou et al., 2016; Sharon and Ballou, unpublished). There is a high incidence of respiratory disease among dairy calves and is the main contributor to the high death losses, 1.8%, after weaning (NAHMS, 2007). This is an exciting area of research that needs to be addressed further.

WHY ARE CALVES SO SUSCEPTIBLE TO ENTERIC DISEASE?

The calf is in a bit of a 'catch-22' situation early in life because it requires the passive absorption of many macromolecules from colostrum and milk, but this also increases the risk of translocation of pathogenic microorganisms. The gastrointestinal tract of many neonates undergoes a rapid maturation after parturition, and the timing of this depends largely on the species of interest. There are large gaps in our knowledge regarding how the gastrointestinal tract of a calf changes early in life; however, using gastrointestinal

morbidity/mortality risk as an indirect measurement, the maturation occurs quite rapidly over the first few weeks of life. There are many components to the gastrointestinal immune system (Figure 1). Most of my discussion in this section was derived from animal models other than the calf, but the general principles can still be applied to the calf.

The epithelial cells that make up the mucosal surface and the tight junctions between those cells form a physical barrier that prevents luminal contents from flowing directly into systemic circulation. A breakdown in the tight junctions increases the likelihood of infectious disease because of increased bacterial translocation. Goblet cells are one of the types of epithelial cells found in the gastrointestinal tract, and they produce mucus that creates a layer that covers most of the intestinal epithelium. This mucus layer forms an additional physical barrier against potential enteric pathogens. Additionally, the mucus layer contains many antimicrobial factors that were secreted from immune cells in the intestinal mucosa. These antimicrobial factors include: defensins, lysozyme, and slgA, and their function is to limit the interactions of live microrganims with epithelial cells by creating a **chemical barrier**. Many leukocytes are found in the mucosa of the gastrointestinal tract as well as large lymphoid aggregates are localized in the submucosa of the distal region of the small intestines. These leukocytes contribute to the immunological barrier of the gastrointestinal tract. The majority of leukocytes found in the gastrointestinal (sub)mucosa contribute to adaptive immune responses and create memory that will help to prevent subsequent infections. Macrophages are found in the mucosa and could be involved in the clearance of some microorganisms, but neutrophils are rarely found in the mucosa and are only present in a pathologic state. Trillions of commensal microorganisms live in the gastrointestinal tract and they have a symbiotic relationship with the calf. These commensal microorganisms are part of a microbial barrier that limits the colonization of the gastrointestinal epithelium with more potentially pathogenic microorganisms. These commensal microorganisms compete directly for substrates and space with the potentially pathogenic microorganisms and many of them produce antimicrobial factors and stimulate mucus production that further restrict potential pathogens from infecting the calf. These barriers work together to create a competent **Immune System** of the gastrointestinal tract. A defect in any of these components can increase the risk for infectious disease.

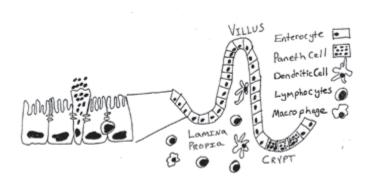


Figure 1. Schematic drawing of the small intestinal mucosa. The crypt-villus axis and common leukocytes found in the mucosa are shown on the right. The insert on the left is a magnification of the epithelial layer, depicting microvilli, tight junctions between epithelial cells, a goblet cell secreting mucus, and an intraepithelial lymphocyte.

Many of the components of the gastrointestinal immune system begin to develop as early as the first trimester of gestation; however, further maturation of many of these barriers occurs only after birth (Guilloteau et al., 2009). This process of rapid intestinal maturation is known as "gut closure" and contributes to the physical barrier. The enterocytes, the nutrient absorptive cells that make up the majority of cells in the intestinal epithelium, are considered fetal-type at birth because they are largely vacuolated and can absorb intact macronutrients through pinocytosis. These fetal-type enterocytes are quickly replaced by more adult-like enterocytes. This process occurs from the proximal to distal intestines and from the crypt to the villus tip; therefore, even though the majority of the gastrointestinal tract may have undergone "gut closure" in the day and a half after birth there likely persist vacuolated, fetal-type enterocytes toward the villus tip of the lower regions of the intestines for a longer period of time. In addition to transcellular absorption of macromolecules, the gastrointestinal epithelium may also be more prone to paracellular absorption because of reduced tight junctions between the enterocytes. The mucus layer that covers the intestinal epithelium is dynamic and cannot be studied with traditional histological methods; therefore, very little is known regarding the postnatal changes in the mucus layer. Goblet cells respond to microbial exposure by increasing mucus secretion; therefore, it is conceivable that the mucus layer develops further during the post-natal period. Intestinal motility and the movement of digesta through the gastrointestinal tract can also reduce colonization of potentially pathogenic microorgansims, so a reduced intestinal motility can also contribute to the high incidence

of enteric disease. Therefore, the **physical barrier** of the intestines is compromised during the early post-natal period and likely contributes to the high incidence of enteric disease and bacterial translocation.

The chemical and immunological barriers are also compromised during the early post-natal period. Paneth cells begin to develop during gestation; however, the number of Paneth cells and the antimicrobial secretions increase throughout life. Additionally, the adaptive arm of the immune system is naïve at birth and develops over the life of the animal as the calf is exposed and re-exposed to antigens. Therefore, slgA concentrations and diversity are low and will remain low until the calf begins to develop it's own active immunity. Antibodies from colostrum are known to recirculate back to the mucosa of the intestines, and can offer some immediate protection from enteric pathogens; however, the half-life of many passively derived antibodies is 1 to 2 weeks. Therefore, the gastrointestinal tract will become more susceptible to those specific microorganisms again until they develop their own active immunity against them. This is probably why many calves start developing localized enteric disease and scours during the 2nd or 3rd week of life. The fact is young animals will always be at an increased risk for infectious diseases until they develop their own active immunity. It's one of the benefits of getting older, the adaptive arm of the immune system becomes 'wiser' because of what it has been exposed to and experienced.

The calf in utero is developing in a relatively sterile environment and upon parturition and during the post-natal life they are exposed to a greater number and diversity of microorganisms. There is a progression in the microbial colonization of the gastrointestinal tract, with facultative anaerobes from the environment (ie: Enterobacteriaceae, Streptococcus, and Staphylococcus) dominating during the early post-natal period. There will be a switch to where strict anaerobes (ie: Bifidobacterium, Bacteroides, Lactobacilli, and Clostridia) will dominate and account for greater than 99% of the bacteria in the intestines for the rest of the animal's life. Therefore, the microbial barrier of the gastrointestinal tract is also compromised during early life and likely contributes to the greater incidence of enteric disease.

Therefore, from a systematic perspective, there are many holes in the gastrointestinal immune system defense during the early post-natal life. This greatly increases the relative risk for enteric disease. It is well known that what an animal is fed during the neonatal period will influence the development of the gastrointestinal immune system and enteric disease resistance. It should be noted that a lot more basic research on the development of the post-natal gastrointestinal immune system in calves is needed and should be a research priority.

MATURATION OF GASTROINTESTINAL TRACT & PREVENTING HOST-PATHOGEN INTERACTIONS

A common management strategy in the dairy industry is to feed approximately 4L of colostrum within the first 6-12 hours of birth. Then calves are switched to either milk or milk replacer. It is well known that bioactive compounds in colostrum and transition milk directly influence the maturation of the gastrointestinal immune system. Our current colostrum management protocols are designed to ensure as many calves as possible get adequate passively derived immunoglobulins as possible. I don't want to down play the importance of passive transfer of immunoglobulins because it is essential in preventing systemic and local enteric diseases while the gastrointestinal tract matures; however, current colostrum management programs completely ignore the role that colostrum and transition milk play in the maturation of the intestinal immune system. Enteric disease would likely be reduced if we fed calves to hasten the maturation of the gastrointestinal immune system. Most of our management decisions after feeding colostrum are aimed at reducing the interaction of potentially pathogenic microorganisms with the intestinal epithelial cells.

Prebiotics, probiotics, and proteins from hyper-immunized egg or spray-dried plasma all have shown some merit in improving the resistance to enteric disease. Prebiotics are dietary components that are not easily digested by the calf, but are used by bacteria in the lower intestines to improve their growth. Probiotics are a vague term, but generally are live microorganisms that provide 'some' health benefit. At first glance this may seem bad, why would be want to improve the growth of bacteria in the lower intestines? As mentioned before, the intestinal tract is not sterile. Soon after birth, a wide range of bacterial species colonizes the gastro-intestinal tract of calves. Most of these bacterial species do not pose any immediate threat to the survival of the calf and in the past were called "good bacteria" and, of which, many of the common probiotic species are routinely classified as, including: lactobaccilus species, bifidobacteria, Enterocooccus faecium, and Bacillus species. Remember that the microbial barrier of the intestinal tract soon after birth is colonized primarily by facultative anaerobes and subsequently becomes inhabited largely by strict anaerobes. Most of the probiotic microorganisms are strict anaerobes. Many of the probiotic species also have a direct bactericidal activity or compete with the more pathogenic microorganisms for limited resources. In addition, probiotics are themselves bacteria and they may "prime" the immune system of the calf by staying alert, as even the immune system recognizes the "good" bacteria as foreign. The common, commerciallyavailable prebiotics available are the fructooligosaccharides (FOS), mannanoligosaccharides (MOS), lactulose, and inulin.

Data on the influence of prebiotics and probiotics alone on the health of dairy calves is equivocal. There are data that show improvements in reducing scouring and improving growth (Abe et al., 1995), whereas equally as many studies show no benefits to including either prebiotics or probiotics in milk (Morrill et al., 1995). The lack of a clear effect in calves is likely due to many environmental factors. Research does however support that many prebiotics and probiotics are generally safe and do not have any adverse effects on calf health of performance. In fact, most regulatory agencies around the world classify most prebiotics and probiotics as Generally Regarded As Safe (GRAS). Lastly, it is important to note that not all probiotic species and further, not all strains of a specific species, ie: not all Lactobaccilus acidophilus strains, behave similarly. Therefore, I would recommend only using probiotic species and strains that have been reported, through 3rd party research, to improve health and performance of calves. Additionally, viability/ stability of the product should be confirmed as many of the probiotic species can become nonviable during processing and storage.

Another strategy to reduce the interaction of pathogenic microorganisms is to feed egg protein from laying hens that were vaccinated against the very microorganisms that cause gastro-intestinal diseases in calves. The laying hens will produce immunoglobulins (IgY) and concentrate those proteins in their eggs, which can recognize the pathogen, bind to it, and prevent its interaction with a calf's gastro-intestinal tract. Inclusion of whole dried egg from these decreased the morbidity due to various bacteria and viruses. In addition to the use of hyper-immunized egg protein, spray-dried plasma proteins can improve gastrointestinal health of calves. Spray-dried plasma is exactly like it sounds, plasma that is spray-dried to preserve the functional characteristics of the diverse group of proteins in plasma. The use of spray-dried plasma has been used for many years in the swine industry to improve the performance and health during the postweaned period. The addition of spray-dried plasma proteins in milk replacer reduced enteric disease in calves (Quigley et al., 2002).

In 2010, my lab evaluated the effects of supplementing a blend of prebiotics, probiotics, and hyper-immunized egg proteins to Holstein calves from immediately after birth through the first 3 weeks of life (Ballou, 2011). Calves given the prophylactic treatment (n=45) were administered directly into the milk 5×109 colony forming units per day (from a combination of *Lactobacillus acidophilus*, *Bacillus subtilis*, *Bifidobacterium thermophilum*, *Enterococcus faecium*, and *Bifidobacterium longum*), 2 grams per day of a blend of MOS, FOS and charcoal, and 3.2 grams per day of dried egg protein from laying

hens vaccinated against K99+ Escherichia coli antigen, Salmonella typhimurium, Salmonella Dublin, coronavirus, and rotavirus. Control calves (n=44) were not given any prebiotics, probiotics, or dried egg protein. All calves were fed 2 Liters of a 20% protein / 20% fat, non-medicated milk replacer twice daily. Prior to each feeding fecal scores were determined by 2 independent trained observers according to Larson et al. (1977). Briefly 1 = firm, well-formed; 2 = soft, pudding-like; 3 = runny, pancake batter; and 4 = liquid splatters, pulpy orange juice. The prophylactic calves refused less milk (P<0.01) during the first 4 days of life (57 vs 149 grams of milk powder). There were no differences in starter intake or average daily gain due to treatments. However, calves that received the prophylactic treatment had decreased incidence of scours (P<0.01) during the first 21 days of life (25.0 vs 51.1%). Scours were classified as a calf having consecutive fecal scores ≥ 3. The intensity of disease in this study was low and only 1 out of 90 calves died during the experiment. These data support that a combination of prebiotics, probiotics, and hyper-immunized egg protein improve gastro-intestinal health and could be an alternative to metaphylactic antibiotic use. Future research should determine the efficacy of that prophylactic treatment in calves that are at a higher risk of developing severe gastrointestinal disease and subsequently death as well as investigate the mechanism(s) of action within the gastrointestinal immune system.

PLANE OF NUTRITION

The interest in the plane of nutrition that calves are fed during the pre-weaned period has increased primarily because data indicate that calves fed a greater plane of nutrition have decreased age at first calving and they may have improved future lactation performance (Soberon et al., 2012). More large prospective studies in various commercial settings should confirm that calves fed greater planes of nutrition during the pre-weaned period have improved future lactation performance. Most data on how plane of nutrition influences the health of calves during the first few weeks of life is limited to small, controlled experiments with fecal scores as the primary outcome variable (Nonnecke et al., 2003; Ballou, 2012). Many studies observed that the calves fed the greater plane of nutrition had more loose feces or greater fecal scores (Nonecke et al., 2003; Bartlett et al., 2006; Ballou et al., 2016), while others reported no differences in fecal scores (Ballou, 2012; Obeidat et al., 2013). It is important to note, that no study has reported greater fecal scores among calves fed a lower plane of nutrition when compared to calves fed a greater plane of nutrition. It has been suggested that the greater fecal scores were not due to a higher incidence of infection

or disease, but may be associated with the additional nutrients consumed. A couple of recent studies from my lab are confirming that calves fed greater quantities of milk solids early in life have greater fecal scores; however, when the dry matter percentage of the calves feces were determined there were no differences between calves fed differing quantities of milk solids (Liang et al., 2016).

It was unknown whether the digestibilities of nutrients of calves fed varying planes of nutrition were different during the first week of life. Decreased nutrient digestibilities would likely increase the risk of enteric disease because the increased supply of nutrients to the lower gastro-intestinal tract could provide a more favorable environment for pathogenic microorganisms to thrive. My lab recently tested the hypothesis that feeding a higher plane of nutrition during the first week of life would decrease the percentages of dietary nutrients that were digested and absorbed (Liang et al., 2016). Our justification for this hypothesis was that the reduced plane of nutrition during the first week of life would allow the gastro-intestinal tract time to adapt to enteric nutrition, without overwhelming the system. However, after conducting a digestibility trial with Jersey calves during the first week of life we had to reject that hypothesis. In fact, there was no difference in the percentage of intake energy that was captured as metabolizable energy, averaging 88% across treatments for the first week of life. We separated the first week of life up into 2 threeday periods and observed a tendency (P=0.058) for more of the intake energy to be captured as metabolizable energy during the 2nd period (85.9 versus 91.2 ± 2.0; 1st and 2nd period, respectively); however, the first period was likely underestimated because residual meconium feces would decrease the apparent digestibility. There was a treatment x period interaction (P=0.038) on the percentage of dietary nitrogen that was retained. The calves fed the greater plane of nutrition had improved nitrogen retention during the first period (88.0 versus 78.7 \pm 1.20; P=0.004), but was not different from calves fed the reduced plane of nutrition during the second period (85.3 versus 85.0 ± 1.20; P=0.904). Most of the difference in nitrogen retention during the first period could be explained by differences in apparent nitrogen digestibility. It should be noted that apparent digestibility was likely more underestimated among the calves fed the restricted milk replacer during the first period because an equal quantity of meconium feces collected across the treatments during period 1 would underestimate the calves fed the restricted quantity of milk replacer more. The data from the digestibility study indicate that healthy calves not only tolerate greater quantities of milk during the first week of life, but they incorporate those nutrients into lean tissue growth. The gastrointestinal immune system and implications to enteric health should further be investigated.

Over the past 7 years, my laboratory has conducted research to better understand the how plane of nutrition during the pre-weaned period influences leukocyte responses and resistance to infectious disease during the pre- and immediate post-weaned periods (Ballou, 2012; Obeidat et al., 2012; Ballou et al., 2016; Liang et al., 2016; Sharon and Ballou, unpublished). The results indicate that plane of nutrition influences leukocyte responses of calves (Ballou, 2012; Obeidat et al., 2013; Ballou et al., 2016). In 2 studies, we reported that when calves were fed a lower plane of nutrition their neutrophils were more active during the pre-weaned period, as evident by increased surface concentrations of the adhesion molecule L-selectin (Figure 1) and a greater neutrophil oxidative burst (Obeidat et al., 2013; Ballou et al., 2016). After weaning the elevated neutrophil responses were no longer apparent in either of those studies. The exact mechanisms for the more active neutrophils among the low plane of nutrition calves are not known, but could be due to increased microbial exposure because of increased non-nutritive suckling, altered microbial ecology of the gastrointestinal tract, or improved maturation of gastrointestinal immune system of calves fed greater quantities of milk solids. If the neutrophils are more active because of increased microbial exposure, calves fed a lower plane of nutrition could be at an increased risk for disease during the pre-weaned period if exposed to more virulent pathogens. Ongoing research in my laboratory is trying to understand the behavior and potential microbial exposure when calves are fed varying planes of nutrition and its influence on risk for enteric disease and immunological development. In fact, a few studies have shown that plane of nutrition during the pre-weaned period influence adaptive leukocyte responses. Pollock et al. (1994) reported that antigen-specific IgA and IgG2 were reduced when calves were fed more milk. In agreement, Nonnecke et al. (2003) reported that less interferon- γ was secreted when peripheral blood mononuclear cells were stimulated with T-lymphocyte mitogens. However, not all data indicate that adaptive leukocyte responses are reduced when greater quantities of milk are fed; Foote et al. (2007) did not observe any difference in either the percentage of memory CD4+ or CD8+ T lymphocytes or antigen-induced interferon-γ secretion. All the leukocyte response data taken together suggest that calves fed lower planes of nutrition may have more active innate leukocyte responses driven by increased microbial exposure, which may explain the greater adaptive leukocyte responses. In a relatively sanitary environment this increased microbial exposure may improve adaptive immune development in the absence of clinical disease, but in a dirty environment it would likely increase the risk of enteric disease.

How plane of nutrition influences resistance to enteric disease is even less clear than how the leukocyte responses are affected. Quigley et

al. (2006) reported that feeding a variable, greater plane of nutrition to high-risk Holstein bull calves, purchased from a sale barn and raised on bedding contaminated with coronavirus, increased the number of days calves had scours by 53% and also increased the number of days calves received antibiotics, 3.1 versus 1.9 days. In contrast, a more recent study reported that calves fed a greater plane of nutrition had improved hydration and fecal scores improved faster when they were challenged with Cryptosporidium parvum at 3 days of age (Ollivett et al., 2012). In a recent study from my lab, we orally challenged calves fed either a restricted plane or a greater plane of milk replacer at 10 days of age with an opportunistic pathogen, Citrobacter freundii (Liang and Ballou, unpublished). The calves fed the greater plane of nutrition had a greater clinical response to the challenge as evident by increased rectal temperatures (P = 0.021) and numerically greater peak plasma haptoglobin concentrations (511 versus 266 ± 108 µg/ mL; P = 0.118). There also was a tendency for total mucosal height of the ileum to be increased among calves fed the greater plane of nutrition (921 versus 752 \pm 59.1 μ m; P = 0.059). The increased surface area of the lower gastrointestinal tract could partially explain the increased clinical response among the calves fed the greater planes of nutrition. Current data indicate that their likely is a pathogen:host interaction on the effects that plane of nutrition influence enteric disease resistance. Larger data sets with naturally occurring disease incidence and more experimentally controlled relevant disease challenges that are focused on the gastrointestinal immune system are needed before definitive conclusions on the role that plane of nutrition plays on enteric health of calves during the first few weeks of life.

In contrast to health during the first few weeks of life, the plane of nutrition calves are fed during the pre-weaned period seems to be influence leukocyte responses and disease resistance among calves after they are weaned (Ballou, 2012; Ballou et al., 2016; Sharon and Ballou, unpublished). Jersey bull calves that were fed a greater plane of fluid nutrition had improved neutrophil and whole blood E. coli killing capacities after they were weaned when compared to Jersey calves fed a more conventional, low plane of nutrition (Ballou, 2012). These effects were only observed among the Jersey calves in this study and not the Holstein calves. In a follow-up study, Jersey calves that were previously fed a greater plane of milk replacer had a more rapid up-regulation of many leukocyte responses, including neutrophil oxidative burst and the secretion of the pro-inflammatory cytokine tumor necrosis factor- α , after they were challenged with an oral bolus of 1.5 x 107 colony-forming units of a Salmonella enterica serotype Typhimurium (Ballou et al., In Press, JDS). The increased activation of innate leukocyte responses among the calves previously fed the greater plane of nutrition calves reduced (P=0.041) the increase in plasma

haptoglobin and those calves also had greater concentrations of plasma zinc. The calves fed the greater plane of nutrition also had improved intake of calf starter beginning 3 days after the challenge (P = 0.039). These data indicate that the Jersey calves previously fed a greater plane of nutrition had improved disease resistance to an oral Salmonella typhimurium challenge approximately a month after weaning.

Recently, my lab recently completed a viral-bacterial respiratory challenge on calves a month after weaning that were previously fed either a restricted quantity or a greater plane of milk replacer (Sharon and Ballou, unpublished). Each calf was challenged intranasal with 1.5x108 plaque forming units of bovine herpes virus-1 per nostril and 3 days later were given either 106, 107, or 108 colony forming units of Mannheimia haemolytica intratracheal in 50 mL of sterile saline (n=5 per plane of nutrition and bacteria dose combination; N=30). Calves were observed for 10 days after the Mannheimia haemolytica challenge. The bovine herpes virus-1 challenge decreased calf starter intake by 21.2% in both plane of nutrition treatments. The Mannheimia haemolytica challenge further decreased calf starter intake, but again was not different between planes of nutrition (7.6%). All calves survived the entire observation period, but 2 calves were euthanized (were completely anorexic and did not respond to antimicrobial / anti-inflammatory treatments) 2 days after the end of the observation period and 2 calves died within a week of completing the observation period. All calves that died or were euthanized were previously fed the restricted plane of nutrition (1, 2, and 1 calves challenged with 106, 107, or 108 Mannheimia haemolytica, respectively). Necropsies of all 4 calves were consistent with severe pneumonia. Hematology and plasma data during both challenges indicated that calves previously fed the restricted quantity had a greater clinical response as evident by greater percentages of neutrophils in peripheral circulation (P=0.041) and plasma haptoglobin concentrations ($P \le 0.097$). Therefore, the calves previously fed the restricted quantities of milk replacer had a more severe response to the combined viral-bacterial respiratory challenge, and the response was relatively independent of the Mannheimia haemolytica dose.

Therefore, the 3 studies from my lab are promising that early plane of milk replacer nutrition can influence the health of dairy calves within 1 month of weaning. Further, it appears that both enteric and respiratory health is improved with feeding greater planes of nutrition during the pre-weaned period. As was noted for enteric health during the pre-weaned period, larger data sets with naturally occurring disease and additional experimentally controlled challenges with leukocyte responses are needed before definitive conclusions can be draw. Further, it is of interest

whether or not the improved health observed within 1 month of weaning would persist later into life and improve resistance to other diseases that are common during the life cycle of dairy cattle, including: gastro-intestinal, respiratory, metritis, and mastitis.

IMPLICATIONS

Dairy calves are extremely susceptible to disease in the first few weeks of life, which may be related to the naïve gastrointestinal immune system of calves. Increasing the plane of nutrition in the first week or $\boldsymbol{2}$ appears to increase fecal scores, although the dry matter percentages of the feces were not different. Additionally, the digestibility of nutrients during the first week of life are great and does not appear to be impaired by feeding a greater quantity of milk replace solids. However, resistance to enteric disease during the first few weeks of life does appear to be influenced by plane of nutrition, but more data are needed before more definitive conclusions can be made. Some early data are suggesting that feeding a greater plane of nutrition during the pre-weaned period may improve leukocyte responses and disease resistance of calves that extends beyond the pre-weaned period, but as with the effects of plane of nutrition on risk for enteric disease, more data are needed before we fully understand how early life plane of nutrition influences disease resistance later in life.

In addition to plane of nutrition, the uses of prebiotics, probiotics, and proteins from hyper-immunized egg or spray-dried plasma were all shown to reduce the incidence of gastro-intestinal disease. If you have a high early mortality I would recommend you look into using a research-backed product with prebiotics, probiotics, or proteins from hyper-immunized egg or spray-dried plasma.

ACKNOWLEDGEMENTS

Many current and past graduate students and visiting scientists have helped collect most of the data presented in this paper. I would like to thank Clayton Cobb, Dr. Lindsey Hulbert, Yu Liang, Dr. Belal Obeidat, Dr. Tyler Harris, Dr. Matthew Sellers, Dr. Amanda Pepper-Yowell, Dr. Devin Hansen, Dr. Kate Sharon, and Emily Davis. I would also like to acknowledge that some of this work was conducted in collaboration with Dr. Jeff Carroll with the USDA-ARS Livestock Issues Research Unit located in Lubbock, TX. I appreciate our collaboration and would like to thank his lab group for all their hard work, especially Jeff Dailey.

REFERENCES

Abe, F., N. Ishibashi, and S. Shimamura. 1995. Effect of administration of Bifidobacteria and Lactic Acid Bacteria to newborn calves and piglets. J. Dairy Sci. 78:2838-2848.

Ballou, M.A. 2011. Case Study: Effects of a blend of prebiotics, probiotics, and hyperimmune dried egg protein on the performance, health, and innate immune responses of Holstein calves. Prof. Anim. Sci. 27:262-268.

Ballou, M.A. 2012. Immune responses of Holstein and Jersey calves during the preweaning and immediate postweaned periods when fed varying planes of milk replacer. 95:7319-7330.

Ballou, M.A., D.L. Hanson, C.J. Cobb, B.S. Obeidat, T.J. Earleywine, J.A. Carroll, M.D. Sellers, and A.R. Pepper-Yowell. 2014. Plane of nutrition influences the performance, innate leukocyte responses, and the pathophysiological response to an oral Salmonella typhimurium challenge in Jersey calves. In Press, J. Dairy Sci

Bartlett, K. S., F. K. McKeith, M.J. VandeHaar, G.E. Dahl, and J.K. Drackley. 2006. Growth and body composition of dairy calves fed milk replacers containing different amounts of protein at two feeding rates. J. Anim. Sci. 84:1454-1467.

Foote, M. R., B. J. Nonnecke, D. C. Beitz, and W. R. Waters. 2007. High growth rate fails to enhance adaptive immune responses of neonatal calves and is associated with reduced lymphocyte viability. J. Dairy Sci. 90:404-417.

Guilloteau, P., R. Zabielski, J.W. Blum. 2009. Gastrointestinal tract digestion in the young ruminant: ontogenesis, adaptations, consequences and manipulations. J. Physiol. Pharmacol.

Morrill, J. L., J. M. Morrill, and A. M. Feyerherm. 1995. Plasma proteins and a probiotic as ingredients in milk replacer. J. Dairy Sci. 78: 902-907.

National Animal Health Monitoring System. 1993. Dairy heifer morbidity, mortality, and health management focusing on preweaned heifers. Ft. Collins, CO: USDA:APHIS:VS.

National Animal Health Monitoring System. 1996. Part 1: Reference of 1996 Dairy Management Practices. Ft. Collins, CO: USDA:APHIS:VS.

National Animal Health Monitoring System. 2007. Dairy 2007: Heifer calf health and management practices on U.S. dairy operations, 2007. Ft. Collins, CO:USDA:APHIS:VS.

Nonnecke, B. J., M.R. Foote, J.M. Smith, B.A. Pesch, and M.E. Van Amburgh. 2003. Composition and functional capacity of blood mononuclear leukocyte populations from neonatal calves on standard and intensified milk replacer diets. J. Dairy Sci. 86:3592-3604.

Obeidat, B.S., C.J. Cobb, M.D. Sellers, A.R. Pepper-Yowell, T.J. Earleywine, and M.A. Ballou. 2013. Plane of nutrition during the preweaning period but not the grower phase influences the neutrophil activity of Holstein calves. J. Dairy Sci. 96:7155-7166.

Ollivett, T.L., D.V. Nydam, T.C. Linden, D.D. Bowmann, and M.E. Van Amburgh. 2012. Effect of nutritional plane on health and performance in dairy calves after experimental infection with Cryptosporidium parvum. J. Am. Vet. Med. Assoc. 241:1514-1520.

Pollock, J. M., T. G. Rowan, J. B. Dixon, and S. D. Carter. 1994. Level of nutrition and age at weaning: Effects on humoral immunity in young calves. Br. J. Nutr. 71:239-248.

Quigley, J.D., III, C.J. Kost, and T.A. Wolfe. 2002. Effects of spray-dried animal plasma in milk replacers or additives containing serum and oligosaccharides on growth and health of calves. J. Dairy Sci. 85:413-421.

Quigley, J.D., T. A. Wolfe and T. H. Elsassert. 2006. Effects of additional milk replacer feeding on calf health, growth, and selected blood metabolites. J. Dairy Sci. 89:207-216.

Soberon, F., E. Raffrenato, R.W. Everett, and M.E. Van Amburgh. 2012. Preweaning milk replacer intake and effects on long-term productivity of dairy calves. J. Dairy Sci. 95:783-793.



THE SUPPORT CALVES NEED

LIFELINE® nutrition solutions all contain a complex mixture of functional proteins that retain biological actions that help to maintain normal gut health in young calves.

Whether you choose a day one colostrum supplement or booster, or a milk additive like Gammulin or ProBalance, you can feel confident your calves are getting the overall support they need.

Investing now pays lifetime benefits.









UNDERSTANDING DYNAMIC GROWTH OF REPLACEMENT HEIFERS

Noah B Litherland, Ph.D., Dairy Youngstock Technical Specialist, Vita Plus Corporation, Madison, WI

Heifer development from birth to puberty can be described as "dynamic". Dynamic changes in nutrient intake, source of nutrients, digestive processes and rate of growth are just some of the highlights during this exciting phase of growth. The dynamic component includes both the rate and direction of change heifers experience. During the first three months of life, calf growth and development requires major and rapid changes to meet the nutrient demands for maintenance and growth.

Supplying calves and heifers with the proper balance of nutrients to achieve steady and consistent growth through the nursery and grower phase is the key to developing quality replacement heifers.

TEN GUIDING PRINCIPLES TO ACHIEVING TARGETED GROWTH AND DEVELOPMENT INCLUDE:

- 1. Calf growth is ultimately dependent upon success during the first two weeks of life.
- 2. We grow calves from the inside out by maturing and developing the GI tract to efficiently supply nutrients needed during transitions from the nursery to the grower phases.
- 3. Maturing and developing the GI tract takes time and cannot happen overnight.
- 4. Calf nutrient requirements are dynamic, but predictable.
- 5. For better or for worse, the calf's microbial ecology is an important component impacting calf growth.
- 6. Gradual changes in feeding plans that maintain consistent nutrient intake and utilization are preferred over feeding plans that induce variation in intake. Feeding methods are likely as important as feed composition. Optimize milk balance of protein and energy allowable gain. Optimize grain balance of starch and fiber.
- 7. Evaluating factors impacting the rate of growth during the nursery, transition, and grower phases in addition to the overall growth offers insight into the performance of the program.
- 8. Maintaining steady growth curves within the group results in increased uniformity of replacement heifers.

- 9. Increasing the trajectory of the growth curve during the first 90 days has a considerable impact on heifer size at calving.
- 10. Developing quality replacement heifers is an investment in the dairies future.

ENERGY

In utero, the calf relies on it's dam's glucose to supply energy for growth and development. The average birth body weight of a Holstein calf is 85 lb. After birth, the calf uses milk fat and lactose as primary energy sources in the first weeks of life. At about fourteen days, a calf's rumen has matured enough to begin supplying energy from fermentation of starter grain into volatile fatty acids. As daily starter intake builds over time, calf energy supply from fermentation end-products continues to increase and is the primary source of energy after weaning from milk. Calf birth body weight, rate of growth, and environmental demand for energy (thermal stress), and severity and duration of health challenge are the primary factors contributing to energy demand for growth.

MANAGING FOR ENERGY BALANCE

What is the cost of no growth or, worse yet, a loss in bodyweight during the first week of life?

Perhaps a good goal for newborn calf performance during the first week of life should be to maintain or even begin gaining bodyweight. Practically, producers should consider weighing a subset of calves at birth and again at one week of age to determine change in calf weight. This measure might be a strong indicator of the success of the calf nutrition and management program.

Factors, such as pathogen challenge, can also increase energy associated with immune function activity and decreased efficiency of nutrient absorption if the pathogen damages the lining of the small intestine.

The immune system needs fuel to function normally and protect the calf from pathogens. The first few weeks of life and during weaning are two key times when energy intake is often limiting resulting in reduced efficiency of immune function. Glucose is the primary source of energy usable by the immune system. When blood glucose is below optimal amounts, the immune system is not able to function normally.

PROTEIN

In utero, the calf relies on amino acids delivered through maternal blood to build structural tissues. After birth, amino acids supplied from milk protein or alternative protein sources such as plasma, wheat, and soy. The amount of protein, the digestibility of the protein, and the amino acid balance are all important factors impacting the efficient of protein utilization. Microbial protein produced in the rumen during fermentation of starter grain has a nearly perfect amino acid profile for growth and will supply an increasing proportion of net protein for growth as weaning approaches. In addition to microbial protein, rumen bypass protein from grain such as soybean meal or roasted soybeans contributes protein at the small intestine. Calf birth weight and rate of growth are primary factors contributing to protein demand for growth. Imbalances in feed amino acid profile, over-feeding protein relative to requirements, and imbalances in osmolality contribute to reductions in the efficiency of protein use.

FUNCTION OF PROTEIN IN MILK REPLACER

Proteins in CMR supply amino acids (AA) which are used in protein synthesis for muscle development, bone growth, and can be broken down to provide energy in times of energy deficit. Proteins are composed of 20 AA's, many of which the calf can synthesize in adequate amounts to meet its needs. But several AA's must be consumed in the diet in amounts sufficient to meet the needs for maintenance and growth. In addition to their important impact on growth, certain AA's may impact immune function, hormone concentrations, and performance as an adult. Amino acid imbalances result in reduced calf performance. Milk replacers should be balanced for AA profile and therefore might include pure AA' such as lysine and methionine. Whey proteins are highly digestible in the small intestine and possess excellent amino acid balance.

FEEDING RATE

As described in Table 1, protein maintenance needs (used to replace proteins in body tissues) are relatively small (less than 0.1lb/day). Amino acids for growth represent the major portion of total protein requirements (0.3 lb/lb of BW gain). As calf body weight and rat of gain increases, the crude protein needed to achieve this growth also increases.

Table 1. Prediction of protein requirements based on calf size and averaged daily gain (NRC, 2001).

CALF BODY WEIGHT, LB	GAIN, LB/D	DMI, LB/D	CRUDE PROTEIN, LB/D
100	0	1.0	0.1
	0.5	1.2	0.2
	1.0	1.6	0.3
	1.3	1.8	0.5
130	0	1.2	0.1
	0.5	1.5	0.2
	1.0	1.9	0.4
	1.3	2.3	0.5
	1.8	2.7	0.6

WATER

Water is the most important nutrient and the amount of water intake has considerable impact on digestive processes, rate of movement of digesta through the gastrointestinal tract, as well as supplying the fluid media for bacterial growth in the rumen. Milk supplies the bulk of water intake during the nursery phase. Water from free-choice supply increases during the weaning process. Water and dry feed intake are positively correlated and increase at a rate of 3:1 water:starter during the nursery phase. Calf size, rate of growth, dry feed intake are important factors contributing to water demand. Overfeeding protein, imbalances in osmolality, thermal stress, and severity and duration of health challenge all contribute to increased water excretion rate and therefore need to increase water intake to maintain hydration status.

It is estimated that three to four pounds of water are required to digest one pound of calf starter grain. We arrived at this conclusion by measuring water and starter grain intake by calves and simply evaluating the ratio water and starter the calf consumed. Making the right mix of starter and water in the rumen seems to be a little like mixing cement. The right amount of water is needed to provide the moisture for rumen microbes to inoculate feed particles, to lubricate feed allowing for regurgitation as well as passing from the reticul-rumen to the abomasum for hydrolytic and enzymatic digestion. Water is the most important nutrient for all of life's processes including transport of nutrients and other compounds to and from cells; digestion and metabolism of nutrients, elimination of wastes, maintenance or proper fluid and ion balance. Water is a big piece of growth as a calf's weight typically is about 75% water. Resident

time of a water molecule in the rumen has been estimated to be a little over an hour in cattle. A calf's water intake typically increases with size and age with the greatest increase occurring at weaning.

A Journal of Dairy Science article in press from Dr. Pete Erickson's lab group at the University of New Hampshire reported water intake and urinary water output by dairy calves fed three planes of milk replacer nutrition (Table 2). Drinking water intake was low and might be due to how water was offered. The author's state drinking water was available at all times but does not indicate timing or temperature of drinking water. We tend to see greatest water intake when offering modest amounts of warm water within ten minutes after completion of the milk meal.

As expected, water intake from milk replacer represented the majority of water intake until weaning when drinking water intake abruptly increased. Urine output was measured through collection via catheters placed in a subset of calves in this experiment. Urine output ranged from approximately 60 to 80% of total water intake with greater urine output measured in calves fed an accelerated plane of nutrition (The authors noted significantly greater urine nitrogen output with increasing plane of nutrition). Fecal moisture also contributes to water in the calf environment but was not reported in this study. Calves with loose stool contribute greater amounts of water to their environment than calves with firmer and drier stool.

A 1918 publication by J. W. Whisenand at the Illinois experiment station demonstrated the water absorbing capacity of a variety of livestock bedding materials. As it turns out, wheat straw can absorb about twice (2.2) its weight in water. If we do a simple calculation with the data below, calves on the control diet would require about 2.1 lb. of wheat straw/day to soak up their urine or about 125 lb. of wheat straw over 2 months. In contrast, the accelerated fed calves would require 4.4 lb. of wheat straw/day to soak up their urine or about 267 lb. of wheat straw over 2 months. These calculations do not take into account evaporation or drainage.

In summary, feeding program has an impact on water intake and urine output. Milk replacer programs that meet but not greatly exceed nutrient requirements and balance protein and energy intake increase calf efficiency. Providing adequate and timely bedding in addition to adequate drainage (drains in concrete floors or sand under hutches) will help keep calves dry during the nursery phase. Additionally, efforts to increase starter grain intake will firm up fecal output and increase water retention by the calf. Finally, ventilation systems that remove moisture from the barn without chilling calves should continue to be investigated.

Table 2. Water intake and urine output of dairy heifer calves fed varying planes of nutrition from milk replacer.

			·				
	TREAT	TREATMENTS ¹					
			ACCELERA	ATED			
D1 to 56, ADG, lb/d	1.23	1.53	1.81				
	DRINK	ING WAT	ER INTAKE, L	B/D			
D1 to 42	0.8	0.9	0.6				
D 43 to 49	3.3	2.9	2.1				
D 50 to 56	5.9	6.0	5.8				
Overall	1.7	1.8	1.4				
Average							
	WATER	WATER INTAKE FROM MILK					
	REPLA	CER, LB/D					
D1 to 42	7.3	8.5	11.3				
	TOTAL	WATER IN	ITAKE				
	(DRIN	KING WAT	ER + MILK				
	REPLA	CER, LB/D))				
D1 to 42	8.1	9.4	11.9				
	URINE OUTPUT, LB/D						
D 35 to 42	4.6	7.1	9.8				

¹Control 20:20 milk replacer fed at 1.0 lb/d; Modified 26:18 milk replacer fed at 1.5 lb/d; Accelerated 26:18 milk replacer fed at 2.0 lb/d.

At each stage of growth bottlenecks can occur that impact calf growth. During each stage, we need to both have a goal defining success but also an understanding of the key challenges as well as the primary factors that are changing during this time.

Table 3. Description of the stage of development, primary goal, key constraint, and dynamic component or changes occurring in the background that impact heifer development.

STAGE OF DEVELOPMENT	GOAL	KEY CONSTRAINT	DYNAMIC COMPONENT
BIRTH	Prime the immune system and the GI tract	Pathogen exposure	Colostrum impact on Gl development
EARLY NURSERY	Establish feeding behavior and GI tract microbial ecology	Stall-out due to pathogen exposure of nutritional stress	Interaction with pathogens and the environment
NURSERY	Balance nutrient intake from milk, water, and grain for optimal growth	Maintaining a consistent feeding and growing environment	Rumen development and rate of growth
WEANING	Ramp up grain and water intake	Large swings in energy and protein balance	Feeding and drinking behavior
TRANSITION	Maintain and further develop grain and water intake.	Additive stressors and changes in feeding behavior	Feeding and socialization and rate of growth
GROWER 1	Transition onto TMR or greater forage intake	Feed bunk ergonomics and TMR formulation	Shift in nutrient supply
GROWER 2	Steady growth towards puberty	Dialing in feed intake	Shift in nutrient supply

SUMMARY

We need to develop an understanding of the dynamic (both rate and direction) changes heifers experience during development. Systems that take advantage of dynamic growth by consistently meeting the needs of the replacement heifer will have the greatest success.

AUTOMATED CALF FEEDERS: WHAT PRODUCERS NEED TO KNOW

Donald C. Sockett DVM, M.S., Ph.D. Diplomate ACVIM,

Wisconsin Veterinary Diagnostic Laboratory, University of Wisconsin-Madison

INTRODUCTION

Automated calf feeders are an ideal way to feed a full potential diet to dairy calves and also get the benefit of feeding the calves more than 2-3 times a day. Currently, it is recommended that dairy calves (Holsteins) should double their birth weight by 56 days of age and add a minimum of 4-5 inches of height when measured at either the withers or the hips. This requires the calves to gain at least 1.6 lbs./hd/day to achieve this goal. Automated calf feeders are an ideal tool that good calf managers can use to achieve this goal.

AUTOMATED CALF FEEDERS

There are at least four to five different automated calf feeders available in the US for dairy producers to purchase. Producers should be encouraged to thoroughly investigate which calf feeder they wish to purchase before they make the capital investment. I have been involved in a number of field investigations involving automated calf feeders and the following is a short summary of what producers need to think about when installing an automated calf feeder into either and existing or new-calf barn.

KEY POINTS TO CONSIDER

Water quality. The potable drinking water should be tested and if there are water quality issues (iron, manganese, sulfates, sodium, hardness etc.,) they should be addressed and fixed before the calves are introduced into the barn.

Owners should consider chemically treating both the potable drinking water and the water that is used to mix up the milk replacer with a chemical that is EPA approved for public drinking water. Automated calf feeder barns that have invested in a commercially available water treatment system usually have much less trouble with respiratory disease and neonatal calf diarrhea (unpublished data) than herds that do not chemically treat their potable drinking water.

Air quality. Producers should invest in a positive tube ventilation system for the calves that are housed in the automated calf

feeder barn. The system should be designed by individuals that have completed the short course on positive pressure tube ventilation that is offered by the School of Veterinary Medicine at the University of Wisconsin-Madison.

Calf numbers. Research has shown that the incidence of respiratory disease increases whenever the group size is larger than 8-10 calves. I don't like to see group sizes larger than 20 calves in automated calf feeder barns.

Space. The bedding pack area needs to be properly drained and there should be a minimum of 35 square feet (preferably 40-45 square feet) of bedding pack area for each calf.

Each pen should be filled within 7-10 days and it should never take more than 14 days to fill each individual pen in the calf barn.

Each pen is the calf barn needs to have its own dedicated waterer that is not shared with other pens of calves. The waterer needs to be constructed of stainless steel. Stainless steel is very robust and easy to clean. Each waterer should have a floor drain placed next to it.

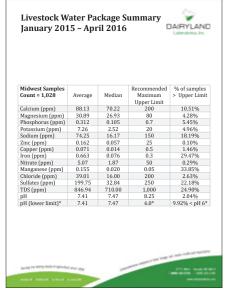
Each group or pen of calves needs to have segregation from other pens or groups of calves in the automated calf feeder barn. This can be done by having 4 foot high solid panels between groups of calves or alternatively there should be a minimum of two feet preferably four feet of segregation between groups of calves.

Individual calf pens should be left empty for 5-7 days after the calves have been weaned and have left the pen. This will provide adequate time for proper cleaning and disinfection of the pen.

Pens should be cleaned using low-pressure foam cleaning after the bedding material has been removed. A high-pressure washer should never be used since they aerosolize pathogens and cause cross-contamination between groups or pens of calves. Pens should be designed with adequate slope in the floors to ensure proper drainage of the water.

The calf feeding nipple needs to be cleaned and replaced with a different nipple (that has been properly cleaned and sanitized) at least once preferable twice a day. The nipples should be turned a







quarter turn when they are replaced on the automated calf feeder.

The raised platform where the automated calf feeding nipple is housed should be scraped and sprayed down at least twice a day with a 200-250 ppm solution of chlorine dioxide.

The calf feeding line (machine to the automated calf feeding nipple) needs to be replaced at least once a week.

The automated calf feeder needs to have at least two automated cleaning cycles done each day (12 hour intervals) and at least one circuit cleaning done once a day. The circuit cleaning cycle needs to use an acid (pH 3-4) which contains 25-50 ppm of chlorine dioxide.

The automated calf feeder needs to be calibrated at least once preferably twice a week.

The automated calf feeder needs to be taken apart and rigorously cleaned at least quarterly preferably monthly.

The floor in the automated calf feeder room needs to be thoroughly cleaned (low pressure foam cleaning) at least semi-annually preferably quarterly.

The room that houses the automated calf feeder needs to be climate controlled (heating and air conditioning) with a dehumidifier installed as well. The dehumidifier will help prevent caking of the milk replacer powder in the hopper and the chute that leads to the mixing vessel. Caking of the milk replacer powder can lead to wide variations in the percent total solids that is fed to the calves leading to abomasitis and digestive upsets.

PRODUCER PANEL: LIGHT THE FIRE THROUGH EMPLOYEE MANAGEMENT

 $\textbf{Moderated by: Ruby Newell-Legner,} \ 7 \ \textit{Star Service}$

RETHINKING COLOSTRUM: IT'S MORE THAN JUST IMMUNOGLOBULINS

Mike Van Amburgh, Ph.D. Department of Animal Science

Cornell University, Ithaca, NY

Email: mev1@cornell.edu Phone: 607-592-1212

INTRODUCTION

It has been well recognized that the phenotypic expression of an individual is affected by both genetic ability as well as the environment. To some degree, while in the uterus, the mother controls the environment in which the fetus is developing, influencing in this way the expression of the genetic material and there is good evidence that the environment can play a role in long-term productivity in beef cattle (Summers and Funston, 2012). For example, heat stress of the dam during late fetal development has been shown to cause effects on subsequent growth, immune function and feed efficiency in the calf (Tao et al., 2012). In that study calves from heat stressed versus cooled dams had lower circulating IgG's, lower efficiency of absorption, reduced immune cell proliferation and lower growth rate through weaning indicating that the effect of heat stress on the calf carried over through at least the weaning period. Thus, environmental factors affect the calf during fetal development and the productivity of the calf can be modified; an outcome that has not been fully recognized and appreciated through the pre-weaning period. Once the calf is born, it will carry these effects with them into post-natal life, where other environmental and maternal factors will continue to impact the productivity of the animal. The first mammary secretion, colostrum, plays an important role in the development of the calf and although traditionally considered only for its role in immune system function, data generated over many years suggests the role in immune system function is more complex than immunoglobulins.

IT'S NOT JUST IGGS - ROLE OF MATERNAL LEUKOCYTES

Colostrum is rich in many different cell types, many of which are lumped into the term "somatic cells" analyzed as such and not always positively. However, those cells are important and data generated in other species clearly demonstrated the presence and

"trafficking" of cells, primarily leukocytes into circulation of the neonate (Williams, 1993; Sheldrake and Husband, 1985). More recently, work has been conducted to understand if the uptake of the maternal leukocytes into circulation have any impact the function and capacity of the immune system of the calf. The implication is that leukocytes from the dam will carry "maternal memory" from prior exposure and recognition of pathogenic organisms and if functional, can enhance cellular immunity in the calf. This adds a new dimension to the role of colostrum with respect to immunity and creates a conflict for management of colostrum if the presence and availability of these cells is important for full immune system stimulation and function in the calf.

Papers have been published over the last decade that clearly demonstrate the uptake of leukocytes from colostrum into the circulation of the calf (Reber et al, 2006; 2008ab; Donovan et al. 2007; Langel et al., 2015; Novo et al., 2017). The data from Reber et al. (2006) clearly demonstrated that maternal leukocytes were transferred into the calf within 12 to 24 hr of colostrum ingestion and disappeared from circulation within 36 hr after ingestion. The implication of this data was maternal leukocytes from the blood stream of the dam were modified in the mammary gland to be more functional and capable of being absorbed into circulation in the calf. This is significant because it implies an active process and not just a process that passively accepts whatever cell might be present in the colostrum. Follow-up work from Reber et al. (2008ab) further demonstrated that the maternal leukocytes were absorbed into circulation and those cells enhanced the rate of maturation of immune cells in the calf and the ability of the cells to recognize particular antigens and the majority of the developmental changes occurred within the first two weeks post colostrum ingestion.

Following this concept, Donovan et al. (2007) studied the effect of maternal leukocyte uptake on cellular immunity in the calf by targeting specific antigen responses. In this study, they vaccinated the dams against BVDV using an inactivated vaccine but did not vaccinate them for mycobacterial antigens, thus the cells would be naïve to the mycobacteria. The colostrum was then fed intact,

after freezing or after cell-removal. Calves were then challenged with BVDV antigens. Calves fed the intact colostrum had enhanced immune responsiveness whereas calves fed the frozen and cell free colostrum did not respond similarly. All calves had similar responses to the mycobacterium antigens demonstrating the lack of maternal information transfer. This study suggests freezing colostrum negatively affects the population of maternal leukocytes preventing them from being absorbed and begs the question about the significance of this outcome given our management of colostrum to ensure low bacteria counts and disease transmission through freezing and pasteurizing.

The positive effect of cell transfer from colostrum on cellular immunity was further demonstrated in both Holstein and Jersey calves in work from Langel et al. (2015) and Novo et al. (2017). In the study from Langel et al. (2015) calves were fed 4 qt of either whole colostrum or cell-free colostrum at birth. Calves receiving the cell-free colostrum had higher respiratory scores at 38 d of age and there were no differences in fecal consistency. Calves fed the whole colostrum had immune cells with the ability to recognize particular pathogens and the only manner in which this could occur would be through the exchange of information from the maternal cells to the intrinsic leukocytes in the calf. In the study of Novo et al. (2017) calves were fed whole fresh colostrum or frozen colostrum in each case from their own dams. Calves given the frozen colostrum had more diarrhea on day 7 than calves fed fresh colostrum. In addition, the calves fed frozen colostrum had less red blood cells, less hemoglobin and more anemia from 21 to 28 days. Overall, the number of leukocytes remained constant in the calves fed whole colostrum whereas the lymphocyte population increased in the calves fed frozen colostrum after 7 days of age. Taken together, these studies demonstrate changes in cellular immunity in neonatal calves with modifications to their ability to recognize possible pathogens and challenges to the system. Implications for colostrum management are that fresh colostrum is best for ensuring the transfer of this information from the dam to the offspring, whether freezing or pasteurizing, but the degree to which this lack of leukocyte transfer would affect the long-term immune function of the animal is still unknown. Thus, it is more prudent to maintain our current protocols and freeze and or pasteurize colostrum to ensure pathogens are managed and colostrum quality is maintained.

COLOSTRUM AS A COMMUNICATION VEHICLE

The effect and extent of maternal influence in the offspring's development does not end at parturition, but continues throughout the first weeks of life through the effect of milk-born factors, including colostrum, which have an impact in the physiological development

of tissues and functions in the offspring. A concept termed the "lactocrine hypothesis" has been introduced and describes the effect of milk-borne factors on the epigenetic development of specific tissues or physiological functions in mammals (Bartol et al., 2008). Data relating to this topic has been described in neonatal pigs (Donovan and Odle, 1994; Burrin et al., 1997) and calves (Baumrucker and Blum, 1993; Blum and Hammon, 2000; Hammon et al., 2012). The implication of this hypothesis and the related observations are that the neonate can be programmed maternally and postnatally to alter development of a particular process and potentially modify genetic ability of the animal.

Table 1. Nutrients, energy, immunoglobulins, hormones and growth factors in colostrum and milk.

COMPONENTS	UNITS	COLOSTRUM	MATURE MILK
Gross Energy	MJ/L	6	2.8
Crude protein	%	14.0	3.0
Fat	%	6.7	3.8
Immunoglobulin G	g/L	81	<2
Lactoferrin	g/L	1.84	Undetectable
Insulin	µg/L	65	1
Glucagon	µg/L	0.16	0.001
Prolactin	µg/dL	280	15
Growth hormone	µg/dL	1.4	<1
IGF-1 Leptin	µg/dL µg/dL	310 30	<1 4.4
TGF-a	µg/dL	210	<1
Cortisol 17βEstradiol	ng/ml µg/dL	11.2 3.3-4.7	1.2 0.54

At birth, the gastrointestinal tract (GIT) is highly developed but naïve and will undergo significant growth, specifically protein synthesis, cell growth and enzyme production to enhance digestion, absorption and create a more robust barrier for immune system defense. Colostrum contains many growth factors that are active at enhancing the development of the GIT (Table 1) and this has been extensively researched and reviewed (Odle et al., 1996; Blum and Hammon, 2000; Steinhoff-Wagner et al. 2011; Hammon et al. 2012). For example, colostrum feeding has been shown to positively affect the development of the gastrointestinal tract (GIT)

and enhance energy metabolism of the calf. Adequate intake of these non-nutritive factors appears to be important for establishing gastrointestinal development for enhanced nutrient intake and nutrient utilization (Blum and Hammon, 2000; Hammon et al. 2012).

Several studies have identified factors in colostrum that enhance crypt cell growth and development which in turn enhances villus height in both calves (Blum and Hammon, 2000; Blätter et al., 2001; Roffler et al., 2003). In addition to the increase in absorption capacity through increased surface area, there is a concomitant increase in enzyme production, especially lactase that enhances digestion and absorption of glucose (Hammon and Blum, 1997; Steinhoff et al., 2010). This leads to data like that from from Steinhoff-Wagner et al. (2011) where they clearly demonstrated that colostrum feeding as compared to iso-nutrient levels of a milk-based formula enhanced the glucose uptake of calves fed solely colostrum for up to four days of life. In that experiment, first milking colostrum was fed as the first meal and second, third and fourth milking colostrum was fed over the next three days, respectively, to examine differences in dietary glucose uptake, insulin responsiveness and endogenous glucose production. Calves fed colostrum had higher levels of plasma glucose, similar endogenous glucose production and higher plasma insulin concentrations post feeding, and suggesting that colostrum enhanced the absorption of glucose and the insulin in the colostrum was absorbed by the GIT and contributed to the endogenous insulin production. It is also important to note that glycogen reserves were greater in the calves fed colostrum and that serum urea nitrogen was lower and amino acid concentration was greater, implying a more anabolic state with colostrum intake as compared to similar nutrient intake from formula. Thus, it appears that in addition to the Ig's, the other non-nutritive factors in colostrum are important to establish enhanced energy utilization and GIT development in newborn calves and these potential effects should be considered when evaluating and diagnosing differences in calf performance under similar management and nutritional conditions.

Given the data on development of the GIT, the next logical outcome is to look for growth responses based on the amount of colostrum fed in the first few hours of life or to find comparison where alternatives to the dam's colostrum was fed and evaluate differences. For example, Jones et al. (2004) examined the differences between maternal colostrum and a serum-derived colostrum replacement. In that study, two sets of calves were fed either maternal colostrum or serum-derived colostrum replacement with nutritional components balanced. The colostrum replacer was developed to provide adequate immunoglobulins to the neonatal calf, however the other nonnutritive factors found in colostrum were not considered. The results demonstrated that in the first 7 days of life, the calves fed maternal colostrum had significantly higher feed efficiency the difference established in that period was still apparent at 29 days, compared to calves fed serum-derived colostrum replacement. I is important to recognize the IgG status of calves on both treatments were nearly identical suggesting that factors in colostrum other than IgG's were important in contributing to the differences. Further, data from Faber et al. (2005) demonstrated that the amount of colostrum, 2 L (2.1 qt) or 4 L (4.3 qt), provided to calves at birth significantly increased pre-pubertal growth rate under similar nutritional and management conditions and tendencies for greater herd life and milk yield through two lactations.

To extend and try to better understand this data, Soberon and Van Amburgh (2011) examined the effect of colostrum status on pre-weaning ADG and also examined the effects of varying milk replacer intake after colostrum ingestion. Calves were fed either high levels (4 L (4.3 qt)) or low levels (2 L (2.1 qt)) of colostrum, and then calves from these two groups were subdivided into two groups that were fed milk-replacer in limited amounts or ad-libitum. Calves fed 4 L of colostrum had significantly greater average daily gains pre-weaning and post-weaning and greater post-weaning feed intake, consistent with the data from Faber et al. (2005) and Jones et al. (2004). The observations from these experiments reinforce the need to ensure that calves receive as much colostrum as possible over the first 24 hr and possibly over the first 4 days as described by Steinhoff-Wagner et al. (2011) to ensure greater nutrient availability and absorption for the calf. The non-nutritive factors in colostrum other than Ig's appear to be important for helping the calf establish a stronger anabolic state and develop a more functional GIT barrier and surface area for absorption.

Table 2. Effect of high (4+2 L) or low (2L) colostrum and ad-lib (H) or restricted (L) milk replacer intake on feed efficiency and feed intake in pre and post-weaned calves (Soberon and Van Amburgh, 2011).

`Treatment1	НН	HL	LH	LL	Std dev
N	34	38	26	27	
Birth wt, Ib	97	95.7	92.1	95.4	2.1
Birth hip height, in	31.7	31.6	31.5	31.9	0.2
lgG concentration, mg/dl*	2,746a	2,480Ь	1,466c	1,417c	98
Weaning wt, lb	172.4	140	159.1	137.5	4.2
Weaning hip height, in	36.6	34.9	36	35.3	0.2
ADG pre-weaning, lb	1.7	0.9	1.5	0.9	0.1
Hip height gain, pre- weaning, in/d	0.1	0.06	0.09	0.06	0
ADG birth to 80 d, lb	1.7	1.3	1.5	1.2	0.1
Hip height gain, birth to 80 d, in/d	0.08	0.06	0.07	0.06	0
Total milk replacer intake, lb DM	97.9	45.2	90.1	44.1	2.6
Grain intake pre- weaning, lb	5.5	26.4	4.6	21.4	3.3
ADG/DMI, pre-weaning	0.6	0.61	0.67	0.61	0.04
ADG post-weaning, lb	2.4	2.1	1.9	2	0.1
DMI post-weaning, lb/d	6.4	6.4	5.7	5.9	0.2
ADG/DMI post-weaning	0.36	0.35	0.34	0.36	0.02

1HH = high colostrum, high feeding level, HL = High colostrum, low feeding level, LH = Low colostrum, high feeding level, LL = Low colostrum, low feeding level. Rows with different superscripts differ P < 0.05.

Also, colostrum is the first meal and accordingly is very important in establishing the nutrient supply needed to maintain the calf over the first day of life. The amount of colostrum is always focused on the idea we are delivering a specific amount of immunoglobulins (Ig's) to the calf, and many times we underestimate the nutrient contribution of colostrum. Further, many times of year, we tend to underestimate the nutrient requirements of the calf, especially for maintenance. For example, a newborn Holstein calf at 85 lbs birth weight has a maintenance requirement of approximately 1.55 Mcals ME at 72 °F. Colostrum contains approximately 2.51 Mcals metabolizable

energy (ME)/lb, and a standard feeding rate of 2 quarts of colostrum from a bottle contains about 1.5 Mcals ME. Thus, at thermoneutral conditions, the calf is fed just at or slightly below maintenance requirements at its first feeding. For comparison, if the ambient temperature is 32 °F the ME requirement for maintenance is 2.4 Mcals, which can only be met if the calf is fed approximately 1 lb of DM or about 3.5 quarts of colostrum. This simple example illustrates one of the recurring issues with diagnosing growth and health problems with calves and that is the use of volume measurements to describe nutrient supply instead of discussing energy and nutrient values. Two quarts of colostrum sounds good because that is what the bottle might hold, but it has little to do with the nutrient requirements of the calf.

Managing the calf for greater intake over the first 24 hours of life is important if we want to ensure positive energy balance and provide adequate lg's and other components from colostrum for proper development. For the first day, at least 3 Mcals ME (approximately 4 quarts of colostrum) would be necessary to meet the maintenance requirements and also provide some nutrients for growth. On many dairies this is done via an esophageal feeder and the amount dictated by the desire to get adequate passive transfer. Those dairies not tube feeding should be encouraging up to 4 quarts by 10 to 12 hours of life to ensure colostrum is fed not only to meet the lg needs of the calf, but also to ensure that the nutrient requirements are met for the first day of life.

SUMMARY

Colostrum is an important part of early calf development, from immune function to digestion and metabolism. The constituents of colostrum are there to ensure the calf is provided support to ensure success at the beginning of extra-uterine life. Given the data on effects of colostrum on metabolism, growth and development of the calf, a management suggestion to make best use of the factors the dam is trying to supply the calf would be to feed first milking colostrum to the calf immediately, then feed colostrum from milkings 2 through 4 (day one and two of lactation) to the calves over the first 4 days. This would ensure the non-nutritive factors are supplied to the calf during the period the calf is responsive to them in an effort to enhance intestinal development and function along with enhancing glucose absorption during a period when energy status is extremely important to the calf.

REFERENCES

Bartol, F. F., A. A. Wiley, and C. A. Bagnell. 2008. Epigenetic programming of porcine endometrial function and the lactocrine hypothesis. Reprod. Domest. Anim. 43:273-279.

Baumrucker, C. R., and J. W. Blum. 1993. Secretion of insulin-like growth factors in milk and their effect on the neonate. Livest. Prod. Sci. 35:49-72.

Blättler U., H.M. Hammon, C. Morel, C. Philipona, A. Rauprich, V. Rome, I. Le Huerou Luron, P. Guilloteau and J. W. Blum. 2001. Feeding colostrum, its composition and feeding duration variably modify proliferation and morphology of the intestine and digestive enzyme activities of neonatal calves. J Nutr. 131:1256-1263.

Blum, J. W., and H. Hammon. 2000. Colostrum effects on the gastrointestinal tract, and nutritional, endocrine and metabolic parameters in neonatal calves. Livest. 66:151-159

Burrin, D.D., T.A. Davis, S. Ebner, P.A. Schoknecht, M.L. Fiorotto, and P.J. Reeds. 1997. Colostrum enhances the nutritional stimulation of vital organ protein synthesis in neonatal pigs. J. Nutr. 127:1284-1289.

Donovan, S. M., and J. Odle. 1994. Growth factors in milk as mediators of infant development. Annu. Rev. Nutr. 14:147-167.

Douglas C. Donovan, Adrian J. Reber, Jon D. Gabbard, Maria Aceves-Avila, Kimberly L. Galland, Katheryn A. Holbert; Lane O. Ely, and David J. Hurley. 2007. Effect of maternal pathogen antigens in neonatal cells transferred with colostrum on cellular responses to calves. Am J Vet Res. 68:778-782.

Faber, S. N., N. E. Faber, T. C. McCauley, and R. L. Ax. 2005. Case Study: Effects of colostrum ingestion on lactational performance. Prof. Anim. Sci. 21:420-425.

Hammon H.M., J.W. Blum. 1997. Prolonged colostrum feeding enhances xylose absorption in neonatal calves. J Anim Sci. 75:2915-2919.

Hammon, H.M., J. Steinhoff-Wagner, U. Schonhusen, C.C. Metges, J.W. Blum. 2012.

Energy metabolism in the newborn farm animal with emphasis on the calf: endocrine changes and responses to milk-born and systemic hormones. Dom. Anim. Endo. 43:171-185

Jones, C. M., R. E. James, J. D. Quiqley, III, and M. L. McGilliard. 2004. Influence of pooled colostrum or colostrum replacement on IgG and evaluation of animal plasma in milk replacer. J. Dairy Sci. 87:1806-1814.

Langel S.N., W.A. Wark, S.N. Garst, R.E. James, M.L. McGilliard, C.S., Petersson Wolfe, and I. Kanevsky-Mullarky. 2015. Effect of feeding whole compared with cell-free colostrum on calf immune status: The neonatal period. J Dairy Sci. 98:3729-3740.

NRC. 2001. Nutrient Requirements of Dairy Cattle. 7th rev. ed. Natl. Acad. Sci., Washington, DC.

Novo, Sylvia Marquart Fontes Juliana Fraça dos Reis Costa, Camila Costa Baccili,

Natália Meirelles Sobreira, Bruno Toledo Silva, Pamella Lorenci de Oliveira, David John Hurley, Viviani Gomes. 2017. Effect of maternal cells transferred with colostrum on the health of neonate calves. Res. Vet. Sci. Available online doi: 10.1016/j.rvsc.2017.01.025

Odle, J., R. T. Zijlstra, and S. M. Donovan. 1996. Intestinal effects of milkborne growth factors in neonates of agricultural importance. J. Anim. Sci. 74:2509-2522.

Reber, A.J., A. Lockwood, A.R. Hippen, D.J. Hurley. 2006. Colostrum induced phenotypic and trafficking changes in maternal mononuclear cells in a peripheral blood leukocyte model for study of leukocyte transfer to the neonatal calf Immun. Immunopathology 109:139-150

Reber A.J., D.C. Donovan, J. Gabbard, K. Galland, M. Aceves-Avila, K.A. Holbert, L. Marshall, and D.J. Hurley. 2008a. Transfer of maternal colostral leukocytes promotes development of the neonatal immune system. Part I. Effects on monocyte lineage cells Vet. Immun. Immunopathology 123:186-196.

Reber A.J., D.C. Donovan, J. Gabbard, K. Galland, M. Aceves-Avila, K.A. Holbert, L. Marshall, and D.J. Hurley. 2008b. Transfer of maternal colostral leukocytes promotes development of the neonatal immune system. Part II. Effects on neonatal lymphocytes. Vet. Immun. Immunopathology 123:305-313.

Roffler B, A Fäh, SN Sauter, HM Hammon, P Gallmann, G Brem, J.W. Blum. 2003. Intestinal morphology, epithelial cell proliferation, and absorptive capacity in neonatal calves fed milk-born insulin-like growth factor-I or a colostrum extract. J. Dairy Sci. 86:1797 - 806.

Sheldrake, R.F., Husband, A.J., 1985. Intestinal uptake of intact maternal lymphocytes neonatal rats and lambs. Res. Vet. Sci. 39:10-15.

Soberon, F. and M. E. Van Amburgh. 2011. Effects of colostrum intake and pre-weaning nutrient intake on post-weaning feed efficiency and voluntary feed intake. J. Dairy Sci. 94:E suppl. 1:69. (abstr.)

Steinhoff J, R. Zitnan, U. Schönhusen, H.M. Hammon. 2010. Effects of colostrum formula feeding on mucosal growth, glucose transporter and lactase in the small intestine of neonatal calves. Proc Soc Nutr Physiol. 19:146.

Steinhoff-Wagner, J., S. Görs, P. Junghans, R. M. Bruckmaier, E. Kanitz, C. C. Metges, and H. M. Hammon. 2011. Intestinal glucose absorption but not endogenous J. Nutr. 141:48production differs between colostrum- and formula-fed neonatal calves.

Summers, A. F. and R. N. Funston. 2012. Fetal programming: implications for beef cattle production. University of Nebraska, West Central Research and Extension Center, North Platte. www.bifconference.com/bif2012/proceedings-pdf/07funston.pdf

Tao, S. A.P.A. Monteiro, I.M. Thompson, M.J. Hayen, and G.E. Dahl. 2012. Effect of late-gestation maternal heat stress on growth and immune function of dairy calves. J. Dairy Sci. 95:7128-7136.

Williams, P.P., 1993. Immunomodulating effects of intestinal absorbed maternal colostral leukocytes by neonatal pigs. Can. J. Vet. Res. 57:1-8.

STAKEHOLDER VIEWS, INCLUDING THE PUBLIC, ON EXPECTATIONS FOR DAIRY CATTLE WELFARE

Marina A. G. von Keyserlingk* and Daniel M. Weary, Animal Welfare Program,

Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC V6T 1Z4, Canada

*Email: marina.vonkeyserlingk@ubc.ca

INTRODUCTION

Questions concerning the sustainability of food-animal producing industries have become the focus of intense public debate by social critics, animal advocates, and scientists. Specific concerns about the welfare of dairy cattle is nothing new; producers and veterinarians have always been concerned about the condition of animals in their care and have tried to ensure that they are healthy and well nourished (von Keyserlingk et al., 2009). In the tradition of good animal husbandry, good welfare can be seen largely as maintaining high levels of production and the absence of illness or injury. However, recent interest in farm animal welfare stems more from concerns about pain or distress that the animals might experience, and concerns that animals are kept under "unnatural" conditions, with limited space and often a limited ability to engage in social interactions and other natural behaviours. For instance the results of a recent survey indicated that providing assurances that dairy cattle are well treated, developing methods to incorporate pasture access and assurance of healthy products without relying on antibiotics or hormones, are all aspects deemed to be important by citizens when asked what they views on the ideal characteristics of a sustainable dairy farm (Cardoso et al., 2016).

In addition to the tremendous increase in scientific research on the welfare of cattle, some new work has begun to investigate stakeholder views on dairy farming and practices common in the dairy industry (see review by Weary et al., 2016). An objective of the current paper is to summarize some of our recent work on stakeholder views. Our first aim is to look at four common management practices (tail docking, pain mitigation for disbudding/dehorning, access to pasture and cow calf separation) and describe how research in the natural sciences and social sciences can be integrated to identify more sustainable practices. Our second aim is highlight some of our most recent work on capturing the views of the public on dairy farming practices and to determine whether education can be used as an effective tool in promoting current dairy farming management practices.

FARM ANIMAL WELFARE

For the purposes of this paper we have adopted the three part definition of animal welfare proposed by Fraser et al. (1997): 1) animals should exhibit good physical health and biological functioning, 2) animals should have the ability to live reasonably natural lives including the ability to perform natural behaviours that are important to them, and 3) animals should experience minimal negative psychological states and the presence of at least some positive psychological states. These different types of concerns can and do overlap. For instance, a lactating dairy cow unable to seek shade on a hot day (natural living) will likely feel uncomfortably hot (affective state) and may show signs of hyperthermia, and ultimately reduced milk production (poor biological functioning) (von Keyserlingk et al., 2009).

These three key concepts of animal welfare have been included in official definitions such as the World Organization for Animal Health (OIE) which defines an animal as being in good welfare if it is "healthy, comfortable, well nourished, safe, able to express innate behavior, and it is not suffering from unpleasant states such as pain, fear, and distress" (OIE, 2013).

AGRICULTURE SUSTAINABILITY

Definitions of sustainability frequently include three pillars, economic, environment and social, which should be weighted equally (see von Keyserlingk et al., 2013). Traditionally academics working in agriculture (for example Steinfeld et al., 2006; Foley et al., 2011), and farmers and others working in food animal production systems, have placed greater emphasis the economic pillar. More recently sustainability discussions on animal agriculture have focused on the environmental concerns resulting in this aspect receiving much attention. For example, debates frequently discuss the role that food-animal production plays in competition for natural resources i.e. water, land, and energy, and how to mitigate any negative effects of food animal agriculture on the environment (Thornton, 2010). The fact that the social pillar has

received the least amount of attention may be a consequence of it having an aspect of human values (Thompson, 1997), and because it is difficult to quantify using traditional natural science based metrics. Furthermore, values are influenced by cultural norms within societies (Boogaard et al., 2011). Despite these difficulties there is a growing recognition that the social pillar is an important component of sustainability (von Keyserlingk et al., 2013). This may be particularly true for production that takes place in intensive housing systems that are the subject of increased societal criticism (Thornton, 2010).

Animal welfare is an important social concern and, as such, needs to be integrated into the concept of sustainable agriculture, rather than made to 'compete' with environmental goals (Hötzel, 2014) and economic goals (von Keyserlingk and Hötzel, 2015). To achieve this we argue that those not directly involved in farming must be accepted as credible stakeholders in the discussions on the way farm animals are cared for.

STAKEHOLDER ENGAGEMENT ON CONTENTIOUS PRACTICES IN DAIRY INDUSTRY

Our perspective is that rather than focusing efforts on oneway efforts to 'educate' the public, we should instead develop methods of facilitating constructive, informed engagement among the stakeholders. We suggest that this approach will likely to be more effective in identifying shared concerns and potential solutions likely to find general appeal.

At The University of British Columbia (UBC) we have been using web-based platforms to provide opportunities for people within the dairy industry to discuss dairy management practices with each other and with members of the public interested in these issues. For example, UBC's Cow Views site provided the opportunity for people to state their views, and also vote on the views of others. The idea was to get people discussing uncomfortable issues in dairy farming. Our aim was to use these discussions to provide farmers and the industry a better basis for making informed decisions about management on farms and policy for the industry.

For each issue, participants were given a brief background of the perceived advantages and disadvantages associated with each practice (see tail docking below for example). They were then asked to vote on whether or not the practice should continue or not. We recruited participants into multiple virtual 'town hall' meetings, such that participants could see each other's responses, but participants in one meeting could not see the reasons discussed in other meetings. In this way each meeting provides an independent test of how this

type of discussion unfolds. Also, an especially persuasive reason can only influence the votes within a single town hall meeting.

Our intention was not to collect a random or representative sample of any specific population, but rather to include a diverse range of participants to increase our chances of achieving saturation in views. The forum was made available on the Internet so anyone with Internet access could participate. To encourage participation of people in the North American dairy industry, we published brief articles in producer magazines (Progressive Dairyman and Ontario Farmer) that invited readers to participate. For the broader public samples we recruited online via Mechanical Turk (MTurk, www.mturk.com). Several studies have assessed this tool and concluded that this approach results in high-quality and reliable data (e.g. Buhrmester et al., 2011; Saunders et al., 2013; Rouse, 2015) that is more representative than many other samples (Mason and Suri, 2012; Rouse, 2015).

To provide context, for each of the specific issues we have summarized below we also state the current position in Canada's Code of Practice, and where relevant have described policy in other parts of the world.

SHOULD WE CONTINUE DOCKING THE TAILS OF DAIRY CATTLE?

The responses to this question are fully described in Weary et al. (2011). Briefly, 178 participants were provided the following context:

"Tail docking dairy cattle first became common in New Zealand where workers thought this could reduce their risk of diseases like leptospirosis that can be carried by cows. Some milkers also preferred working with docked cows because the shortened tail was less likely to hit them in the parlor. Some people also felt that docking improved cow cleanliness, and cleaner cows should be exposed to fewer pathogens and have improved udder health.

There may also be disadvantages associated with docking. For some, at least, there is a 'yuk' factor of seeing cows without their tails. Docking might also cause pain, and prevents cows from using their natural fly-swatter. For these reasons several European countries including Norway, Sweden, the Netherlands, the United Kingdom, and Switzerland have prohibited tail docking of dairy cattle.

More recently, Canada's new Code of Practice for the Care and Handling of Dairy Cattle states that dairy cattle "must not be tail docked".

In the United States, about 40% of dairy cows have docked tails."

Participants were then asked, "Should we continue docking the tails of dairy cattle?"

Approximately 79% of participants were opposed to docking (i.e. responded "No" to the question). Responses varied with participant demographics (e.g. females were more likely than males to oppose docking), but in every demographic sub-group (e.g. by gender, age, country of origin and dairy production experience) the majority of respondents were opposed to tail docking. Common reasons for opposition to docking included the lack of scientific evidence that docking improves cleanliness or udder health, that docking is painful for cows, that docking is unnatural and that tails are important for controlling flies. Some respondents in favour of docking cited cow cleanliness as an issue, despite the scientific evidence showing no positive effect of docking on cow cleanliness or udder health. Additional reasons included protecting producer safety.

These results illustrate the range of reasons that are cited for supporting and opposing tail docking. This approach can be used to better target outreach efforts (e.g. improving farmer education on the lack of positive effects of docking on cleanliness and udder health while addressing concerns about producer safety).

Given the extent of public opposition to this practice it is not surprising that in some countries tail docking has been banned, including Norway, Sweden, the Netherlands, the United Kingdom and Switzerland. This has also likely motivated corporations to take a stand on this issue as part of their corporate social responsibility practices. For example, Nestle, the world's largest food company, has announced their objection to tail docking.

In Canada, dairy producers have taken a clear position on this issue. Our Code of Practice for the Care and Handling of Dairy Cattle has a requirement that cows "must not be tail docked unless medically necessary." This is also the position of the Canadian Veterinarian Association and the American Association of Bovine Practitioners. Most recently the National Federation of Milk Producers in the US announced that members of their assurance program will be prohibited from tail docking their cows effective January 1, 2017.

SHOULD WE PROVIDE PAIN RELIEF FOR DISBUDDING AND DEHORNING DAIRY CALVES?

The responses to this question are fully described in Robbins et al. (2015).

For this issue participants were provided the following context:

"The developing horns of dairy calves are typically removed to reduce the risk of injuries to farm workers or other cattle that can be caused by horned cattle. Horns of calves three months of age or

older are normally removed surgically ("dehorning") by scooping, shearing or sawing. Horn buds of younger calves are typically removed ("disbudding") using a caustic paste or a hot iron.

There is considerable scientific evidence that all of these procedures cause pain. The immediate pain can be reduced using a local anesthetic to provide a nerve block – this procedure has been used safely for decades and costs just pennies a shot. Pain can persist 24 hours or more; this longer lasting pain can be reduced using non-steroidal anti-inflammatory drugs (like the ibuprofen you take for a headache). Providing calves a sedative before the procedure can reduce handling stress and make the procedure easier to carry out.

In many countries some pain relief is required. For example, Canada's new Code of Practice for the Care and Handling of Dairy Cattle requires that pain control be used. Approximately 18% of dairy farms in the United States report using pain relieving drugs for disbudding or dehorning dairy calves."

Participants then answered the question "Should we provide pain relief for disbudding and dehorning dairy calves?"

Participant composition was as follows: dairy producer or other farm worker (10%); veterinarian or other professional working with the dairy industry (7%); student, teacher or researcher (16%); animal advocate (9%) and no involvement with the dairy industry (57%).

Of 354 participants, 90% thought pain relief should be provided when disbudding and dehorning. This support was consistent across all demographic categories suggesting the industry practice of disbudding and dehorning without pain control is not consistent with normative beliefs. The most common themes in participants' comments were: pain intensity and duration, concerns about drug use, cost, ease and practicality and availability of alternatives.

These results show a clear disconnect between current practice (with many famers failing to provide pain control) and the attitudes of participants (including dairy producers) in these virtual town hall meetings. Causing pain to animals under our care, especially when this pain can easily be prevented, no longer seems acceptable. Our challenge is to find ways of getting pain control techniques applied widely on dairy farms.

In Canada, dairy producers have also taken a clear position on this issue. The Code of Practice for the Care and Handling of

Dairy Cattle requires that "Pain control must be used when dehorning or disbudding." In many countries (i.e. Sweden, Denmark, Netherlands, New Zealand and Australia) pain control for disbudding and dehorning is a legal requirement (ALCASDE, 2009; NAWAC, 2005; PIMC, 2004).

SHOULD DAIRY COWS BE PROVIDED ACCESS TO **PASTURE?**

The responses to this question are fully described in Schuppli et al. (2014).

For this issue participants were provided the following context:

"On many dairy farms cows are always kept indoors. Some dairy farmers believe that well-designed indoor housing provides a more comfortable and more suitable environment for the cows. In addition, some farmers keep cows indoors to more easily provide and control diets formulated to sustain high milk production.

Others consider pasture access to be important. For example, some believe that grazing is more environmentally sustainable, that pasture provides a healthier and more comfortable environment for cows, and that grazing is a natural behaviour important for cows.

Participants then answered the question "Should dairy cows be provided access to pasture?"

A total of 414 people participated. Providing access to more natural living conditions, including pasture, was viewed as important for the large majority of participants, including those affiliated with the dairy industry. This finding is at odds with current practice on the majority of farms in the United States where less than 5% of lactating dairy cows have routine access to pasture (see USDA 2007). To our knowledge there is no research indicating about how many lactating cows in Canada have routine access to pasture.

Participant comments showed that the perceived value of pasture access for dairy cattle went beyond the benefits of eating grass; participants cited as benefits exposure to fresh air, ability to move freely, ability to live in social groups, improved health, and healthier milk products. To accommodate the challenges of allowing pasture access on farms, some participants argued in favor of hybrid systems that provide a mixture of indoor confinement housing and grazing.

Despite the public indicating that access to pasture is important (see

also Cardoso et al. 2016), the Code of Practice is largely silent on this issue, recommending only "for bedded-pack or composted-pack barns, provide access to pasture or an exercise or an exercise yard to decrease labor and bedding requirements." In contrast, Sweden requires that cows be given pasture access during summer months (Ministry for Rural Affairs - Government Offices of Sweden, 2009).

SHOULD DAIRY CALVES BE SEPARATED FROM THE COW WITHIN THE FIRST FEW HOURS AFTER **BIRTH?**

The responses to this question are fully described in Ventura et al. (2013).

For this issue 195 participants were provided the following context:

"Dairy farmers often remove the calf from within the first few hours of birth. This is done in response to several concerns including the following: the calf may become infected from pathogens carried by the cow or her environment; the calf may become injured by the cow or the barn equipment; the calf will not be able to nurse from the cow and receive adequate colostrum (first milk produced by the cow after birth) and milk; the calf will drink too much milk which increases the farmer's cost of feeding and increases the risk of diarrhea; allowing the cow and calf to bond will result in greater separation distress when separation does occur; farms are often not well designed for cowcalf pairs, so keeping cows and calves together can be considered an extra chore. Others consider that some form of cow-calf contact is an important element of natural behavior, and believe that this contact is beneficial to the cow and calf. On these farms the cow and calf are kept together for days or even weeks after birth."

Participants then answered the question "Should dairy calves be separated from the cow within the first few hours after birth?"

Opponents of early separation contended that it is emotionally stressful for the calf and cow, it compromises calf and cow health, it is unnatural, and the industry can and should accommodate cow-calf pairs. In contrast, supporters of early separation reasoned that emotional distress is minimized by separating before bonds develop, that it promotes calf and cow health, and that the industry is limited in its ability to accommodate cow-calf pairs. Opponents of separating calves from their cows in the first few hours after birth often based their based their views on the emotional experiences of cows and calves. They compared the bond of a cow and her calf to the bond between mother and offspring in other species.

A major theme raised by proponents was that separation was

inevitable, and that early separation was easier on the cow and calf than separation at a later age. There is considerable scientific evidence in support of this claim. Separating calves at an older age results in a much stronger response (high rates of vocalization and other activities) in comparison with calves separated soon after birth (Flower et al., 2003). Some respondents also believed that early separation minimized disease transmission from the cow. We are aware of little evidence to support this link.

The Canadian Dairy Code of Practice (NFACC 2009) states the following:

"Generally, dairy calves are separated from their mothers shortly after birth. There are benefits to both calf and dam by allowing the pair to bond. Allowing the calf to spend a longer period of time with the dam may result in lowered morbidity and mortality in the calf; however, separation stress to both the cow and calf will be higher the longer they are together. Cow health is generally improved by allowing the calf to suckle (related to oxytocin effects on the post partum uterus)".

Based on this summary of information the Code provides the following recommended best practice – "reduce separation distress by either removing the calf shortly after birth or by using a two-step weaning process."

The fact that cows and calves are routinely separated at birth is an issue that the public is largely unaware of (Ventura et al., submitted), perhaps explaining why this issue has received little attention within non-dairy audiences. However, we speculate that external stakeholders will become increasingly unwilling to accept this practice.

CONCLUSIONS

The examples illustrated in this paper show how social science methodologies can document the shared and divergent values of different stakeholders, the associated beliefs regarding the available evidence, and the barriers in implementing changes. In some cases we documented shared values amongst the majority of stakeholders (e.g. that dehorning causes pain), but we also found important disconnects between current dairy production methods and widely held public values. Understanding the attitudes of people affiliated and unaffiliated with the dairy industry allows for the identification of contentious topics as well as areas of agreement; this is important in efforts to better harmonize industry practices with societal expectations.

We have also identified where the Code of Practice on the Care and Handling of Dairy Cattle aligns with stakeholder expectations and where gaps exist. We encourage the dairy industry to work to overcome these gaps.

ACKNOWLEDGEMENTS

M.A.G. von Keyserlingk and D.M. Weary are supported by Canada's Natural Sciences and Engineering Research Council (NSERC) Industrial Research Chair Program with industry contributions from the Dairy Farmers of Canada (Ottawa, ON, Canada), British Columbia Dairy Association (Burnaby, BC Canada), Westgen Endowment Fund (Milner, BC, Canada), Intervet Canada Corporation (Kirkland, QC, Canada), Zoetis (Kirkland, QC, Canada), BC Cattle Industry Development Fund (Kamloops, BC, Canada), Alberta Milk (Edmonton, AB, Canada), Valacta (St. Anne-de-Bellevue, QC, Canada), and CanWest DHI (Guelph, ON, Canada).

REFERENCES

ALCASDE. 2009. Report on dehorning practices across EU member states. http://ec.europa.eu/food/animal/welfare/farm/docs/calves_alcasde_D-2-1-1.pdf. (Accessed 20 May 2013.)

Boogaard, B.K., Bock, B.B., Oosting, S.J., Wiskerke, J.S.C., van der Zijpp, A.J., 2011. Social Acceptance of Dairy Farming: The Ambivalence Between the Two Faces of Modernity. Journal of Agricultural & Environmental Ethics 24, 259-282.

Buhrmester, M., T. Kwang, S.D. and Gosling. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality, data? Perspectives on Psychological Science 6, 3-5.

Cardoso, C.S., Hötzel, M.J., Weary, D.M., Robbins, J.A., von Keyserlingk, M.A.G., 2016. Imagining the ideal dairy farm. Journal of Dairy Science, doi.org/10.3168/jds.2015-9925.

Flower, F. C. & Weary, D. M. (2003). The effects of early separation on the dairy cow and calf. Animal Welfare 12, 339-348.

Foley, J. A., Ramankutty, N., Brauman, K. A., et al. (2011) Solutions for a cultivated planet. Nature 478, 337-342.

Fraser, D., Weary, D. M., Pajor, E. and Milligan, B. N. (1997) A scientific conception of animal welfare that reflects ethical concerns. Animal Welfare 6, 187-205.

Hötzel, M. J. (2014) Improving farm animal welfare: is evolution or revolution needed in production systems? In: Dilemmas in Animal Welfare, pp. 67-84. Appleby, M. C., Weary, D. M. and Sandoe, P. Eds. Oxfordshire, UK: CABI.

Mason, W. and Suri, S. (2012). Conducting behavioral research on Amazon's Mechanical Turk. Behavior Research Methods 44, 1-23.

Ministry for Rural Affairs - Government Offices of Sweden, 2009. The Animal Welfare Act - The Animal Welfare Ordinance, Ministry for Rural Affairs - Government Offices of Sweden Jo 09.021, Stockholm, Sweden.

NAWAC. 2005. Animal Welfare (Painful Husbandry Procedures) Code of Welfare. Code of Welfare No. 7. National Animal Welfare Advisory Committee, Wellington, NZ.

NFACC. 2009. Code of Practice for the Care and Handling of Dairy Cattle. http://www.nfacc.ca/pdfs/codes/Dairy%20Code%20of%20Practice.pdf (Accessed January 6, 2016.)

OIE (2013) Terrestrial Animal Health Code, pp. 406. Paris, France: World Organisations for Animal Health.

 $PIMC.\ 2004.\ Model\ code\ of\ practice\ for\ the\ welfare\ of\ animals-cattle.\ http://www.publish.\ csiro.au/Books/download.cfm?ID=4831\ (Accessed\ 15\ June\ 2013.)$

Robbins, J. A., Weary, D. M., Schuppli, C. A. and Von Keyserlingk, M. A. G. (2015). Stakeholder views on treating pain due to dehorning dairy calves. Animal Welfare 24, 399-406.

Rouse, S. V. (2015). A reliability analysis of Mechanical Turk data. Computers in Human Behavior 43,304-307.

Saunders, D. R., Bex, P. J. and Woods R. L. (2013). Crowdsourcing a normative natural language dataset: a comparison of Amazon Mechanical Turk and in-lab data collection. Journal of Medical Internet Research 15, e100,

Schuppli, C. A., von Keyserlingk, M. A. G. and Weary, D. M. (2014). Access to pasture for dairy cows: Responses from an online engagement. Journal of Animal Science 92, 5185-5192.

Steinfeld, H., Gerber, P., Wassenaar, P., Castle, V., Rosales, M. and De Haan, D. (2006) Livestock's long shadow: Environmental issues and options. pp. 407. Rome: Food and Agriculture Organization of the United Nations.

Thompson, P. B. (1997) Sustainability as a norm. Society for Philosophy and Technology 2, 75-94.

Thornton, P. K. (2010) Livestock production: recent trends, future prospects. Philosophical Transactions of the Royal Society B-Biological Sciences 365, 2853-2867.

USDA (2007) National Animal Health Monitoring System - `Facility characteristics and cow comfort on U.S. dairy operations. Vol. 524.1210. USDA-APHIS-VS-

CEAH, Fort Collins, CO.

Ventura, B. A., von Keyserlingk, M. A. G. and Weary D. M. (2015) Animal Welfare Concerns and Values of Stakeholders Within the Dairy Industry. Journal of Agricultural and Environmental

von Keyserlingk, M. A. G., Rushen, J., de Passillé, A. M. B. and Weary, D. M. (2009) The Invited review: Welfare of dairy cattle - Key concepts and the role of science. Journal of Dairy Science 92.4101-4111.

von Keyserlingk, M. A. G., Martin, N. P., Kebreab, E., Sniffen, C. J., Harner III, J. P., Wright, A. D. and Smith. S. I. (2013) Invited review: Sustainability of the US dairy industry. Journal of Dairy Science 96, 5405-5425.

von Keyserlingk, M. A. G. and Hötzel, M. J. (2015) The ticking clock: Addressing farm animal welfare in emerging countries. Journal of Agricultural & Environmental Ethics 28, 179-195.

Weary, D.M., Schuppli, C.A., Von Keyserlingk, M.A.G., 2011. Tail docking dairy cattle: Responses from an online engagement. J. Anim. Sci. 89, 3831-3837.

Weary, D. M., Ventura, B. A. & von Keyserlingk, M. A. G. Societal views and animal welfare science: understanding why the modified cage may fail and other stories. Animal, doi 10.1017/ S1751731115001160.



THE FULL VALUE OF A TRUE PARTNERSHIP

Full Value Beef™ starts with you and a thorough understanding of why you do what you do and how the industry's challenges affect your operation and your livelihood. Whether it's using our data and analytic capabilities to discover insights that are meaningful to your business or delivering solutions through both our innovative new products and the trusted brands producers have depended on for years, it's all about showing you the full value of a true partnership.







Contact your local sales representative



Elanco, Full Value Beef, Titanium*, Nuplura*, Vira Shield* and the diagonal bar are trademarks owned or licensed by Eli Lilly and Company, its subsidiaries or affiliates. | © 2016 Eli Lilly and Company, its subsidiaries or affiliates.

NEW REPRODUCTIVE STRATEGIES AND ECONOMIC OUTCOMES FOR DAIRY HEIFERS

Joseph C. Dalton, Ph.D., University of Idaho, Caldwell

INTRODUCTION

The three largest expenses of a dairy business are feed costs for the lactating herd, labor, and raising replacement heifers (Frazer, 2016). Feed is the major cost in raising replacement heifers, accounting for 45 to 64% of total costs in Dutch and US dairy farms (Mohd Nor et al., 2012; Gabler et al., 2000).

Dairy producers and heifer raisers must have a plan for getting heifers into the reproductive program. Growth (weight and wither or hip height) of heifers should be monitored regularly. Groups of heifers should be moved into the breeding pen weekly, as soon as target size is reached, regardless of age. If heifers gain weight faster than expected and attain the proper size for breeding earlier, breeding should not be delayed, as the heifers will likely become over-conditioned (Vandehaar, 2001).

When developing heifers, the focus should be on age at conception, not age at first calving. A delay in age at conception will lead to a delay in age at first calving, along with increased rearing costs (primarily from extra days on feed) and lost income opportunity. Consequently, implementation of a reproductive program focused on age at conception is beneficial to the long-term viability of the heifer-raising enterprise.

SYNCHRONIZATION PROGRAMS

Synchronization programs for dairy heifers have been developed to facilitate timely reproduction and help dairy producers and heifer raisers attain their age at conception and age at first calving goals. The simplest program for dairy heifers includes administering a single injection of prostaglandin (PGF2 α) on the day of breeding eligibility to synchronize estrus, and facilitate estrous detection and AI (Mann, 2013). Treatment of heifers not identified in estrus with a second dose of PGF2 α 11 to 14 d after the first dose may cause those heifers to exhibit estrus. A variety of synchronization programs have been previously described elsewhere (Dalton, 2012; Dairy Cattle Reproduction Council, 2016). The discussion in this paper will be limited to two new reproductive strategies and economic outcomes.

STRATEGY #1: PRESYNCHRONIZATION OF DAIRY HEIFERS WITH A 14-D CIDR PROTOCOL

Presynchronization is an effective management strategy applied during the voluntary wait period in lactating dairy cows to enhance pregnancy per Al (P/Al) to a timed Al (TAl) protocol (Moreira et al., 2001), or facilitate Al following detection of estrus, shortly after breeding eligibility (Chebel and Santos, 2010). Presynchronization of dairy heifers, however, is not often used to manage the immediate pre-breeding period. Nevertheless, presynchronization of heifers may be an effective strategy to accomplish first Al shortly after eligibility, and has the potential to decrease days on feed prior to first calving.

In dairy heifers, 14-d CIDR (controlled internal drug release insert containing progesterone) treatment has been shown to be effective to synchronize ovulation (Escalante et al., 2013a). The use of a CIDR insert for 14 d inhibits estrus and ovulation, and induces a persistent dominant follicle that can ovulate after CIDR removal (Roche et al., 1999). Ovulation of the dominant follicle results in a synchronized estrous cycle that can be used for presynchronization (Escalante et al., 2013b). In this scenario, PGF2 α is injected 16 d after CIDR removal and followed by an injection of GnRH and TAI (Mallory et al., 2013) or AI upon detected estrus (Leitman et al., 2009).

A recent study (Claypool et al., 2015a) investigated presynchronization of dairy heifers, either with a 14 d CIDR or PGF2 α , followed by PGF2 α on the day of breeding eligibility and AI upon detected estrus, as compared to control heifers (no presynchronization, but PGF2 α on the day of breeding eligibility and AI upon detected estrus). The objectives were to evaluate P/AI, days to first AI, proportion of heifers pregnant within the first week of breeding eligibility, and economic outcomes of heifers subjected to presynchronization compared with control heifers.

Heifers and treatments. Following selection based on projected criteria on day of entry to AI pen (weight \geq 860 lb., height at the withers \geq 51 in, and age \geq 12.5 mo.), Holstein heifers (n= 358) were randomly assigned to 1 of 3 treatments: 1) 14-d CIDR-PGF2 α , 2) prostaglandin (2X PGF2 α), or 3) control (1X PGF2 α). The 14-d CIDR-PGF2 α group (n = 119) received a CIDR on d -30, which was removed on d -16. Immediately after CIDR removal, all heifers received an Estrotect

patch to aid in estrous detection following CIDR removal. No heifers received Al at this time. The 14-d CIDR- PGF2 α group received an injection of PGF2 α upon entry to the breeding program (d 0). The 2X PGF2 α group (n = 118) received an initial injection of PGF2 α on d -11, and a second injection of PGF2 α on d 0. The control (1X PGF2 α) group (n = 121) received an injection of PGF2 α on d 0. All heifers received tail paint on d 0, were observed for behavioral estrus once daily, and received Al within 1 hour after detected estrus. Heifers were housed in dry lots with self-locking stanchions.

STRATEGY #1: RESULTS

Detection of estrus. Claypool et al. (2015b) reported 96.7% of heifers were detected in estrus within 5 d after CIDR removal. Following PGF2 α administration on d 0, 95.8% of heifers in the 14 d CIDR-PGF2 α group were detected in estrus during the first week, as compared to 74.6% and 66.9% for the 2X PGF2 α and control groups, respectively (Table 1).

Days to first AI and days to pregnancy. Claypool et al. (2015a) reported days to first AI following breeding eligibility were fewest for heifers in the 14 d CIDR-PGF2 α group (3.6 d), intermediate for heifers in the 2X PGF2 α group (5.0 d), and highest for heifers in the control group (6.8 d; Table 1). Days from breeding eligibility to pregnancy were fewest for heifers in the 14 d CIDR-PGF2 α group (15.1 d), as compared to heifers in the control group (25.0 d) (Table 1; Claypool et al., 2015a).

Pregnancy per AI (P/AI). Pregnancy per AI for first AI occurring during the first week of breeding eligibility were 71.9% (14 d CIDR-PGF2a), 58.0% (2X PGF2a), and 61.7% (control) (Table 1; Claypool et al., 2015a).

Proportion of heifers pregnant within first week of breeding eligibility. A greater proportion of heifers became pregnant (Claypool et al., 2015a) within the first week of breeding eligibility in the 14 d CIDR-PGF2 α group as compared to the 2X PGF2 α and control groups (68.9 vs. 43.2% and 41.3%, respectively). There was no difference between 2X PGF2 α and control groups (Claypool et al., 2015a; Table 1).

Days on feed. There was a treatment effect for days on feed (DOF = d 0, date of breeding eligibility, to projected calving date; Claypool et al., 2016). Days on feed were 295 d (14 d CIDR-PGF2 α), 302 d (2X PGF2 α), and 305 d (control), and were different between 14 d CIDR-PGF2 α and control heifers, and tended to differ between 14 d CIDR-PGF2 α and 2X PGF2 α groups (Claypool et al., 2016; Table 1).

Table 1. Effect of treatment on fertility responses of heifers and projected days on feed1

	Treatment2			
ltem	14 d CIDR-PGF2α	2X PGF2a	Control	
In estrus (first week), % (no./no.)	95.8a (114/119)	74.6b (88/118)	66.9ь (81/121)	
P/AI (first AI)3,4, % (no./no.)	71.9a (82/114)	58.0ь (51/88)	61.7a,b (50/81)	
Pregnant (first week)4,5, % (no./no.)	68.9a (82/119)	43.2b (51/118)	41.3b (50/121)	
Days to first AI, d	3.6 ± 0.4a	5.0 ± 0.4b	6.8 ± 0.5c	
Days to pregnancy4, d	15.1 ± 2.3a,*	21.8 ± 2.7b	25.0 ± 2.8b	
Days on feed (projected), d	295 ± 2.6a,†	302 ± 2.6b	305 ± 2.5b	

1Adapted from Claypool et al. 2015a, 2015b

214 d CIDR-PGF2a: CIDR inserted on d -30, removed on d -16, PGF2a on d 0; 2X PGF2a: PGF2a on d -11 and d 0; Control: PGF2a on d 0.

3P/AI = pregnancy per AI for first AI during first week of breeding eligibility

4Pregnancy diagnosis at 35 d after Al

5Proportion of heifers pregnant within first week of breeding eligibility

a, b Values within a row with different superscripts differ (P<0.05)

a,* Value tends to differ from 2X PGF2 α (P = 0.06)

a,† Value tends to differ from 2X PGF2 α (P = 0.07)

STRATEGY #1: ECONOMIC ANALYSIS

Claypool et al. (2016) developed a partial budget to describe the economic benefit of presynchronization of heifers (with a 14 d CIDR) relative to control heifers. No economic analyses were done between 14 d CIDR-PGF2 α and 2X PGF2 α groups, or between 2X PGF2 α and the control group as these comparisons lacked statistical significance (Table 1). Expenses included were: PGF2 α , per dose: \$2.80; CIDR insert, per insert: \$10.50; Labor was based on a wage of \$15.00/h. With two employees working together, the time required to complete a task, for example, identifying a heifer, loading the CIDR insertion device, addition of lubricant, insertion of the CIDR, trimming the exposed tail of the CIDR, identifying a heifer prior to removal of the CIDR, and removal of the CIDR, was estimated at 5 min per heifer. Feed costs at the collaborating facility were \$2.35 per heifer per day during the experiment which appears similar to another report (Silva et al. 2015).

Due to fewer days on feed, the 14-d CIDR- PGF2 α group had a reduced feed cost of \$23.50 per animal, and decreased labor costs (\$4.10) per animal, resulting in a total reduced cost of \$27.60 per heifer compared with the control (Table 2). There were, however, increased costs associated with the 14-d CIDR presynchronization treatment (\$11.75 per heifer) as compared to the control, due to cost of the CIDR and increased labor (\$10.50 + \$1.25 = \$11.75 per heifer).

Subtraction of the treatment cost (cost of presynchronization) from the total reduced costs results in the treatment balance (\$27.60 - \$11.75 = \$15.85), or the potential economic benefit to the producer. Presynchronization with the 14-d CIDR protocol resulted in an overall treatment balance of \$15.85 per heifer (Table 2).

Table 2. Partial budget for presynchronization of dairy heifers1

	Cartari	
	Control	14 d CIDR-PGF2a
Days to calving ² , d	305	295
Time savings from treatment, d		10
Feed cost ³ , (\$/heifer/day)		\$ 2.35
Labor ⁴ , (\$/heifer/day)		\$ 0.41
INCREASED COSTS		
Treatment materials ⁵		\$10.50
Treatment labor ⁶		\$1.25
Treatment cost, (\$/heifer)		\$ 11.75
REDUCED COSTS		
Feed		\$ 23.50
Labor		\$ 4.10
Total reduced costs, (\$/heifer)		\$ 27.60
Treatment balance, (\$/heifer)		\$ 15.85

¹Adapted from Claypool et al. (2016)

STRATEGY #1: CONCLUSIONS

Presynchronization of dairy heifers with a 14-d CIDR followed by a single injection of PGF2 α on the day of entry to the AI pen appears to be an effective strategy to 1) increase P/AI (first AI during the first week), 2) increase the proportion of pregnant heifers within the first week upon entry to the breeding program, 3) decrease days on feed, and 4) provide an economic benefit to the producer.

STRATEGY #2: 5-D TIMED AI PROTOCOL

In 2010, Rabaglino et al. reported on the development of a 5-d TAI protocol for dairy heifers. Lima et al. (2013) reported P/AI (first AI) of approximately 60% using a slightly modified version of the 5 d timed AI protocol (GnRH + CIDR IN-5d-CIDR OUT + PGF2 α -24 h-PGF2 α -48 h-GNRH + TAI). Lima et al. (2013) concluded 1) the use of GnRH at CIDR insertion requires 2 doses of PGF2 α administered 24 h apart to cause regression of a newly formed CL, and 2) the P/AI of approximately 60% supports the use of the 5-d TAI protocol when estrous detection and AI is not used, as the results are similar to AI following estrous detection (Kuhn et al., 2006). Neither Rabaglino et al. (2010) nor Lima et al. (2011, 2013), however, were designed to compare TAI to AI after estrous detection. Consequently, Silva et al. (2015) investigated the reproductive performance and cost per pregnancy in dairy heifers following a 5-d TAI program as compared to AI following estrous detection.

Heifers and treatments. Holstein heifers (n= 611), approximately 400 d of age were enrolled in the study. On d -6 heifers were randomly assigned to either Al after detected estrus (CON, n = 306) from d 0 to 84, or timed Al (TAI, n = 305) for first Al followed by Al after detected estrus for the remainder of the 84-d study. Heifers in the TAI group received GnRH and a CIDR insert on d -6, PGF2 α and CIDR insert removal on d -1, PGF2 α on d 0, and GnRH and TAI on d 2. Heifers in the TAI group detected in estrus the day before scheduled TAI received Al the same day. Estrus was detected daily starting on d 0. Heifers detected in estrus received Al on the same morning as detected estrus. Control heifers not inseminated by d 7 received PGF2 α (treatment was repeated every 2 weeks until Al). Duration of the study was 84 d to allow a breeding period equivalent to four 21-d estrous cycles.

²Entrance to breeding pen (d 0) to projected calving date

³Total mixed ration value from collaborating feedlot

⁴University of Idaho Heifer Replacement Budget

⁵EAZI BREED CIDR, Zoetis, Florham Park, NJ

⁶Estimated at \$15/h; 5 m to identify heifer and prep, insert, and remove CIDR

STRATEGY #2: RESULTS

Days to first Al. Silva et al. (2015) reported days to first Al was approximately 8 d shorter for TAI heifers than for CON heifers (1.7 vs. 10.4, respectively; Table 3).

Pregnant at first Al. Silva et al. (2015) reported the percentage of heifers pregnant (as determined 60 d after Al) did not differ between CON heifers (58.3%) and TAI heifers (62.8%) (Table 3). Likewise, the percentage of heifers pregnant following AI with conventional semen was not different for CON and TAI heifers (64.6 vs. 65.4%, respectively). In contrast, there was an increased percentage of TAI heifers pregnant following AI with sexed semen as compared to CON heifers (54.8% vs. 31.6% respectively; Table 3).

Table 3. Effect of treatment on fertility responses of dairy heifers at first Al

	Treatment ²		
ltem	CON	TAI	
Days to first Al, d	10.4 ± 0.4	1.7 ± 0.1	
Pregnant at first Al ³ , % (no./no.)	58.3 (173/297)	62.8 (191/304)	
Days to pregnancy ³ , d	28.9 ± 1.6a	18.9 ± 1.6b	
Pregnant according to semen type ³			
Conventional semen, % (no./no)	64.6 (155/240)	65.4 (151/231)	
Sexed semen, % (no./no)	31.6 (18/57) a	54.8 (40/73) b	

¹Adapted from Silva et al. (2015)

Insemination rate and pregnancy rate. The 21-d insemination rate was greater for TAI than CON heifers (91.4 vs. 82.4%, respectively), even when evaluated after the first 21 d of the study (TAI = 77.1% vs. CON = 68.2). The increased insemination rate in the TAI group led to an improved 21-d pregnancy rate (57.2% vs. 47.9% for TAI and CON heifers, respectively).

Days to pregnancy. The increased 21-d pregnancy rate of TAI heifers reduced the mean days to pregnancy by 10 d (18.9 d vs. 28.9 d for TAI and CON heifers, respectively; Table 3). Furthermore, the proportion of pregnant heifers was increased by 6.3 percentage points in the TAI group by the end of the study (d 84; 91.5% vs. 85.2% for TAI and CON heifers, respectively.

STRATEGY #2: ECONOMIC ANALYSIS

A partial budget was developed by Silva et al. (2015) to calculate the economic differences between the two reproductive programs (CON and TAI). Briefly, expenses included hormones for synchronization of estrus or ovulation, labor, semen and Al supplies, pregnancy diagnosis, and feed. Costs used for GnRH and PGF2 α were \$2.00 per dose, while the CIDR insert was \$8.00 per unit - but with two uses per insert (including the cost of cleaning and autoclaving) which resulted in a cost of \$4.12 per insert. Labor was based on \$10.00/h. Cost of the 5d TAI protocol was \$12.87. (See Silva et al., 2015 for a detailed breakdown of labor and treatment costs).

Silva et al. (2015) calculated the cost associated with extra days on feed in two ways: for heifers that became pregnant, and for heifers that never became pregnant. Considering first heifers that became pregnant, Silva et al. (2015) used a calculated cost of approximately \$2.11 per day (\$0.17/kg dry matter (DM), with dry matter intake (DMI) of 13.0 kg/d) for each additional day. Secondly, Silva et al. (2015) used a calculated cost of \$1.80 per day (average value of TMR fed to breeding heifers: \$0.20/kg DM, with DMI of 9.0 kg/d) for heifers that never became pregnant during the study. (See Silva et al., 2015 for a detailed discussion of expenses associated with extra days on feed).

²CON: Al after detected estrus from d 0 to 84 of the study; TAI: timed Al using the 5-d timed Al protocol for first Al followed by Al upon detection of estrus for the remainder of the 84-d study.

³Pregnancy diagnosis at 60 d after Al.

a, b Values within a row with different superscripts differ (P<0.01)

Table 4. Effects of treatment on costs per heifer or per pregnancy

	Treatment ³		
ltem ²	CON	TAI	Difference ⁴
Cost per heifer, \$			
Hormonal treatment	1.31	12.87	-11.56
Detection of estrus	4.57	3.92	0.65
Semen and Al	13.28	14.50	-1.22
Pregnancy diagnosis	3.68	3.86	-0.18
Extra feed	62.11	40.43	21.68
Total cost	85.00	75.57	9.43
Cost per pregnancy, \$			
Hormonal treatment	1.54	14.07	-12.53
Detection of estrus	5.37	4.28	1.09
Semen and Al	15.56	15.83	-0.27
Pregnancy diagnosis	4.31	4.22	0.09
Extra feed	72.82	44.17	28.65
Total cost	99.59	82.59	17.00

¹Adapted from Silva et al. (2015)

Not surprisingly, whether the calculations were done on a cost per heifer or a cost per pregnancy basis, extra feed was the major factor to be considered. The cost per pregnancy was \$17.00 less for TAI than CON (Table 4).

STRATEGY #2: CONCLUSIONS

Implementation of a 5-d TAI protocol (Lima et al. 2013), beginning on d -6 before entry to the Al program (d 0), results in similar P/Al (first Al), reduces mean d to pregnancy, improves 21-d pregnancy rate, and reduces cost per pregnancy compared with Al after detected estrus.

TAKE HOME MESSAGES

Replacement heifers will not provide a return on investment until after first calving and initiation of lactation; therefore, it is imperative that dairy producers and heifer growers recognize the importance of timely pregnancy production to dairy profitability.

Feed is the major cost in raising replacement heifers, accounting for 45 to 64% of total costs.

When developing heifers, the focus should be on age at conception, not age at first calving.

A delay in age at conception will lead to a delay in age at first calving, along with increased rearing costs (primarily from extra days on feed) and lost income opportunity.

Presynchronization of heifers with a 14 d CIDR protocol, followed 16 d later by a single injection of PGF2 α on the day of Al eligibility, with Al upon detection of estrus, appears to be an effective strategy to generate pregnancies in a timely manner, with fewer days on feed ultimately resulting in an economic benefit to the producer.

The 5 d TAI protocol (GnRH + CIDR IN-5d-CIDR OUT + PGF2 α -24 $h-PGF2\alpha-48 h-GNRH + TAI)$, when initiated 6 d prior to entry to the Al program (with the final injection of PGF2 α on entry to the Al program) and TAI on d 2, results in fewer days to first AI, fewer days to pregnancy, less days on feed, and a cost per pregnancy \$17.00 less than heifers that received AI following detection of estrus.

ACKNOWLEDGEMENTS

The author thanks Zoetis (Florham Park, NJ) for the donation of PGF2α (dinoprost tromethamine; Lutalyse Sterile Solution) and EAZI-BREED CIDR inserts for the research conducted by Claypool et al. (2015a; 2015b; 2016).

LITERATURE CITED

Chebel, R.C., and J.E.P. Santos. 2010. Effect of inseminating cows in estrus following a presynchronization protocol on reproductive and lactation performances. J. Dairy Sci. 93:4632-4643.

Claypool, C.K., J. Spencer, S. Menegatti Zoca, B. Shafii, B. Price, A. Ahmadzadeh, N. Rimbey, and J.C. Dalton. 2015a. Reproductive outcomes of dairy heifers following pre-synchronization with a 14 d CIDR and prostaglandin F2a. J. Dairy Sci. 98:E. Suppl. 2: 874.

Claypool, C.K., J. Spencer, S. Menegatti Zoca, B. Shafii, B. Price, A. Ahmadzadeh, N. Rimbey, and J.C. Dalton. 2015b. Distribution of detected estrus following 14 day CIDR and prostaglandin F2α treatment as a pre-synchronization strategy in dairy heifers. J. Dairy Sci. 98:E. Suppl. 2: 115.

Claypool, C., J. Spencer, S. Menegatti Zoca, B. Shafii, W. Price, A. Ahmadzadeh, N. Rimbey, and J.C. Dalton. 2016. The reproductive and economic benefits of presynchronization of Holstein dairy heifers with a 14-day CIDR protocol. Int'l Cong. Anim. Reprod., Tours, France, pp. 492-

²Costs were calculated as per heifer enrolled in each treatment and per pregnancy obtained by 84 d of eligibility.

³CON: Al after detected estrus from d 0 to 84 of the study; TAI: timed Al using the 5-d timed Al protocol for first Al followed by Al upon detection of estrus for the remainder of the 84-d study.

⁴Cost of CON minus the cost for TAI. A positive value denotes higher cost for CON than TAI, and a negative value denotes a lesser cost for CON than TAI.



YOUR CALVES COME FIRST

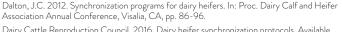
Profits follow

Healthy calves create a more profitable herd. First Arrival® with Encrypt® is an all-natural supplement targeting 98 percent of scours-causing pathogens (including Crypto) and supporting overall intestinal health in calves. With First Arrival® added to your calves' milk replacer, milk or water, you can help calves thrive – even during the most vulnerable period of their lives – returning productivity and profit to the future herd.

Visit us at booth 52 or in the foyer to learn more.



DBC www.DBCAgProducts.com Ag Products



Dairy Cattle Reproduction Council. 2016. Dairy heifer synchronization protocols. Available on-line at: http://www.dcrcouncil.org/media/Public/Dairy_Heifer_Reproduction_Protocols_ Final09302015.pdf

Escalante, R.C., S.E. Poock, and M.C. Lucy. 2013a. Follicular populations and luteal function in dairy heifers treated with a controlled internal drug release insert for 14 days as a method to synchronize the estrous cycle before prostaglandin $\tilde{F}2\alpha$ treatment and artificial insemination. J. Dairy Sci. 96:3806-3816.

Escalante, R.C., S.E. Poock, D.J. Mathew, W.R. Martin, E.M. Newsom, S.A. Hamilton, K.G. Pohler, and M.C. Lucy. 2013b. Reproduction in grazing dairy cows treated with 14-day controlled internal drug release for presynchronization before timed artificial insemination compared with artificial insemination after observed estrus. J. Dairy Sci. 96:300-306.

Frazer, LLP, Certified Public Accountants and Consultants. 2016. In: Dairy Farm Operating Trends, June 30, 2016, pp. 1-4.

Gabler, M.T., P.R. Tozer, and A.J. Heinrichs. 2000. Development of a cost analysis spreadsheet for calculating the costs to raise a replacement dairy heifer. J. Dairy Sci. 83:1104-1109.

Kuhn, M.T., J.L. Hutchison, and G.R. Wiggans. 2006. Characterization of Holstein heifer fertility in the United States. J. Dairy Sci. 89:4907-4920.

Leitman, N.R., D.C. Busch, D.A. Mallory, D.J. Wilson, M.R. Ellersieck, M.F. Smith, and D.J. Patterson. 2009. Comparison of long-term CIDR-based protocols to synchronize estrus in beef heifers. Anim. Reprod. Sci. 114:345-355.

Lima, F.S., H. Ayres, M.G. Favoreto, R.S. Bisinotto, L.F. Greco, E.S. Ribeiro, P.S. Baruselli, C. A. Risco, W.W. Thatcher, and J.E.P. Santos. 2011. Effects of gonadotropin-releasing hormone at initiation of the 5-d timed artificial insemination (AI) program and timing of induction of ovulation relative to Al on ovarian dynamics and fertility of dairy heifers. J. Dairy Sci. 94:4997-5004.

Lima, F.S., E.S. Ribeiro, R.S. Bisinotto, L.F. Greco, N.M. Martinez, M. Amstalden, W.W. Thatcher, and J.E.P. Santos. 2013. Hormonal manipulations in the 5-day timed artificial insemination protocol to optimize estrous cycle synchrony and fertility in dairy heifers. J. Dairy Sci. 96:7054-7065.

Mallory, D.A., S.L. Lock, D.C. Woods, S.E. Poock, and D.J. Patterson. 2013. Comparison of sex-sorted and conventional semen within a fixed-time artificial insemination protocol designed for dairy heifers. J. Dairy Sci. 96:854-856.

Mann, D. 2013. Raising heifers for reproductive success, costs and benefits to the producer. In: Proc. Dairy Cattle Reproduction Council Annual Meeting, Indianapolis, IN, pp. 49-52.

Mohd Nor, N., W. Steeneveld, M.C.M. Mourits, and H. Hogeveen. 2012. Estimating the costs of rearing young dairy cattle in the Netherlands using a simulation model that accounts for uncertainty related to diseases. Prev. Vet. Med. 106:214-224.

Moreira, F., C. Orlandi, C.A. Risco, R. Mattos, F. Lopes, and W.W. Thatcher. 2001. Effects of presynchronization and bovine somatotropin on pregnancy rates to a timed artificial insemination protocol in lactating dairy cows. J. Dairy Sci. 84: 1646-1659.

Rabaglino, M.B., C.A. Risco, M-J. Thatcher, I.H. Kim, J.E.P. Santos, and W.W. Thatcher. 2010. Application of one injection of prostaglandin $F2\alpha$ in the five-day Co-Synch + CIDR protocol for estrous synchronization and resynchronization of dairy heifers. J. Dairy Sci. 93:1050–1058.

Roche, J.F., E.J. Austin, M. Ryan, M.O'Rourke, M. Mihm, and M.G. Diskin. 1999. Regulation of follicle waves to maximize fertility in cattle. J. Reprod. Fertil. Suppl. 54:61-71.

Silva, T.V., F.S. Lima, W.W. Thatcher, and J.E.P. Santos. 2015. Synchronized ovulation for first insemination improves reproductive performance and reduces cost per pregnancy in dairy heifers. J. Dairy Sci. 98:7810-7822.

Vandehaar, M.J. 2001. Accelerated growth for dairy heifers: I'd rather bet on blackjack. In: Proc. 5th West. Dairy Mgt. Conf., Las Vegas, NV, pp. 123-131.

DEFINE, DETECT, AND DIAGNOSE BRD FOR GREATER PREVENTION AND TREATMENT SUCCESS

Terri Ollivett, Ph.D., University of Wisconsin - Madison						
	_					
	_					
	_					
	_					
	_					
	_					

PRODUCER PANEL: DEVELOPING PROTOCOLS FOR ANIMAL HANDLING

Moderator: Dr. Michael Bolton, Merck Animal Health

CALVES, CONSUMER AND COMMUNICATION: PERSPECTIVES FROM ACROSS NORTH AMERICA

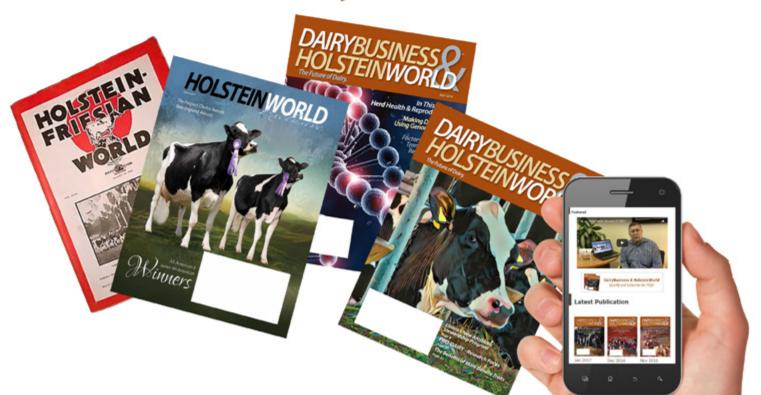
derated by: Emily Yeiser Stepp, National Milk Producers Federation; elists: Dr. Marina von Keyserlingk, Katie Dotterer-Pyle, Denise Skidmore and Katie Grinstead						

ADDITIONAL NOTES

DAIRYBUSINESS HOLSTEINWORLD The Future of Dairy

Relevant news and information since 1904.
We <u>are</u> the Future of Dairy!

www.DairyBusiness.com





Help protect your investment against bovine respiratory disease (BRD) with ZACTRAN.

The first 12 months is a crucial time in a heifer's life. Stress from weaning can leave them susceptible to pneumonia, which can have a long-term effect on lifetime milk production. With ZACTRAN, you get a potent combination of six factors that helps you protect the genetic potential of your heifers. Get the facts and find out what makes ZACTRAN the smart choice for your weaning protocol. ZACTRAN.com

IMPORTANT SAFETY INFORMATION: For use in cattle only. Do not treat cattle within 35 days of slaughter. Because a discard time in milk has not been established, do not use in female dairy cattle 20 months of age or older, or in calves to be processed for yeal. The effects of ZACTRAN on bovine reproductive performance, pregnancy and lactation have not been determined.

Merial is now part of Boehringer Ingelheim

- 1 Susceptibility
- 2 Speed
- 3 Site of infection
- 4 Staying power
- **5** Safety
- **6** Saves money







150 mg/mL ANTIMICROBIAL

For subcutaneous injection in beef and non-lactating dairy cattle only. Not for use in female dairy cattle 20 months of age or older or in calves to be processed for yeal.

Caution: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

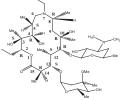
READ ENTIRE BROCHURE CAREFULLY BEFORE USING THIS PRODUCT.

DESCRIPTION

ZACTRAN® Injection for Cattle is a ready to use sterile parenteral solution containing gamithromycin, a macrolide sub-class, 7a-azalide antimicrobial. Each mL of ZACTRAN contains 150 mg of gamithromycin as the free base, 1 mg of monothioglycerol and 40 mg of succinic acid in a glycerol formal vehicle.

The chemical name of qamithromycin is 1-Oxa-7-azacyclopentadecan-15-

one,13-[(2,6-dideoy-3-C-methyl-3-0-methyl-alpha-vl-ribo-hexopyranosyl) oxy]-2-ethyl-3,4,10-trihydroxy 3,5,8,10,12,14-hexamethyl-7-propyl-11-[{3,4,6-trideoxy-3-(dimethylamino)-beta-D-xylo-hexopyranosyl]oxy]-, [(2R*, 3S*,4 R*,5S*,8R*,10R*,11R*,12S*,13S*,14R*)]-and the structure is shown below.



INDICATIONS

ZACTRAN is indicated for the treatment of

bovine respiratory disease (BRD) associated with Mannheimia haemolytica, Pasteurella multocida, Histophilus somni and Mycoplasma bovis in beef and non-lactating dairy cattle. ZACTRAN is also indicated for the control of respiratory disease in beef and non-lactating dairy cattle at high risk of developing BRD associated with Mannheimia haemolytica and Pasteurella multocida.

DOSAGE and ADMINISTRATION

Administer ZACTRAN one time as a subcutaneous injection in the neck at 6 mg/kg (2 mL/110 lb) body weight (BW). If the total dose exceeds 10 mL, divide the dose so that no more than 10 mL is administered at each injection site.

Body Weight (lb)	Dose
110	2
220	4
330	6
440	8
550	10
660	12
770	14
880	16
990	18
1100	20

Animals should be appropriately restrained to achieve the proper route of administration. Use sterile equipment. Inject under the skin in front of the shoulder (see illustration).



CONTRAINDICATIONS

As with all drugs, the use of ZACTRAN is contraindicated in animals previously found to be hypersensitive to this drug.

WARNING:

FOR USE IN CATTLE ONLY.
NOT FOR USE IN HUMANS.
KEEP THIS AND ALL DRUGS OUT OF REACH OF CHILDREN.
NOT FOR USE IN CHICKENS OR TURKEYS.

The material safety data sheet (MSDS) contains more detailed occupational safety information. To report adverse effects, obtain an MSDS or for assistance, contact Merial at 1-888-637-4251.

RESIDUE WARNINGS: Do not treat cattle within 35 days of slaughter. Because a discard time in milk has not been established, do not use in female dairy cattle 20 months of age or older. A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for yeal.

PRECAUTIONS

The effects of ZACTRAN on bovine reproductive performance, pregnancy, and lactation have not been determined. Subcutaneous injection of ZACTRAN may cause a transient local tissue reaction in some cattle that may result in trim loss of edible tissues at slaughter.

ADVERSE REACTIONS

Transient animal discomfort and mild to moderate injection site swelling may be seen in cattle treated with ZACTRAN.

CLINICAL PHARMACOLOGY

The macrolide antimicrobials as a class are weak bases and as such concentrate in some cells (such as pulmonary leukocytes). Prolonged exposure of extracellular pulmonary pathogens to macrolides appears to reflect the slow release of drug from its intracellular reservoir to the site of action, the pulmonary epithelial lining fluid (ELF). It is the ELF that is relevant to the successful treatment and control of BRD. Gamithromycin is primarily bacteriostatic at therapeutic concentrations. However, in vitro bactericidal activity has been observed at concentrations of 10 µg/mL (Mueller-Hinton broth) and after exposure to the 6-hour and 24-hour plasma samples derived from cattle dosed at 6 mg qamithromycin/kg BW.

Macrolides typically exhibit substantially higher concentrations in the alveolar macrophages and ELF as compared to concentrations observed in plasma. Gamithromycin concentrations in the ELF and ELF cells exceed the concentrations observed in the plasma. Postmortem gamithromycin concentrations in ELF exceed the MIC₉₀ of *M. haemolytica*, *H. somni* and *P. multocida* through at least 72 hours after drug administration. Because M. haemolytica, P. multocida and H. somni are extracellular pathogens, drug concentrations in the ELF are considered to be clinically relevant. The postmortem area under the concentration-time curve (AUC) observed in lysed ELF cells (e.g., alveolar macrophages) are at least 300-times greater than that in the plasma. Although published studies suggest that inflammation can increase the release of drug from macrophages and neutrophils, these high concentrations in the alveolar macrophages should not be considered indicative of the magnitude or duration of response to the pathogens for which this product is indicated. ZACTRAN administered subcutaneously in the neck of cattle at a single dosage of 6 mg/kg BW is rapidly and completely absorbed, with peak concentrations generally occurring within 1 hour after administration. Based upon plasma and lung homogenate data, the terminal half-life (T½) of gamithromycin is approximately 3 days. In vitro plasma protein binding studies show that 26% of the gamithromycin binds to plasma protein, resulting in free drug available for rapid and extensive distribution into body tissues. The free drug is rapidly cleared from the systemic circulation with a clearance rate of 712 mL/hr/kg and a volume of distribution of 25 L/kg. Dose proportionality was established based on AUC over a range of 3 mg/kg BW to 9 mg/kg BW. Biliary excretion of the unchanged drug is the major route of elimination.

MICROBIOLOGY

The minimum inhibitory concentrations (MIC's) of gamithromycin were determined for BRD isolates obtained from calves enrolled in BRD treatment field studies in the U.S. in 2004 using methods recommended by the Clinical and Laboratory Standards Institute (M31-A2). Isolates were obtained from pre-treatment nasopharyngeal swabs from each enrolled calf and from calves removed from the study due to BRD. The results are shown below in Table 1.

Table 1. Gamithromycin minimum inhibitory concentration (MIC) values* of indicated pathogens isolated from BRD treatment field studies in the U.S.

	Indicated Pathogens	Years of isolation	No. of isolates	MIC _{s0} ** (μg/mL)	MIC ₉₀ ** (μg/mL)	MIC range (μg/mL)
	M. haemolytica	2004	89	1	1	0.5 to >32
	P. multocida	2004	79	0.5	1	0.12 to >32
	H. somni	2004	32	0.5	0.5	0.25 to 1

^{*}The correlation between in vitro susceptibility data and clinical effectiveness is unknown.

EFFECTIVENESS

The effectiveness of ZACTRAN for the treatment of BRD associated with Mannheimia haemolytica, Pasteurella multocida and Histophilus somni was demonstrated in a field study conducted at four geographic locations in the United States. A total of 497 cattle exhibiting clinical signs of BRD were enrolled in the study. Cattle were administered ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline as a subcutaneous injection once on Day 0. Cattle were observed daily for clinical signs of BRD and were evaluated for clinical success on Day 10. The percentage of successes in cattle treated with ZACTRAN (58%) was statistically significantly higher (p<0.05) than the percentage of successes in the cattle treated with saline (19%).

The effectiveness of ZACTRAN for the treatment of BRD associated with M. bovis was demonstrated independently at two U.S. study sites. A total of 502 cattle exhibiting clinical signs of BRD were enrolled in the studies. Cattle were administered ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline as a subcutaneous injection once on Day 0. At each site, the percentage of successes in cattle treated with ZACTRAN on Day 10 was statistically significantly higher than the percentage of successes in the cattle treated with saline (74.4% vs. 24% [p < 0.001], and 67.4% vs. 46.2% [p = 0.002]). In addition, in the group of calves treated with gamithromycin that were confirmed positive for M. bovis (pre-treatment nasopharyngeal swabs), there were more calves at each site (45 of 57 calves, and 5 of 6 calves) classified as successes than as failures.

The effectiveness of ZACTRAN for the control of respiratory disease in cattle at high risk of developing BRD associated with Mannheimia haemolytica and Pasteurella multocida was demonstrated in two independent studies conducted in the United States. A total of 467 crossbred beef cattle at high risk of developing BRD were enrolled in the study. ZACTRAN (6 mg/kg BW) or an equivalent volume of sterile saline was administered as a single subcutaneous injection within one day after arrival. Cattle were observed daily for clinical signs of BRD and were evaluated for clinical success on Day 10 post-treatment. In each of the two studies, the percentage of successes in the cattle treated with ZACTRAN (86% and 78%) was statistically significantly higher (p = 0.0019 and p = 0.0016) than the percentage of successes in the cattle treated with saline (36% and 58%).

ANIMAL SAFETY

In a target animal safety study in healthy, six-month old beef cattle, ZACTRAN was administered by subcutaneous injection at 6, 18, and 30 mg/kg bodyweight (1, 3, and 5 times the labeled dose) on Day 0, 5, and 10 (3 times the labeled administration frequency). Injection site discomfort (neck twisting, attempts to scratch or lick the injection site, and pawing at the ground) was observed in calves in the 18 mg/kg BW and 30 mg/kg BW groups at 10 minutes post-treatment following each injection. Mild to moderate injection site swelling and pathology changes consistent with inflammation were observed in the gamithromycin-treated groups. Other than injection site reactions, no clinically relevant treatment-related effects were observed.

STORAGE CONDITIONS

Store at or below $77^{\circ}F$ ($25^{\circ}C$) with excursions between $59-86^{\circ}F$ ($15-30^{\circ}C$). Use within 18 months of first puncture.

HOW SUPPLIED

ZACTRAN is available in three ready-to-use bottle sizes. The 100, 250 and 500 mL bottles contain sufficient solution that will treat 10, 25 and 50 head of 550 lb (250 kg) cattle respectively.

Marketed by Merial

3239 Satellite Blvd., Duluth, GA 30096-4640 U.S.A.
Made in Austria

®ZACTRAN is a registered trademark of Merial.

©2016 Merial. All rights reserved.

M088812/02 US Code 6411 Rev. 01/2016

^{**}The lowest MIC to encompass 50% and 90% of the most susceptible isolates, respectively.



MADE POSSIBLE BY



There is one industry-leading source of networking, education, and improvement for the raising of dairy calves and heifers. The Dairy Calf and Heifer Association has a renewed commitment to their vision to be just that.

Be a part of the dairy industry's future.

BECOME A MEMBER TODAY!

855-400-DCHA | INFO@CALFANDHEIFER.ORG | WWW.CALFANDHEIFER.ORG | F

2017 CONFERENCE PLANNING COMMITTEE

Co-Chairs: Bob James and Brent Caffee

Ann Hoskins Lavon Yoder
Brett Barlass Sam Gardner
Jane Griswold Jenna Hurty

Jason Karszes

2016–2017 DCHA BOARD OF DIRECTORS

President Lane Sollenberger

Vice President
Paul Jacobs

Secretary/Treasurer Vickie Franken

Southwest Regional Director T.J. McClure

Northeast Regional Director Elizabeth Quinn

North Central Regional Director Amy Shiplett

Academia-at-Large Director Bob James

Allied Professional/ Company-at-Large Director Tamilee Nennich

Director-at-Large Jack Banker

Management Team Ed Peck Kylene Anderson Katie Wilke Junkers Kelsi Mayer

THANK YOU TO OUR SPONSORS

DIAMOND



















PLATINUM





GOLD







SILVER















BRONZE

Bio-Vet, Inc.

The Country Today

Biomin

FutureCow

CRI - GENEX

Golden Calf Company

ImmuCell Corporation

Lallemand Animal Nutrition Micronutrients

Nurtriad, Inc.