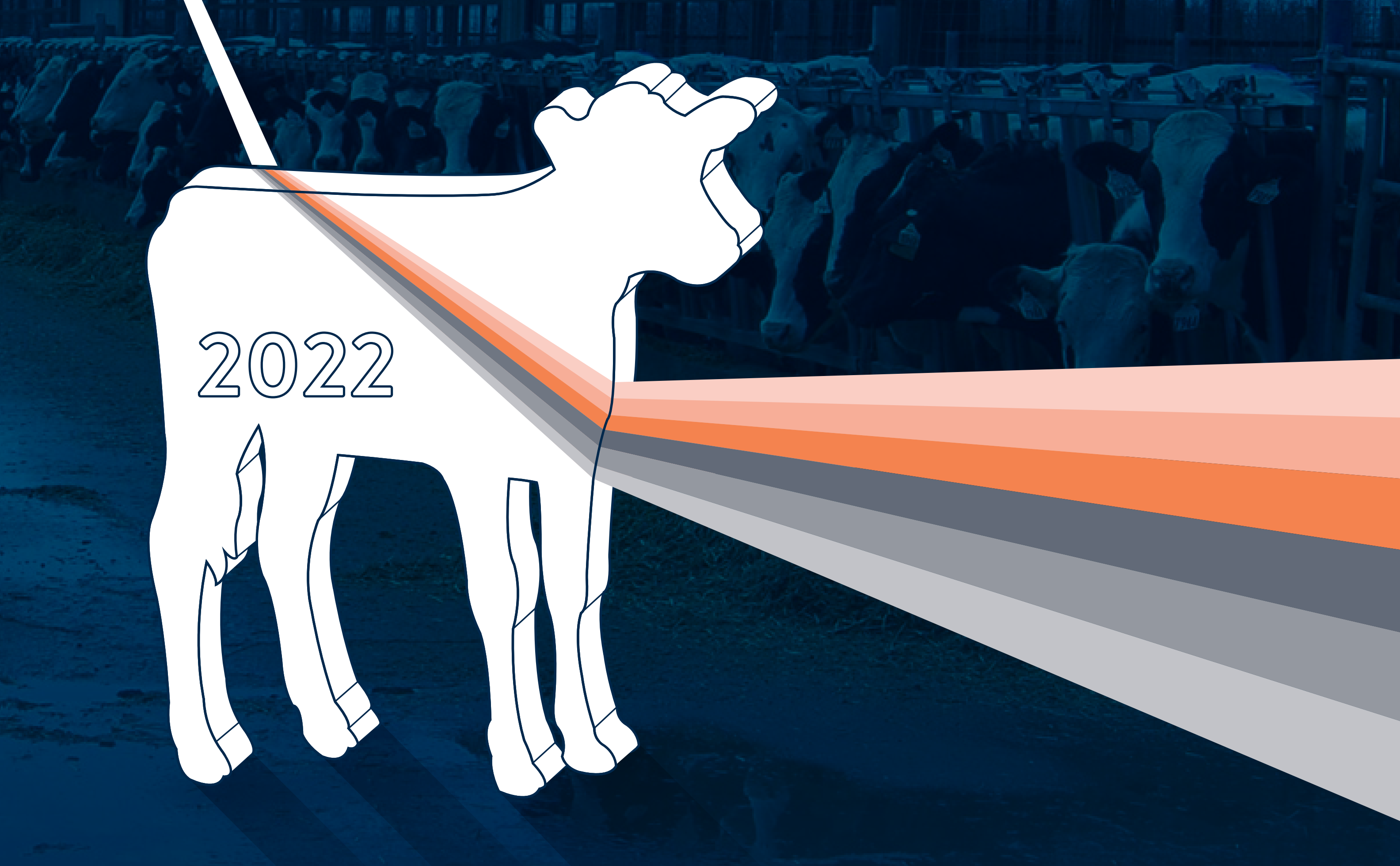
RESOURCE GUIDE

A SPECTRUM of OPPORTUNITIES



2022 ANNUAL CONFERENCE

Bloomington, MN | April 12–14

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A SPECTRUM of OPPORTUNITIES

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WELCOME!

Welcome to the 2022 Dairy Calf and Heifer Association Annual Conference and Trade Show. Themed "A Spectrum of Opportunities," this year's conference features three specialty tracks – wet-calf/weaning, post-weaning/reproduction, and beef x dairy. Pick the track that's most pertinent to your business or explore a track that may fit a future dairy business model.

REGISTRATION

TUESDAY, APRIL 12
6:30 a.m.—6:00 p.m.

WEDNESDAY, APRIL 13
7:00 a.m.—5:00 p.m.

THURSDAY APRIL 14
7:00 a.m.—1:00 p.m.

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 12

4:30 p.m.–6:00 p.m.	Trade Show Reception

WEDNESDAY, APRIL 13

12:30–1:00 p.m.	Trade Show Open
4:30–6:00 p.m.	Trade Show Reception

THURSDAY APRIL 14

7:45–8:30 a.m.	Trade Show Open
12:00–12:30 p.m..	Trade Show Open

AGRI-PLASTICS HUTCHES, PENS AND ACCESSORIES

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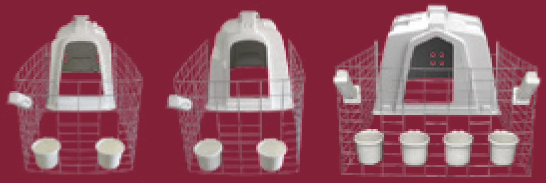
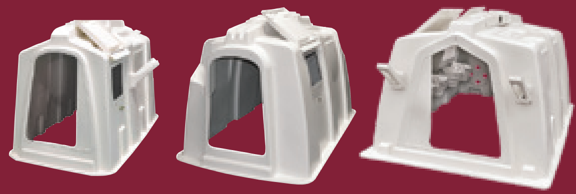


SL, EXL and Dual XL Rancher Hutches

NEW FOR 2022!



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CONFERENCE AGENDA

All times listed are Central time.

TUESDAY, APRIL 12

Registration opens
6:30 a.m.

OPTIONAL TOURS

Set-up for success: Maternity, calves and employees
7:00 a.m. | Meet at Northwest Entrance
Scheps Dairy, Almena, WI, and Minglewood Dairy, Deer Park, WI
Sponsored by: Adisseo, AgPartners, Agri-Plastics and Vita Plus

Looking forward: Reproduction, facilities, social media
7:45 a.m. | Meet at Northwest Entrance
Bomaz Farms, Hammond, WI, and Jon-De Farm, Baldwin, WI
Sponsored by: Calf-Tel

Beef x Dairy: From hutch to rail
8:15 a.m. | Meet at Northwest Entrance
Larson Farm, Farmington, MN, and University of Minnesota Meat Science Lab, St. Paul, MN
Sponsored by: ABS, American Foods Group and Axiota

Tour buses return to hotel
1:30 p.m.

PRE-CONFERENCE SESSION

A practical approach for improving colostrum quality on farm
2:00 p.m. | Grand Ballroom West
Adam Geiger, Zinpro, and Dave Cook, Milk Products Inc.
Sponsored by: Zinpro and Milk Products Inc.

Beef x Dairy: Maximizing the potential of a new industry normal
3:15 p.m. | Grand Ballroom West
Ben Voelz, STgenetics
Sponsored by: STgenetics

Reception in the Trade Show
4:30–6:00 p.m.

WEDNESDAY, APRIL 13

Breakfast
7:00 a.m. | Grand Ballroom West
Sponsored by: Zoetis

GENERAL SESSION

It's your bid
8:00 a.m. | Grand Ballroom West
Kevin Ochsner, Agcellerate

TRACK OPTIONS – SELECT ONE

9:15 a.m.

WET-CALF/WEANING TRACK

Colostrum and immunity of the preweaned calf. It is more than IgG!
Edina
Robert James, Down Home Heifer Solutions, LLC

POST-WEANING/REPRO TRACK

Heifer fertility programs and record analysis
Bloomington
Joseph Dalton, University of Idaho

BEEF X DAIRY TRACK

New paradigms for a new enterprise: Dairy producer and calf ranch perspectives
Atrium 4
Brent Czech, New Heights Dairy, Randall Grimmius, Grimmius Cattle, moderated by Bob Weaber, Kansas State University
Sponsored by: TransOva

Morning break
10:15 a.m.

TRACK OPTIONS – SELECT ONE

10:45 a.m.

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Sponsored by: TransOva

Lunch
11:45 a.m | Grand Ballroom West

DCHA Annual Business Meeting
12:00 p.m.

Trade Show open
12:30–1:00 p.m.

TRACK OPTIONS – SELECT ONE

1:00 p.m.

WET-CALF/WEANING TRACK

Milk feeding, weaning and beyond: Vision 2032
Edina
Michael Steele, University of Guelph
Sponsored by: Diamond V

POST-WEANING/REPRO TRACK

Optimizing heifer reproductive efficiency through data insights
Bloomington
Luis Mendonça, Merck Animal Health
Sponsored by: Merck Animal Health


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BEEF X DAIRY TRACK

New paradigms for a new enterprise: Feedlot and meat quality perspectives

Atrium 4

Bob Sato, Friona Industries, and Dale R. Woerner, Texas Tech University, moderated by Jeremy Howard, Simplot

TRACK OPTIONS – SELECT ONE

2:00 p.m.

WET-CALF/WEANING TRACK

Milk feeding, weaning and beyond: Vision 2032

Edina

Michael Steele, University of Guelph

Sponsored by: Diamond V

POST-WEANING/REPRO TRACK

Optimizing heifer reproductive efficiency through data insights

Bloomington

Luis Mendonça, Merck Animal Health

Sponsored by: Merck Animal Health

BEEF X DAIRY TRACK

New paradigms for a new enterprise: Feedlot and meat quality perspectives

Atrium 4

Bob Sato, Friona Industries, and Dale R. Woerner, Texas Tech University, moderated by Jeremy Howard, Simplot

Break

3:00 p.m.

GENERAL SESSION

Navigating the road to the future

3:30 p.m. | Grand Ballroom West

Kevin Ochsner, Agcellerate

Reception in the Trade Show

4:30–6:00 p.m.

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THURSDAY, APRIL 14

Breakfast
7:00 a.m. | Grand Ballroom West
Sponsored by: Axiota

Trade Show Open
7:45–8:30 a.m.

TRACK OPTIONS – SELECT ONE
8:30 a.m.

WET-CALF/WEANING TRACK

Health and biosecurity: Management practice to improve calf health
Edina
Terri Ollivett, University of Wisconsin-Madison, and Richard Pereira, University of California-Davis

POST-WEANING/REPRO TRACK

Real heifer grower reproduction performance data and what does it tell us?
Bloomington
Jon Holewinski, Alta Genetics

BEEF X DAIRY TRACK

New paradigms for a new enterprise: Question and answer session
Atrium 4
Brent Czech, Randall Grimmius, Bob Sato and Dale R. Woerner; Moderated by Peggy Coffeen, Progressive Dairy *magazine*

Break
9:30 a.m.
Sponsored by: AHV International

TRACK OPTIONS – SELECT ONE
9:45 a.m.

WET-CALF/WEANING TRACK

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GENERAL SESSION
11:00 a.m. | Grand Ballroom West

Practical ideas on employee management and engagement: Let's go back to the basics
Izabella Toledo, University of Florida, and Jorge Delgado, Alltech
Sponsored by: Alltech

Trade Show Open
12:00–12:30 p.m.

POST-CONFERENCE SESSION
1:00 p.m. | Bloomington

Calf Care Quality Assurance instructor course
Steven Roche, ACER Consulting
Sponsored by: BQA, VQA, FARM, DCHA

Schedule subject to change

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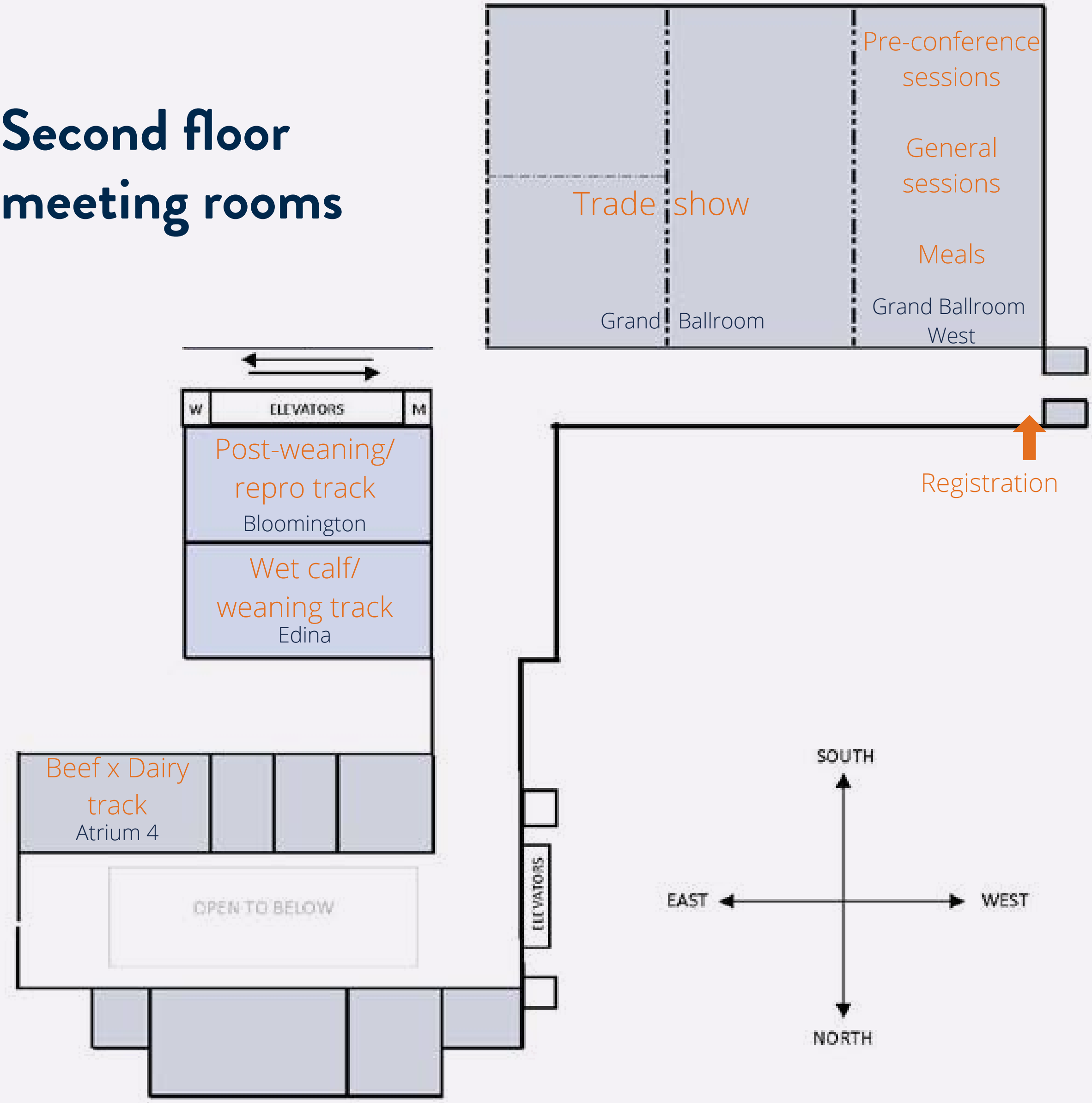
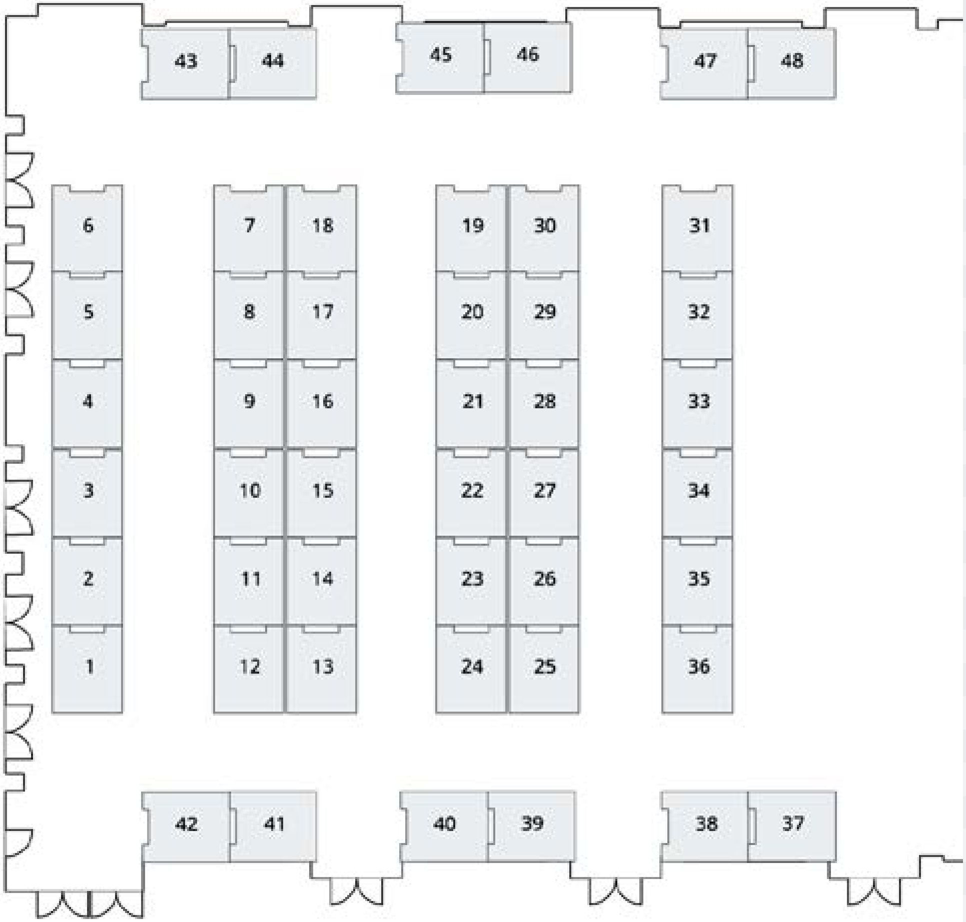
MEETING SPACE MAP

Second floor meeting rooms



EXHIBITION HALL MAP



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11	Casper's Calf Ranch, LLC
17	Cerdos, LLC
20	The Coburn Company Inc
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35	Denkavit
36	Endovac Animal Health
8	Foerster Technik North America
14 & 15	Genova Labs, LLC
39 & 40	Hampel Corporation
7	Hubbard Feeds
4	ImmuCell Corporation
12	JDJ Solutions (Peach Teats)
31	Key Ag Distributors
34	Kunafin 'The Insectary'
9	Laird Manufacturing
1 & 2	MicroBasics
10	Midwest Milk Products
16	MISCO Refractometer
38	Norbrook Inc
32	Organix Recycling
27	Parnell Living Science
18	Phileo-Lesaffre Animal Care
19	Select Sires, Inc.
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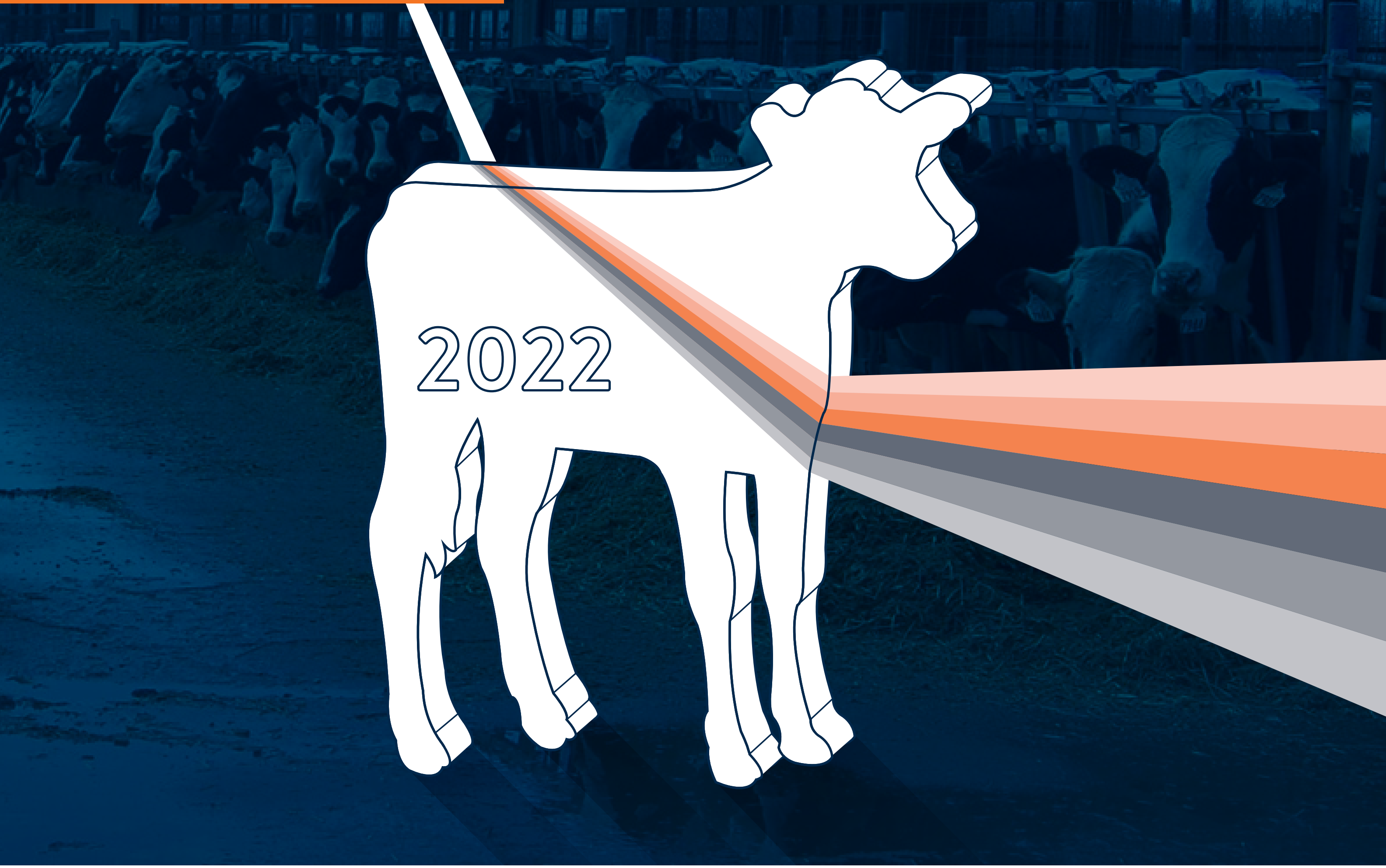

Colostrum and immunity of the preweaned calf. It is more than IgG!

Robert James, *Down Home Heifer Solutions, LLC*

Our traditional view of colostrum management has emphasized the feeding of at least 4 quarts (liters) of colostrum containing at least 50 grams of IgG/L (grams of immunoglobulin G/liter) within the first 6 hours of life. These recommendations still apply today, but what else have we learned? During this time, our goals for assessing colostrum management were focused on achieving a serum IgG level of >10 g/L for calves between 24 hours and 7 days of age. A group of dairy industry professionals led by U.S. Department of Agriculture Animal and Plant Health Inspection Service scientists conducted an exhaustive review of calf data from U.S. dairy farms, including amount of colostrum consumed, IgG content of colostrum, morbidity, and mortality. Rather than a single cut point, new standards for assessing transfer of passive immunity were developed and published in the Journal of Dairy Science in 2019 (see Table 1).

Table 1. Consensus serum IgG concentrations and equivalent total protein (TP) and Brix measurements, and percentage of calves recommended in each passive immunity (TPI) category

TPI category	Serum IgG (g/L)	Equivalent TP (g/dl)	Equivalent Brix %	Consensus (% of calves)	NAHMS study (% of calves)[1]
Excellent	≥25.0	>6.2	>9.4	>40	>35.5
Good	18.0–24.9	5.8–6.2	8.9–9.3	~30	25.7
Fair	10.0–17.9	5.1–5.7	8.1–8.8	~20	26.8
Poor	<10.0	<5.1	<8.1	<10	12.0

[1] Percent of calves in National Animal Health Monitoring System (NAHMS) 2014 Dairy Study (Shively et al., 2018) in each consensus category.

Our knowledge of the "science of colostrum" and its impact on management of the on-farm colostrum program has advanced over the past years. Part of this comes from the assay techniques that enable us to study the potential impact of non-IgG components of colostrum on calf development and health. We have also come to recognize the importance of colostrum and the impact calf management during the first hours of life has on later development of the heifer and her performance and longevity in the dairy herd. Recent findings are summarized below.

Heat stress

Workers in Georgia found that calves born from heat-stressed dams were more than 12 pounds smaller than calves born from dams that were cooled in late gestation, most likely due to "early" calving. In addition, calves born from cooled dams were more efficient in absorbing colostrum IgG and achieved higher levels of IgG. Heat stress accelerated "closure" of the gut to IgG uptake.

The biome

At birth, calves are essentially "sterile" or have exceptionally low levels of bacteria in their GI tract. The dam's oral, vaginal and fecal flora, as well as the bacteria in the calving environment, are influential in establishing the calf's biome. Colostrum, when obtained from the dam, has low levels of bacteria. However, once colostrum is harvested, bacterial populations rapidly increase during storage and until fed to the calf. Early work by this author and later work by Minnesota workers found a significant negative relationship between extent of coliform and other microbial populations present in colostrum and the small intestine, and IgG absorption by the calf. Consumption of "clean" colostrum very early in life leads to higher levels of IgG absorption. Earlier feeding of "clean" colostrum also encourages establishment of higher levels of desirable bacteria (Bifidobacteria and Lactobacilli) in the GI tract. The challenge is in creating conditions for establishing desirable populations of the "biome" and discouraging the establishment of undesirable populations.

Dairy calf feeding management

It is interesting to compare how we manage the newborn and preweaned calf, as compared to beef cattle and other mammals. Dairy farms have focused on one feeding of colostrum at varying ages that often does not come from the calf's dam and rarely are multiple meals of colostrum and "transition" milk consumed by dairy calves, as compared to most mammalian newborns. Does this have an impact on the calf immediately and later in life?

Development of the GI tract and calf growth

It has been known for some time that colostrum contains high levels of many bioactive components at the first milking and gradually decrease over the first days of lactation. Research has demonstrated that feeding colostrum beyond the first feeding and the use of transition milk can have significant benefits to the calf. Supplying two feedings of colostrum (~300g of IgG total) followed by additional feedings of colostrum or transition milk for several days results in higher IgG levels in the blood and stimulates increased growth and development of the intestinal epithelium. This, in turn, appears to stimulate improved function of the digestive system and growth.

In addition to IgG, there are many "bioactive" components in colostrum and transition milk, which are present in high amounts and decline over the first 3 to 5 days of lactation. Oligosaccharides may contribute to improved gut function through stimulatory effects on desirable bacteria, binding of pathogenic *E. coli* or enhancement of IgG uptake by intestinal tissue.

Other "bioactive" components that are present in higher concentrations in colostrum and transition milk, which may have an influence on digestive function and calf development, include certain fatty acids, lactoferrin, growth factors (e.g., IGF and TGF), enzymes and enzyme inhibitors, microRNAs, and cytokines. Recognize that it is challenging to determine the impact of individual components or how they may act in a complementary or inhibitory manner. However, it has become increasingly evident that the benefits of extended feeding of colostrum and transition milk are significant.

Immune cells from the dam's colostrum

The newborn calf will absorb leukocytes present in the dam's colostrum if it is not pasteurized or subject to freezing and thawing. Studies have shown improved resistance to respiratory disease and enhanced response to vaccines up to 10 months of age in calves receiving fresh colostrum from their dams.

Challenges to optimizing benefits of colostrum

The optimum benefit of colostrum is achieved by feeding the dam's colostrum to her calf and continuing to feed transition milk as the supply allows. This presents a significant challenge on many dairy farms. When colostrum is commingled, there will be no benefit to the immune cells in colostrum because they are not absorbed. Heat treatment is commonly recommended when feeding commingled colostrum as it reduces pathogens and organisms associated with reduced IgG absorption. We have much to learn regarding the impact of heat treatment on other bioactive compounds. Ultimately, decisions on how to manage colostrum feeding programs are based on determining the costs of needed changes to colostrum management systems versus the expected benefits. Given the use of genomics to increase genetic selection and that many farms are raising fewer replacements, there is an increased likelihood of achieving a positive net benefit achieved by feeding the dam's colostrum to her calf and developing systems to feed transition milk to calves during the first days of their lives.

References available upon request.

Heifer fertility programs and record analysis

Joseph C. Dalton, *University of Idaho*

The three largest expenses of a dairy business are feed costs for the lactating herd, labor, and raising replacement heifers (Frazer, 2022). Feed is the major cost in raising replacement heifers, accounting for 53 to 64% of total costs in U.S. dairy farms (Gabler et al., 2000).

When developing heifers, the reproductive focus should be on age at first pregnancy, not age at first calving. A delay in age at first pregnancy 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 (Lormore, 2006). Previous research (Lopes et al., 2013; Silva et al., 2015; Giordano and Masello, 2019) provides evidence that heifers become pregnant earlier after breeding eligibility have reduced rearing costs. Consequently, implementation of a reproductive program focused on age at first pregnancy is beneficial to the long-term viability of the heifer-raising enterprise.

Fertility programs

5-day CIDR-Synch (Conventional and sexed semen)

Silva et al. (2015) investigated the reproductive performance and cost per pregnancy in dairy heifers following a 5-day controlled internal drug release- (CIDR) Synch timed artificial insemination (TAI) program as compared to AI following estrous detection (CON).

Results

Silva et al. (2015) reported days to first AI was approximately 8 days shorter for TAI heifers than for CON heifers (1.7 vs. 10.4, respectively). The percentage of heifers pregnant (as determined 60 days after AI) did not differ between CON (58.3%) and TAI heifers (62.8%). 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).

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). 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.

5-day CIDR-Synch (sexed semen)

Lauber et al. (2021) studied estrous expression and pregnancy outcomes in a 5-day CIDR-Synch timed AI (TAI) program as compared to AI following estrous detection (EDAI).

Results

Overall, 5-day CIDR-Synch heifers tended to have more pregnancies per AI (P/AI) than EDAI heifers at 64 ± 5 days (52% and 45%, respectively) after AI (Lauber et al., 2021).

Economic analysis

A partial budget was developed to determine the cost per pregnancy for heifers in each treatment during the 84-day breeding period. The feed cost was $1.70 per heifer per day. Feed costs for nonpregnant heifers or heifers that were moved to a bull pen during the study were allocated to the feed costs for heifers within the same treatment group that became pregnant during the 84-day breeding period. The cost per pregnancy was $16.66 less for 5-day CIDR-Synch heifers compared with EDAI heifers (Lauber et al., 2021).

14-day CIDR – $PGF_{2\alpha}$ (conventional semen)

Claypool et al. (2019) investigated presynchronization of dairy heifers, either with a 14-day CIDR or $PGF_{2\alpha}$, followed by $PGF_{2\alpha}$ on the day of breeding eligibility and AI upon detected estrus, as compared to control heifers (no presynchronization, but $PGF_{2\alpha}$ on the day of breeding eligibility and AI upon detected estrus).

Results

Claypool et al. (2019) reported 96.7% of heifers were detected in estrus within 5 days after CIDR removal. Following $PGF_{2\alpha}$ administration on day 0, 95.8% of heifers in the 14-day CIDR-$PGF_{2\alpha}$ group were detected in estrus during the first week, as compared to 74.6% and 66.9% for the 2X $PGF_{2\alpha}$ and control groups, respectively. Days to first AI following breeding eligibility were fewest for heifers in the 14-day CIDR-$PGF_{2\alpha}$ group (3.6 days), intermediate for heifers in the 2X $PGF_{2\alpha}$ group (5.0 days), and highest for heifers in the control group (6.8 days). Days from breeding eligibility to pregnancy were fewest for heifers in the 14-day CIDR-$PGF_{2\alpha}$ group (15.1 days), as compared to heifers in the control group (25.0 days) (Claypool et al., 2019).

Pregnancy per AI for first AI occurring during the first week of breeding eligibility were 71.9% (14-day CIDR-$PGF_{2\alpha}$), 58.0% (2X $PGF_{2\alpha}$), and 61.7% (control) (Claypool et al., 2019). A greater proportion of heifers became pregnant within the first week of breeding eligibility in the 14-day CIDR-$PGF_{2\alpha}$ group as compared to the 2X $PGF_{2\alpha}$ and control groups (68.9 vs. 43.2% and 41.3%, respectively). There was no difference between 2X $PGF_{2\alpha}$ and control groups (Claypool et al., 2019).

There was a treatment effect for days on feed (DOF = day 0, date of breeding eligibility, to projected calving date; Claypool et al., 2019).

Days on feed were 295 days (14-day CIDR-$PGF_{2\alpha}$), 302 days (2X $PGF_{2\alpha}$), and 305 days (control), and were different between 14-day CIDR-$PGF_{2\alpha}$ and control heifers, and tended to differ between 14-day CIDR-$PGF_{2\alpha}$ and 2X $PGF_{2\alpha}$ groups (Claypool et al., 2019).

Economic analysis

Claypool et al. (2019) developed a partial budget to describe the economic benefit of presynchronization of heifers (with a 14-day CIDR) relative to control heifers. No economic analyses were done between 14-day CIDR-$PGF_{2\alpha}$ and 2X $PGF_{2\alpha}$ groups, or between 2X $PGF_{2\alpha}$ and the control group, as these comparisons lacked statistical significance. Subtraction of the treatment cost (cost of presynchronization) from the total reduced costs resulted in a treatment balance of $15.85, the potential economic benefit to the producer for heifers in the 14-day CIDR-$PGF_{2\alpha}$ group.

Record analysis

Every consultant will use their own approach when evaluating reproduction based on dairy records. A basic reproductive record analysis should include an evaluation of voluntary waiting period compliance, 21-day pregnancy rate, conception at each service, and conception by each AI technician.

According to the Dairy Calf and Heifer Association (DCHA), heifers should become AI eligible when they attain 55% of mature weight (DCHA, 2016). In well-developed Holsteins, this will coincide with an age of 12 to 13 months. With conventional semen, DCHA recommends striving to attain a target of 70% first service P/AI and a 21-day pregnancy rate of 47% (DCHA, 2016). With sexed semen, DCHA recommends a target of 60% first service P/AI and a 21-day pregnancy rate of 37% (DCHA, 2016).

References available upon request.

Milk feeding, weaning and beyond: Vision 2032

Michael A. Steele and Juanita Echeverry Munera, *University of Guelph*

The past decade has been marked by a surge in calf research and several new nutritional concepts have been developed. These new nutritional concepts show great potential for on-farm implementation. Even with this recent increase in calf research, calf morbidity and mortality rates still reach 34 percent and 5 percent, respectively (NAHMS, 2011), with digestive disorders accounting for more than half of illnesses and one-third of deaths (Urie et al., 2018). The abundance of knowledge generated on a yearly basis pertaining to calf nutrition and the recent implementation of automated feeding provide many opportunities to develop new feeding programs to improve calf productivity and health, while simultaneously improving the efficiency of dairy operations during the preweaning and postweaning periods. Therefore, this brief review will focus on the future of preweaning and weaning nutrition concepts in calves, and highlight opportunities to improve calf health and development via nutrition.

Milk feeding

The traditional method of feeding less milk (<10 percent of body weight by volume) has been challenged for more than two decades. It is now generally accepted that feeding more milk results in more preweaning growth and enhanced organ development (van Niekerk et al., 2021). However, it is possible to achieve high average daily gain (ADG; >800 g/day) with low milk feeding levels but only after the first month of life when starter intake becomes a more significant contributor to energy intake. In the first weeks of life, "elevated" or "biologically normal" planes of milk nutrition offer clear advantages for increasing growth during a time when feed efficiency is the greatest (Bach and Ahedo, 2008). While the plane of milk nutrition has dominated calf research over the past decade, researchers are now exploring diet composition in different stages of the preweaning period when feeding more colostrum and milk.

As an industry, our attention has been too focused on the passive transfer of immunoglobulin G (IgG) in the first meals of life, often neglecting the transition from colostrum to milk for neonatal calves. Benefits to health, gastrointestinal development and IgG persistency from feeding a transition program from colostrum to milk have been characterized in dairy calves. Most noteworthy would be the recent evidence supporting the use of extended colostrum and transition milk feeding programs in the first days or weeks of life (Pyo et al., 2020; Hare et al.,2020). In addition to colostrum, our lab recently reported that calves fed milk replacer that is higher in fat grow more efficiently compared to calves fed milk replacer higher in lactose, but only in the first week of life (Welboren et al., 2021). This indicates a potential age effect of dietary composition and growth performance. Therefore, it is possible that calves require specific macro- and micro-nutrients at specific points of time during the pre-weaning phase. The concept that youngstock should be offered multiple diets during the early stages of life is termed "phase-feeding" and is widely adopted in other livestock sectors (e.g., pigs, poultry). This feeding program has great potential for implementation in the dairy calf nutrition industry.

Our lab has been exploring how milk composition impacts growth and metabolic development in calves at many stages of the preweaning period when elevated planes of milk nutrition are offered. Although investigating how macronutrients impact growth rates has been extensively studied (Tikofsky et al., 2001; Hill et al., 2008), it has not considered the impacts of elevated planes of milk nutrition and ad libitum milk feeding systems, where growth rates are double what was reported a decade ago. In a recent study investigating high fat and high lactose milk replacers in ad libitum feeding systems, it was determined that calves can regulate daily milk intake based on the milk replacer's energy composition (Echeverry-Munera et al., 2021). For example, calves fed a high-fat milk replacer (15 percent more metabolizable energy [ME] per gram of dry matter) consume less volume. However, daily energy intake is the same. Calves on both treatments were able to reach 1.4 kg intake of powder per day and reach 1.2 kg of ADG pre-weaning. This shows that both treatments can perform with similar ADG, yet the metabolic and inflammatory markers in these calves differ significantly (Berends et al., 2020; Echeverry-Munera et al., 2021; Wilms et al., 2022). The long-term consequences of these differences are unknown and provide a real knowledge gap in our understanding of the long-term consequences of these changes. For example, increasing protein in infant formulas results in greater growth preweaning but causes obesity during childhood (Weber et al., 2014). Thus, the formulas we provide to calves in the preweaning period program might potentially imprint nutrition utilization and physiology for life, which is why it is critical for researchers to properly understand how preweaning nutrition impacts heifer and cow performance.

Weaning

Feeding more milk during the preweaning period can compromise weaning performance and make the calf more prone to disease if not managed properly. First and foremost, calves fed more milk need to be weaned later in life (minimum 8 weeks of age). If weaned earlier, growth advantages achieved during the preweaning period will be lost, as the calf is not ready to consume enough energy from dry feed at this age (de Passillé et al., 2011). These severe diet changes early in life can compromise gut integrity and make the calf more prone to disease (Gressley et al., 2011; Gelsinger et al., 2020). In addition, a proper stepdown is essential and having multiple steps over a span of two weeks is ideal. These broad recommendations, however, do not account for one major contributor to performance – starter composition. While milk replacer formulations vary significantly, starter compositions are arguably more variable, particularly with respect to starch content. Some concentrates contain double the amount of starch compared with what we would feed to a cow (Yohe et al., 2022).

As weaning is already one of the most challenging periods of a calf's life from a production and health standpoint, feeding high levels of starch in starter may further exacerbate this stress, especially when calves are weaned from elevated feeding levels of milk. Currently, there is little work integrating the amount of milk fed and starter composition. Thus, it is pertinent to address this large knowledge gap to improve weaning transition.

Although research has focused on both the pre- and post-weaning periods, the months following weaning are essentially the "black box" of calf and heifer nutritional management. This is a critical period in heifer development. However, the industry tends to underfeed calves during the months post-weaning, as we assume they eat a large amount of forage and underfeed concentrate. Evidence suggests that high planes of post-weaning heifer feeding can result in improved growth and sexual development. Thus, determining the ideal age and strategy for step-down from the high concentrate is essential to improving heifer development.

Precision feeding management technologies

With all the advancements in calf nutrition research, along with the advancements in automated feeding, there are definitely opportunities to start feeding more individualized feeding programs to calves. Firstly, calves born at different body weights should be fed different feeding programs. The birthweights of Holstein dairy calves can range from 25-65 kg, and as such, it does not make sense to feed the same level despite dramatically different nutritional requirements. With technological advancements, we can easily feed different combinations of milk replacers or supplements in milk. Yet, these custom programs remain rare in current production systems. Using sensing technology to detect disease before it happens needs to be implemented on more commercial farms with automated technology, so we can deliver nutritional therapies in a timely and effective manner. In addition, automated scales and feeders will dramatically increase our knowledge of calf growth performance, intake and behavior in response to specific feeding strategies. These data will enable automated feeders to be programmed on an individual calf basis, based on calf behavior, body weight, growth rates, intake and health metrics, thus ensuring not only better animal welfare but potentially greater performance and profitability as well.

It is clear that the next decade will be an exciting time to study and work in the field of calf nutrition. Continuously challenging our existing practices and developing new concepts in dairy calf nutritional management will enable dairy producers to make confident decisions that promote calf health, welfare and productivity to ensure the dairy industry's long-term success and sustainability.

References available upon request.


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Optimizing heifer reproductive efficiency through data insights

Luís G.D. Mendonça, *Merck Animal Health*

Considering that raising replacement heifers is the second largest expense in a dairy farm (Gabler et al., 2000), optimizing reproductive performance of dairy heifers is desired. Suboptimal reproductive efficiency results in increased days on feed, age at calving, and breeding expenses, and potential costs with purchase of new replacements. Depending on heifer availability, outstanding reproductive efficiency is crucial. Because of the increased use of beef semen in dairies and herds striving to optimize replacement numbers, some herds have a limited supply of replacement heifers. Therefore, in some instances, poor reproductive performance may force producers to purchase replacements, which may result in undesired outcomes, such as introducing infectious diseases to the existing herd or purchase of heifers with inferior genetics.

Monitoring the outcomes of the herd reproductive program is necessary to ensure that success is being achieved. Mendonça (2015) and Dalton (2021) outlined the key performance indicators that should be assessed when evaluating heifer reproductive efficiency. Besides monitoring metrics related to reproduction, other measures should be evaluated because several factors affect reproductive performance directly or indirectly. Modern dairy farms record several data points across the calves' and cows' lifetime. In some instances, the wealth of records allows one to identify areas of opportunities that may be associated to the heifer breeding program. Before attempting to gain additional insights through records from on-farm management software, accuracy, quality, and completeness of the data should be taken into consideration (e.g., issues with case definitions and bias related to over or under reporting of events).

Calf health may affect the overall goal of the heifer reproductive program because diseases during early life impact mortality rate, which will dictate the number of future replacement heifers available to enter the heifer breeding program. Therefore, a comprehensive evaluation of calf and heifer records may reveal hidden opportunities to increase the total number of eligible animals to become pregnant. Determining the incidence of calf health disorders in a herd and exploring their effects on culling and reproduction may assist in suggesting whether factors before the voluntary waiting period are influencing the number of replacement heifers that become pregnant. In addition, herds with accurate and complete records allow consultants to further explore whether management practices and vaccination strategies, or lack thereof, may be influencing calf health, and consequently, reproductive performance.

Nevertheless, caution is warranted when exploring records related to calf health because depending on the disorder, diagnosis is based on subjective clinical signs. In fact, this must be considered if major decisions regarding culling are based on health records (e.g., culling of heifers with three or more cases of pneumonia). Utilizing farm records for an evidence-based approach to decision making might avoid wrong predetermined assumptions. Awareness of bias while evaluating records must be taken into consideration to minimize inaccurate conclusions.

For farms that utilize automated behavior monitoring technologies, a vast amount of data is available, which may be utilized to gain insights to improve reproductive efficiency or optimize management practices related to reproduction. In recent years, researchers have conducted experiments using automated estrous detection devices in heifers and explored ways to improve efficiency. Following are a few examples.

Chebel and Cunha (2020) demonstrated that timing of artificial insemination (AI) relative to onset of estrus impacts pregnancy outcomes in heifers. Heifers inseminated with sexed semen within 14 hours of onset of estrus had decreased conception rate. In addition, Veronese et al. (2019) showed that stage of the estrous cycle when prostaglandin was administered was associated with pregnancy per AI. Heifers injected with prostaglandin in early and mid-diestrus had a lower conception rate than other stages of the cycle. Furthermore, the same researchers also showed that depending on the stage of the cycle, heifers treated with dinoprost tromethamine had reduced likelihood of displaying estrus than heifers treated with cloprostenol sodium.

These findings demonstrate that herds utilizing monitoring technology may consider timing of AI relative to onset of estrus, and potentially, target prostaglandin administration to a specific stage of the estrous cycle to optimize fertility. Depending on the availability of records, this information can be assessed by consultants to understand if changes in the reproductive program are needed to maximize conception rate. It is important to note that manufacturers of automated estrous detection devices use different algorithms to determine onset of estrus and estrous intensity. Therefore, caution is warranted in extrapolating results from these research findings to other monitoring devices. Veronese et al. (2019) and Chebel and Cunha (2020) used the HR-LD tags in the experiments.

Another insight that can be derived from monitoring technology is the percent of heifers with an estrous event at specific days of age, which may be a proxy for cyclic status. Furthermore, for herds with limited pen space, managers can utilize a prior estrous event as part of their management practice to move heifers to the breeding pen, besides accounting for body weight and height. Other insights, such as conception rate based on prior estrous events or heat index, can be evaluated to fine-tune reproductive efficiency.

In order to achieve the DCHA Gold Standards regarding targets of percent of mature body weight at first breeding and post-calving, several aspects of calf and heifer rearing should be considered – not only reproductive performance. Data insights from record analyses may uncover areas of opportunities, help monitor changes, and assist in decision-making processes to maximize heifer reproductive efficiency. Farms utilizing monitoring technology have unique opportunities to maximize fertility by using information captured by the devices.

References available upon request.

Health and biosecurity: Management practices to improve calf health

Richard V. Pereira, *University of California Davis*

Non-saleable milk, also known as waste milk (WM), is milk withheld from human consumption due to the presence of residual concentrations of therapeutics, high somatic cell count (SCC), or due to the presence of other undesirable components. Disposal of waste milk can be a challenge, given its potential impacts on the environment. Some common disposal managements for WM include application to the land, disposal in a composting pile, or in an aerobic manure lagoon. Some of these disposal options, including direct land application and lagoon discharge of WM, must follow local rules and regulations. Furthermore, nutrients in WM can affect nutrient balance in the soil or in a manure lagoon, having severe negative effects. Because of that, it is essential to have disposal plans for WM using these options that carefully consider potential undesirable outcomes (https://tammi.tamu.edu/2020/05/07/things-you-should-know-before-disposing-waste-milk). An alternative to circumvent these challenging, laborious, and costly options in the disposal of WM is to feed it to preweaned calves.

The U.S. Department of Agriculture (USDA) National Animal Health Monitoring System (NAHMS) Dairy Report from 2007 reported that 30.6% of dairy farms in the United States fed waste milk to preweaned calves (USDA-NAHMS, 2008). In a more recent USDA-NAHMS Dairy Report, about 27% of dairy operations supplied waste milk to off-site calf ranch facilities, with a higher percentage of large operations than medium operations supplying waste milk to the off-site calf-rearing facilities (38.4 vs. 4.5%, respectively) (USDA, 2016). Beyond removing the need to identify solutions for discarding WM on the farm, feeding pasteurized waste milk instead of milk replacer to preweaned calves has been shown to result in daily feed cost savings to dairies (Godden et al., 2005). However, many questions remain regarding the potential impacts of feeding WM to dairy calves (Figure 1).

Waste milk: Drug residues, bacteria load, and nutrient composition

Two studies evaluating antimicrobials in WM bulk tanks in New York (n= 34) and California (n= 25) dairy farms found that ceftiofur was the most common drug detected, with multiple other beta-lactam drugs (e.g., ampicillin, penicillin) and tetracycline drugs also observed (Pereira et al., 2014b, Tempini et al., 2018). Ceftiofur is a drug of critical importance, given that it is a third-generation cephalosporin, a drug class of critical importance to both animal and human health. The California study also observed a large variation in important nutrients in WM (Table 1), as well as a high standard plate count (SPC) and coliform counts (CC), and the presence of critically important disease-causing bacteria for calves, such as Mycoplasma. Another finding in this study was the presence of multidrug-resistant *Escherichia coli*. This is of critical importance, as it represents a potential source for the spread of enteric bacteria that already carry resistant mechanism to multiple antibiotics. Together, findings from these studies highlight the potential hazards of WM for the spread of antimicrobial resistance due to antibiotic residues and antibiotic resistant bacteria.

Table 1. Milk quality parameters for waste milk samples collected from a convenience sample in California dairies (n = 25) (Tempini et al., 2018)

Variable	Mean	SD	95% CI (Lower-Upper)
Milk fat (%)	4.24	1.41	3.66–4.82
Milk protein (%)	3.74	0.43	3.56–3.92
Lactose (%)	4.4	0.22	4.31–4.49
SNF (%)	8.77	0.45	8.59–8.96
SCC (x 103 cells/ml)	2,133.60	1,260.14	1,613.44–2,653.76
Coliforms (cfu/ml)	702.4	691.12	417.12–987.68
SPC (x 103 cfu/ml)	116.27	101.19	74.50–158.04

Figure 1. Concerns with feeding waste milk to preweaned calves include questions related to the waste milk itself, impacts on individual calves, and potential resulting consequences to the herd's health

❖ Waste milk
- Biosecurity concern?
- Microbial load?
- Pathogenic bacteria?
- Antibiotic-resistant bacteria?
- Drug residues?
- Nutrient composition?

❖ Individual calf
- Effect on health?
- Effect on weight gain/nutrient requirements?
- Effect on gut microbiota?
- Antibiotic resistance?

❖ Herd health
- Biosecurity concerns?
- Effect on antimicrobial resistance at the herd level/spread?
- Feeding management (e.g., pasteurization)
- Managing excess/leftover WM?

Waste milk and calves: Antimicrobial resistance and the fecal microbiota

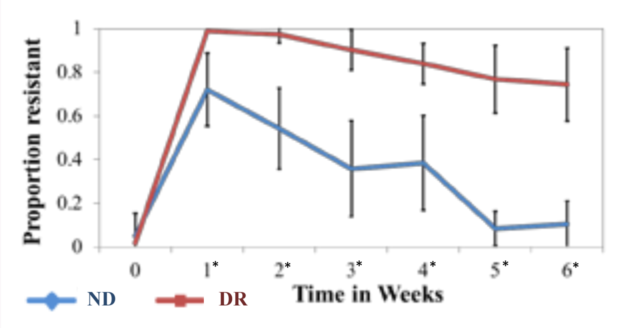
Although the negative impact of high bacteria counts and/or pathogenic bacteria in milk fed to calves is well known, limited information is available on the potential impacts of feeding milk with drug residues on antibiotic resistance. In an effort to begin addressing this knowledge gap, a calf trial evaluated the impact of feeding calves with raw saleable whole milk spiked with residual concentrations of ampicillin, penicillin, ceftiofur, and tetracycline, with the aim of simulating both drugs and their concentrations as previously observed in WM bulk tanks (Pereira et al., 2014a). For this feeding trial, 30 calves were randomly assigned to a controlled feeding trial at birth where: 15 calves were fed raw milk with no drug residues (NR) and 15 calves were fed raw milk with added drug residues (DR). Fecal samples were rectally collected from each calf once a week, starting at birth prior to the first feeding in the trial (pre-treatment) until 6 weeks of age. During and by the end of the trial, calves in the DR group had significantly higher proportions of multidrug-resistant (MDR) *E. coli* (resistant to three or more drugs) compared with control calves fed milk without added antimicrobials (71% MDR in DR vs 13% MDR in NR/control, $P < 0.0001$) (Figure 2). Further analysis comparing the impacts of this feeding trial on the fecal microbiota observed that DR calves had distinct fecal microbial compositions when compared with ND/control calves, including changes in the functional profile of microbial populations (Pereira et al., 2016, Pereira et al., 2018).

In another study evaluating risk factors for the prevalence of extended-spectrum β-lactamases- (ESBL) *E. coli* (carry antibiotic resistance to both third- and fourth-generation cephalosporin drugs) on 72 German dairy farms, the most important risk factor associated with high prevalence of ESBL-*E. coli* in calves was the feeding of WM, whereas the use of milk replacer was associated with a lower prevalence of this antibiotic-resistant bacteria (Weber et al., 2021). These findings highlighted the impacts drug residues in WM could have in preweaned calves, warranting the need for interventions or management to reduce the selection of antibiotic-resistant bacteria as a consequence of this feeding practice.

Waste milk: Removing drug residues

A potential option for reducing the negative impacts of antibiotics in WM is to degrade these drugs prior to feeding WM to preweaned calves. A 2016 report on WM by the European Food Safety Authority (EFSA) summarized a few approaches to reduce antibiotic residues in WM from published, peer-reviewed articles (EFSA Panel on Biological Hazards [BIOHAZ], 2017). Some of the challenges for using these methods include limited information on different treatment options for the various antibiotics that could be found in WM (many studies focus on a few single drugs), cost, as well as potential impacts of these treatments on nutrients present in the milk. These limit the possibility of using it as a feed source after treatment. Currently, there is a lack of cost-effective practical approaches for the degradation of antibiotics in WM on dairy farms, representing a research knowledge gap. In an effort to address this gap, one of the research focuses in my laboratory has been evaluating approaches to degrade antibiotics in WM. The most recent published study revealed alkalinizing milk to a pH 10 as a promising potential option for the degradation of ceftiofur in milk. This study also found that acidifying milk (pH 4) and traditional heat treatment options (low temperature, long time [LTLT], at 63 C [145 F] for 30 minutes; high temperature, short time [HTST] at 72 C [162 F] for 15 seconds) were not effective in degrading ceftiofur in milk (Garzon et al., 2020). There is still more to be learned before viable and safe on-farm options can be implemented. Further studies are needed to evaluate potential cost-effective approaches that could be used on farms to degrade antibiotics in WM.

Figure 2. Proportion of resistant E. coli *from milk feeding treatment effect over time in weeks. Error bars represent 95% confidence interval of the least square mean.*



ND, calves fed raw milk without the addition of drug residues. DR, calves fed raw milk with the addition of residual concentrations of ceftiofur, penicillin, ampicillin, and oxytetracycline from birth to 6 weeks of age. *Sampling weeks where the proportion of resistance was significantly different between NR and DR.

Waste milk: Take-home message

In summary, although feeding WM to calves is a financially beneficial practice and an approach to avoid discarding a nutrient-rich product, there are important factors to consider. These include that WM may contain drug residues and have a wide nutritional composition and high bacterial load that could result in disease. Furthermore, evidence-based data support that feeding WM is a potential risk for increasing antimicrobial resistance in calves on the farm. Although current efforts are underway to help address some of the negative impacts from drug residues present in WM, current approaches that can be implemented include having good biosecurity, hygiene, and standard practices when handing WM, milking equipment, and calf-feeding equipment, outlining criteria for selection of milk/cows that contribute to the WM pool to be fed to calves (e.g., avoiding cows with known mycoplasma mastitis), as well as pasteurizing WM that will be fed to calves. Together, these are just a few steps that can mitigate potential unwanted consequences from feeding WM to calves, helping to improve their health, growth, and future productivity.

References available upon request.

Real heifer grower reproduction performance data and what does it tell us?

Jon Holewinski, *Alta Genetics*

Reproduction performance and key performance indicators associated with reproduction are regularly scrutinized within the dairy herd – primarily focused on the lactating herd. However, with more of a shift of dairy producers opting to have their youngstock custom raised, reproduction is often not examined as often or with as much vigor as the lactating herd. The adage "out of sight, out of mind" holds somewhat true when heifers are no longer raised by their owners. However, this is not saying that only you (dairy producers/dairy owners) can raise a good heifer. In fact, many could argue that having your heifers custom raised will yield a better-grown heifer to maximize phenotypic performance of a healthy and profitable dairy cow.

Heifer reproductive performance, in this discussion, will look at raw heifer data from dairy/heifer operations across the United States. The purpose of this is twofold. First, learn what good heifer reproduction looks like and the variation across operations. And second, when looking at high performers, what are the keys to their management to achieve a high standard?

First off, here is some context to better understand the purpose of this discussion. Heifer dynamics are constantly evolving with the ever-changing dairy market. Over the past 10 years, sexed-sorted dairy semen has replaced a lot of conventional dairy semen for use on dairy heifers and dairy cows. Over the last three years, this change, along with improved reproduction performance, has yielded a plethora of dairy replacements. This plethora of future dairy replacements changed the market for dairy producers. Thus, they altered their approach from creating dairy bulls (which went into the beef supply chain) and dairy heifers – often in excess or growing their own cattle numbers – to now creating dairy heifers to either maintain herd size or strategically grow, depending on their own situational factors, and breeding their older cows or poorer genetics with beef genetics

Figure 1

Cattle Inventory by Class and Calf Crop — United States: January 1, 2021 and 2022

Class	2021	2022	Percent of previous year
	(1,000 head)	(1,000 head)	(percent)
All cattle and calves	93,789.5	91, 901.6	98
All cows and heifers that have calved	40,286.0	39,500.1	98
Beef cows	30,843.6	30,125.1	98
Milk cows	9,442.4	9,375.0	99
All heifers 500 pounds and over	20,200.1	19,776.0	98
For beef cow replacement	5,803.1	5,611.5	97
Expected to calve[1]	3,509.6	3,411.5	97
For milk cow replacement	4,608.5	4,450.6	97
Expected to calve[1]	2,915.9	2,836.2	97
Other heifers	9,788.5	9,713.9	99
Steers 500 pounds and over	16,787.8	16,579.7	99
Bulls 500 pounds and over	2,210.5	2,109.6	95
Calves under 500 pounds	14,305.1	13,936.2	97
All cattle on feed	14,667.4	14,692.6	100
	2020	2021	Percent of previous year
Calf crop	34,495.5	35,085.4	99

[1] Replacement heifers expected to calve during the year

to add value to their business operations. By looking at the dairy cattle inventories from the U.S. Department of Agriculture cattle inventory report, you can see that the market is starting to change. See Figure 1.

One common reproduction metric that producers often look at is conception rate. However, this only tells a small portion of the story and doesn't really signify whether a reproduction program is successful or not. Look at the 1,924 Holstein herds and 123 Jersey herds from the VAS website, which gives industry benchmarks from AgSource. See Figure 2. These data still focus a lot on conception rate. There are many other metrics that signify whether a heifer reproduction program is successful.

This information analyzes 10 Holstein heifer-growing operations, totaling around 215,000 heifers in inventory, across the United States. The metrics this discussion will focus on are conception rates by semen type and service number, insemination rates, pregnancy rates, age in days at first breeding, age in days at pregnancy, do not breed (DNB) rates, pregnancy loss/abortion rates, heifer weights at breeding age in days (only select data from sites with weights), and fertility programs to enhance heifer flow throughput.

The overarching goal on raising heifers is very similar across the globe. All producers want to raise a heifer that grows very well with minimal inputs and performs well in the lactating herd with minimal issues to last multiple lactations. However, to achieve the outcome of a dairy animal lasting for multiple lactations, reproduction is key. The byproduct of reproduction is milk production. Learn how to gauge and monitor reproduction.

References available upon request.

NOTES

Figure 2

	HOLSTEIN ALL				JERSEY ALL		
	Herd Count	1924			Herd Count	123	
	80th Percentile	Average	20th Percentile		80th Percentile	Average	20th Percentile
Herd Age Measure				**Herd Age Measure**			
1st Lact Age at Calving	23.4	25.7	27.5	1st Lact Age at Calving	23	24.7	26.2
Reproductive Analysis - Heifers				**Reproductive Analysis - Heifers**			
Conception Rate % Heifers	66	60.8	56	Conception Rate % Heifers	65	57.7	52
Services Per Conception	1.5	1.7	1.8	Services Per Conception	1.5	1.8	1.9
% < 23 Months at Calving	0	15.7	32	% < 23 Months at Calving	0	24.4	47
% > 25 Months at Calving	6	37.5	72	% > 25 Months at Calving	2	29.2	53

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