**American Dairy Science Association 2025 Annual Meeting**
**Louisville, KY. June 22 - 25, 2025.**
***J. Dairy Sci Vol. 108 (Suppl 1)***

**Dairy calf pertinent abstracts**

Dave Wood, Animix, 920-342-9039. davewood@animix.net
Bethany Dado-Senn, Vita Plus, 715-554-1634, bdado-senn@vitaplus.com
Dave Wood author to red abstracts; Bethany Dado-Senn author to blue abstracts.

**Abbreviations:**

ADG = average daily gain
AEA = apparent efficiency of absorption
AMF = automated milk feeder
BW = body weight
BBW = birth body weight
BRD = bovine respiratory disease
cfu = colony forming units
CMR = calf milk replacer
CR = colostrum replacer
d = days
DEG = differentially expressed genes
DFM = direct-fed microbial
FPT = failure of passive transfer
fdg = feeding(s)
g = gram
hr = hour
HH = hip height
G:F = gain:feed ratio
GIT= gastro-intestinal tract
m/min = minutes
MC=maternal colostrum
NSD= no significant difference
STP = serum total protein
TM = trace mineral
TPI = transfer of passive immunity
trt = treatments
wk = week

**Assumptions:**

- Water was offered *ad lib*.
- Grain was offered *ad lib* unless specified.
- Only differences (P≤0.05) and trends (P≤0.10) are mentioned.
- If something obvious like ADG is not mentioned, it indicates NSD.

**Table of Contents**

**Nutrition (52 abstracts)**



**Maternal-fetal (46 abstracts)**



**Health (37 abstracts)**



**Physiology (9 abstracts)**



**Management (35 abstracts)**

**Behavior and welfare (22 abstracts)**



**Non-replacement calves (23 abstracts)**

**Nutrition (53 abstracts):**

**Additives in CMR, whole milk, or starter grain (23 abstracts):**

2145. *Stability of Bacillus-based direct-fed microbial in whole milk and milk replacer*. Queiroz et. al., Novonesis Lyngby, Denmark.

- Three independent batches of DFM containing *Bacillus licheniformis* 809 and *Bacillus subtilis* 810 (Bovacillus; Novonesis, Denmark) were used to determine stability.
- At 0 h, 10 g of *bacillus* blend was suspended in 90 ml of tap water then treated in a stomacher for 2 min for homogeneity. The suspension was diluted into whole milk and CMR at 37 °C to a target concentration ≥7.0 x $10^5$ cfu/ml. 100-ml aliquots stored at 25 °C for 1 and 4 hrs.
- NSD hour x batch interactions (P≥0.41). NSD for hour effect in recovery of Bacillus spores in whole milk, which indicates stability. Concentration of Bacillus spores in CMR was constant until 4 hr when a slight ↑ in counts occurred (P=0.05).
- **Take-home** – Bacillus-based DFM remained stable in whole milk and milk replacer for up to 4 hr after mixing.

1177. *Metabolomic investigation revealed that microbial feed additives influenced amino acid and carbohydrate metabolism in calves*. Adelusi et al. NC A&T State U; Casper's Calf Ranch

- Holstein bull calves (n=86) were fed either a.) starter grain w/ *lactobacillus plantarum*, b.) CMR w/ *bifidobacterium animalis* and *lactobacillus animalis*, c.) both strategies in tandem, or d.) unsupplemented CMR and grain.
- Blood samples were collected d 0 and d 54 for plasma LC-MS. Differential metabolites were ID'ed using a volcano plot for metabolites w/ a fold change = 1.2 or =0.83 and P ≤ 0.05.
- Detected n=231 metabolites w/ n=24 differentially abundant metabolites like several ketone bodies and AA compounds upregulated for CMR, grain, and combo DFM.
- Key metabolites: keto-D-fructose, aldehyde-D-mannose, and 5-methyl-5-hexen-2-one abundant in all three DFM trts. Furostanol-26-aldehyde abundant only in the combo DFM. Rotundifolone and 2D-5-O-methyl-2,3,5/4,6-pentahydroxycyclohexanone abundant in CMR and combo DFM. 2-methyl-3-ketovaleric abundant in grain and combo DFM.
- Eleven metabolic pathways were significantly enriched. AA degradation pathways of Val, Leu, and Ile were enriched in the grain and combo DFM, while carbohydrate metabolism pathways such as pentose/glucoronate interconversion were enriched in grain and CMR DFM but not combo.
- **Take-home** – "…microbial additives altered plasma metabolome of calves through changes in the abundances and/or activities of pathways involved in amino acid and carbohydrate metabolism."

2407. *Effect of probiotic fed in milk and starter grain during the pre-wean period on gut development, diarrhea, and gut microbiome in pre-weaned Holstein x Angus calves*. Brasil et al. UC-Davis

- Holstein x Angus cross calves (<48 h age, ≥5.2 g/dL STP; n=299) reared on a commercial calf ranch in CA received either a.) no DFM (control), or b.) 1 B CFU combination *Lactobacillus acidophilus* and *Lactobacillus casei* DFM in both milk and starter grain 1x/d.

- Calves were housed individually in wooden slatted hutches. Starter was provided d 14 onward. Two L of CMR was fed 2x/d. DFM was added as 50 mg/calf/d to milk bottles in the AM feeding and 50 mg/calf/d top-dressed on starter grain until d 60.
- Blood samples collected from ~ 50 calves/trt every 2 wks to measure gut development (BHB, glucose). Scour scores (1-3 scale) evaluated daily. Fecal sample at d 42 (n=10/trt) for micobiome metagenomics.
- NSD of trt on BHB and glucose concentrations. NSD of median time to diarrhea (14 d).
- Metagenomics: NSD for gut community structure and alpha diversity assessment.
- **Take-home** - *Lactobacillus acidophilus* and *Lactobacillus casei* DFM in both milk and starter grain for 60 d noted NSD on gut health, gut development, or gut microbiome.

2411. *Impact of* Bacillus subtilis 810 *and* Bacillus licheniformis 809 *on average daily gain in preweaning calves: A meta-analysis*. Morrill et al, Novonesis, Milwaukee.

- Eight studies (n=350 calves total) were analyzed via a meta-analysis using Excel. Criteria to enter the study were a.) pre-weaned dairy calves, b.) known concentration of these two strains of bacillus, and c.) individual BW and feed intakes.
- The meta-analysis revealed a significant ↑ in ADG for calves receiving the two bacillus strains vs. control (+81.2 ±26.9 g/hd/d; P<0.01).
- **Take-home** – a meta-analysis of 8 controlled calf studies examining *Bacillus subtilis 810* and *Bacillus licheniformis 809* noted significant improvements (+0.18 lb/d) in prewean ADG.

*1252*. *Long-term effect of prebiotic, probiotic, and synbiotic additives fed during the preweaning period on subsequent milk production of Holstein dairy cows.* Muhffel et al. UC-Davis.

- Retrospective analysis of milk records from n=1,296 Holstein cows (n=26,975 milk records; lactation 1-3) assigned one of four treatments during pre-weaning: prebiotic (PRE, 7 mL *S. cerevisiae* yeast culture), probiotic (PRO, 1 bill cfu *B. subtilis*, 250 mill *L. plantarum*), PRE + PRO (SYN), and no additive (CON).
- SYN ↑ ECM yield (1.0 kg/d, P=0.04) vs. CON, NSD any other trts.
- **Take-home** – Supplementing prebiotic and probiotic (i.e., synbiotic) during pre-weaning could increase milk production of mature cows across the first three lactations.

2154. *Performance and health of calves fed milk replacer with or without a mannan oligosaccharide and bacillus additive*. Dufour et. al. Hubbard Feeds

- Heifer calves (n=106) were fed 24:20 CMR either w/ or w/out MOS and Bacillus (1.6 g/d).
- CMR fed at 1.65 lbs/d until d 43 to 49 when fed 1x/d at 0.83 lbs. All calves received free choice grain (18% CP) void of DFM/MOS. Calves housed individually in a curtain-sided barn. BW measures d 0, 14, 28, 42, 49, and 56. Fecal scores bi-weekly. Feed intake measured daily.
- NSD in CMR or starter intake, hip height gain, or health events. Post-wean ADG tended ↑ for MOS/Bacillus (2.27 vs. 2.05 lbs./d, P=0.09).
- G:F ↑ post-wean for calves fed MOS/Bacillus (0.44 vs. 0.39; P=0.02) and G:F ↑ for MOS/Bacillus supplemented calves during the entire 56 d study (0.51 vs. 0.50, P=0.04).
- **Take-home** – "…supplementing calves with MOS/Bacillus blend in CMR improved G:F and nutrient utilization throughout the milk feeding phase and immediately postweaning."

1554. Sialyllactose *supplementation in milk replacer enhances growth performance via modulation of intestinal microecological development in preweaning dairy calves*. Guo et al. State Key Lab, Beijing, China

- Sialyllactose is a human milk oligosaccharide that consists of lactose with sialic acid attached. Newborn Holstein calves (n=48) were fed CMR with or w/o 11.12 g/d sialyllactose supplemented d 1-14.
- All calves received CR w/in 1 hr of birth then fed 2.5 (d 1-7), 3 (d 8-14) and 3.5 (d 15-50) L 3x/d and weaned d 56. Grain offered ad lib and intake measured daily. Fecal scores daily. BW measured d 12, 14, 28, and 56. Fecal samples collected the same days.
- Sialyllactose ↑ ADG d 1-56 and starter intake d 3-56 ($P<0.01$). Diarrhea freq tended ↓ in calves supplemented sialyllactose ($P=0.06$).
- Sialyllactose altered the fecal metabolic profile of calves at d 28 and 56 w/ nucleotide metabolism and ABC transporter pathways ↑ at d 28, and tryptophan metabolism and taste transduction pathways ↑ at d 56.
- Sialyllactose supplemented calves ↑ fecal microbiota and α-diversity d 14 and 28 ($P\leq0.04$). Beta diversity differed d 14, 28 and 56 ($P\leq0.07$).
- **Take-home** – "early-life sialyllactose supplementation could serve as a nutritional strategy to enhance calf growth and health during the preweaning period."

1552. *Evaluating the microbiome profile of neonatal calves supplemented with galacto-oligosaccharide using shotgun metagenomics*. Ike et al. et al. NC A&T State U; Casper's Calf Ranch

- Newborn Holstein bull calves (n=88) received a 22:20 AA-balanced CMR with either 0 g/d, 2 g/d, 4 g/d or 8 g/d galacto-oligosaccharides (GOS). Calves were fed 1.25 lbs./d CMR d 1-14, 1.9 lbs./d d 15-35 and weaned at 0.95 lbs./d from d 36-42 in 1x/d weaning strategy.
- Fecal samples were taken rectally on d 40 prior to weaning.
- *Bacillota* (firmicutes) phylum was dominant across all treatments. Calves on 4 g/d GOS had ↑ relative abundance for *Bacillota* (firmicutes) phylum and ↓ for *Bacteroidota* phylum.
- Relative abundance of *Lachnospiraceae* family ↑ in calves fed 2, 4, or 8 g/d GOS vs. 0 g/d. 4 g/d calves ↑ abundance *Atopobiaceae*, and 2 g/d calves ↑ abundance *Coriobacteriaceae*.
- Calves fed 2, 4, or 8 g/d were differentially ↓ for *Shigella*, *Clostridum*, and *Campylobacter* genera, *E.coli,* and several viruses incl. *Tunavirus* strains ((false discover rate <0.05).
- *Salmonella* was differentially ↓ for calves fed 4 g/d GOS vs. other trt.
- **Take-home** – "Results from this study suggest that GOS helped to shape gut microbiome, reduce pathogenic burdens, and promote microbial homeostasis."

2159. *Effects of sodium butyrate supplementation on performance and rumen fermentation in dairy calves*. Gheller et. al. U of Sao Paulo, Brazil.

- Male Holstein calves (n=24) fed either a.) basal diet or b.) basal diet + 3 g/kg DM of sodium butyrate in grain from 7 to 63 d of age. Calves fed 6 L/d of CMR (20:14) until d 49 w/ gradual wean on d 63.
- Grain offered ad lib, intake monitored daily via automatic feeding system. Calves weighed weekly and on d 64, n = 6 calves/trt were slaughtered for rumen fluid samples.
- NSD of trt on grain intake (0.67 vs. 0.74 lbs./d) or ADG (1.1 vs. 1.0 lbs./d).

- Addition of sodium butyrate ↑ rumen fluid acetate proportion (58.4 vs. 51.9 mM/100 mM) and C2:C3 ratio (2.38 vs. 1.63) but ↓ propionate proportion (25.4 vs. 31.4 mM/100mM; P≤0.01) and NSD on butyrate proportion (9.31 vs. 9.42 mM). NSD for total VFA conc., rumen pH, or N-$NH_3$ conc.
- **Take-home** – "Sodium butyrate supplementation modified rumen fermentation by increasing acetate and the C2:C3 ratio while reducing propionate, but it had no effect on performance."

1173. *Effect of fortifying fresh whole milk with a tributyrin-containing fat concentrate on growth, feed intake, and health in calves*. Wilms, et. al. Trouw Nutrition

- Holstein male calves (n=27) received either a.) fresh whole milk, b.) fresh whole milk w/fat concentrate formulated w/ vegetable oils, or c.) diet (b) plus tributyrin. Fat concentrates supplemented at 35 g/L (16% total solids).
- Individually housed calves fed 6 L/d from 1-3 d, 7 L/d from 4 to 9 d, 8 L/d from 10-42 d then step-down weaned at 6 L/d from 43-49 d, 4 L/d from 50-56 d, and 2 L from 57-63 d. Calf starter provided from wk 2. Fecal scores taken daily and BW recorded weekly.
- SCalves fed fat + tributyrin ↑ scours vs. control at wk 3 (P=0.04) but NSD of fat alone. Both fat trt ↓ scours at wk 4 vs. control (P<0.01).
- NSD of trt on milk intake except wk 1 when control ↓ refusals (P=0.04). NSD in starter intake except during the final 2 wks when fat + tributyrin ↑ starter intake (P<0.01). NSD in BW or ADG over the 12-wks, but fat trts ↑ post-wean BW vs. control (P=0.05).
- **Take-home** – Adding fat concentrate or fat + tributyrin resulted in no effect on 12-week performance. Tributyrin-containing fat concentrate increased post-wean starter feed intake.

2409. *Effect of tributyrin and tricaproin in a low-fat milk replacer on feeding behavior and growth in 2-wk-old calves*. Wilms and Leal. Trouw Nutrition

- Holstein calves (n=36) 15.5 ±0.9 d old from two dairy farms group-housed w/ 9 calves/pen were fed either a.) CMR composed of vegetable fats or, b.) same CMR + 3.0% (of total fatty acids) C4:0 from tributyrin and 2.3% C6:0 from tricaproin.
- CMR was 18% fat, 46% lactose, and 23% CP (DM basis). Calves fed multiple meals/d thru autofeeders at 15% solids. D 0-7 CMR allowance ↑ from 6.0 to 8.0 L/d, peaked a 8.0 L/d from d 8-35, then gradually weaned from d 36-56. D 57-70 calves were completely weaned.
- Pelleted starter and chopped straw offered ad lib. BW measured weekly.
- NSD in CMR and grain intake, leading to similar growth (P≥0.47). NSD for rewarded visits to autofeeder (P=0.72), but tendency for ↑ unrewarded visits from wks 6-7 for supplemented FA calves (P=0.10). Interrupted CMR meals ↑ for control calves (P=0.04).
- NSD in calves treated for diarrhea or respiratory disease (P≥0.14).
- **Take-home** – Incorporating tributyrin and tricaproin in low-fat CMR had no effect on calf health or performance but may have influenced feeding behavior.

1174. *Effects of dietary resin acids supplementation on overall health and performance of Holstein milking calves*. Caixeta et. al., Universidade Federal de Goias Goiania.

- Resin acids are hypothesized to ↓ inflammation and ↑ gut health. Holstein x Zebu calves (n=20, ~ 111 lbs., 20 d age) were fed whole milk either a.) w/ resin acids (9% conc) at 1 ml/ feeding (2 ml/d) or b.) w/o resin. Hay offered ad lib and increasing grain to 1.3 lbs./d.
- Feces collected d 17 and 52 of study and tested for *E. coli* and drug resistance to *E. coli*.

- Freq of multi-drug resistance to *E. coli* ↑ for control vs. resin acid calves (45 vs. 5%, P≤0.05).
- Blood platelets ↑ for control vs. resin acid calves (402,000 vs. 306,000 $mm^3$, P≤0.05) → possible infection or inflammatory disorders. NSD of trt on any other blood parameters, liver enzymes, or kidney function markers.
- Control calves ↓ BW at d 38 vs. resin acid calves (141.3 vs. 166.2 lbs, P=0.08).
- **Take-home** – Resin acid "has potential to improve calf health and reduce the incidence of multidrug-resistant *E coli*."

2156. *Effects of different applications of oregano essential oil on performance and health of rearing calves*. Beckmann and Borchardt. Dostofarm

- Male Holstein calves (n=321) were fed CMR and grain (no details provided) composed of either a.) no oregano oil, b.) 75 g/mt oregano (DOSTO Powder, Dostofarm) in CMR, c.) 52.5 g/mt oregano (DOSTO Ruminant bi-active, combo encapsulated and non-encapsulated oregano), or d.) both (oregano in CMR and starter grain)
- ADG, feed conversion ratio and medication use were monitored (no details provided).
- NSD of trt on 2-6 wk or 10-12 wk ADG (2.08-2.16 lbs./d early; 2.8-3.0 lbs./d late).
- Feed conversion ↑ (P<0.05) in calves fed oregano in both CMR and starter vs. control, oregano in CMR, and oregano in starter grain (1.22 vs. 1.24-1.29, P<0.05)
- **Take-home** – "It might be supportive to start using oregano with the CMR for the first days of life and to offer oregano in addition to the starter feed for optimum feed conversion rate."

1178. *The effect of ionophores or oregano extract and saponins-based product supplementation on weaned calves after an* Eimeria bovis *infection challenge*. Rocha et al. TX Tech

- 56 d-old hutch-housed Holstein (n=47) or beef x dairy (n=62) calves undergoing *Eimeria bovis* challenge (i.e. coccidiosis) were fed either a.) 200 mg/d of lasalocid sodium, b.) 200 mg/d of monensin, c.) 3 g/d of a 5% essential oil product (Orego Stim Powder) d.) 1.5 g/d of a 10% essential oil + 10% *Quillaja saponaraia* product (Orego Stim Powder 2x), e.) + control (i.e. no additives but cocci challenged), or, f.) - control (no additives, no cocci challenge).
- Treatments were fed daily, and calves were challenged (except - control) with cocci d 14 after enrollment (~200,000 oocysts in 10 mL of sterile saline). Fecal samples collected at enrollment and weekly to d 49.
- "Treatment influenced *Eimeria bovis* counts at peak Emeria bovis shedding, but only at 21 post-challenge." Fecal *Eimeria bovis* counts ↑ (P<0.01) in positive control, lasalocid sodium, oregano, and oregano + saponins vs. negative control (2,207, 1,191, 1,399, and 656 vs. 0 count, P<0.01). NSD of Monensin vs. negative control (2.5 vs. 0 count, P=0.84)
- Fecal *Emeria bovis* count ↓ monensin, and oregano + saponins vs. positive control (P<0.01). NSD between positive control and lasalocid sodium or oregano alone, and NSD between other trt pair-wise comparisons (P≥0.14).
- Supplementing monensin ↓ *Emeria bovis* count vs. oregano + saponins (P<0.01).
- **Take-home –** Efficacy of oregano or oregano + saponins in reducing *Eimeria bovis* shedding after challenge was comparable lasalocid, which was not as effective as monensin.

2148. *Performance and health of postweaning Holstein heifers offered a low-moisture-block self-fed nutritional supplement with varying levels of menthol*. Dufour et. al. Hubbard Feeds

- "Menthol is a naturally occurring compound shown to assist in easing respiratory issues by reducing mucous production."
- Low moisture blocks formulated w/ 0.5, 1.0, 1.5, or 2.0 g/kg menthol were provided to 16 pens (n=4/trt) of dairy heifers 2 to 4 mo of age (n=7 heifers/pen; BW = 184.7 ±3.9 lbs. on d 1). Feed intake was measured daily and BW measured d 1, 28, and 56.
- NSD in grain, hay, or low moisture block intake, or feed efficiency (P>0.1).
- Tendency for ↑ BW for 1.5 vs. 0.5 g/kg menthol (260.1 vs. 242.9 lbs, P=0.07) at d 28 with 1.0 g/kg and 2.0 g/kg intermediary (254.9 and 248.5 lbs).
- Hip height tended ↑ for 1.0 and 1.5 g/kg vs. 0.5 g/kg (101.8 and 101.6 vs. 99.6 cm, P=0.07).
- "Although not statistically significant, calves fed block with 1.0 g/kg menthol required no treatment for respiratory disease whereas all other treatment groups did over the 56-d study.
- **Take-home** – Low moisture block supplemented with 1.0 to 1.5 g/kg can improve performance and may diminish respiratory disease in heifers from 2 to 4 months of age.

*2160*. *Effects of age, calf starter intake, and calcified marine algae supplementation on bone development in Holstein calves*. Sayles et al. U Alberta.

- Holstein calves (n=24) were enrolled in 2x2 factorial: starter supplement (limestone vs. 1.25% calcified marine algae [CMA]) and slaughter stage (70 d of age vs. 50 kg cumulative starter intake → ~10 wk old). Cumulative CMA or limestone intake not reported.
- Calves fed 0.9 kg/d CMR and ad lib starter grain. They were monitored for growth and rib bone structure and mineralization at slaughter.
- NSD of trt on hip height (but time and cumulative starter intake influental). % bone volume correlated w/ slaughter age (r=0.36, P<0.01). NSD other bone parameters.
- **Take-home** – Calcified marine algae likely does not influence calf bone development.

1553. *Effect of calcified marine algae in calf starter, intake, and age on growth and rumen development in dairy calves*. Hoving et al. Wageningen U; U of Alberta

- Same experiment as 2160 except for growth and metabolism parameters. Calves received 6 L/d CMR, and weaned d 49-63. Starter was offered ad lib from d 15 and intake measured daily, health daily, and BW weekly. Feces and rumen digesta sampled d 42, 56, 70, and at harvest. On d 51, rumen pH was monitored continuously via indwelling bolus.
- Before starter provision at d 15, CMA calves ↑ sick days vs. limestone calves (P<0.01). After starter provision, NSD in sick days (P=0.10). NSD of trt on grain intake or growth (P≥0.12).
- Rumen pH tended ↓ in CMA calves (P=0.07), but NSD fecal pH (P=0.29). NSD of trt on either total rumen or fecal VFA concentration (P=0.11).
- Slaughter based on intake (i.e., 50 kg) ↑ empty rumen and abomasum weigh vs. slaughter at 70 d (P<0.02). CMA calves ↑ abomasum weight vs. limestone calves (P<0.01).
- Rumen papillae length ↓ in CMA calves fed marine algae (P=0.04) but NSD papillae width.
- **Take-home** – "Calcium marine algae may delay rumen development."

2153. *Effects and mechanisms of* Schizochytrium *supplementation on* Escherichia coli K-99 *induced calf diarrhea*. Fu et. al. Inst. of An. Sci, Chinese Academy of Ag Sci.

- Microalgae *Schizochytrium* spp (SZ) rich in n-3 FA, hypothesized to prevent calf diarrhea.
- Calves (n=65) assigned to a.) control, b.) K-99 challenged only, c.) antibiotic treatment, d.) SZ-prevention, or e.) SZ-treatment. Except for control, calves were challenged w/ E. coli K99 at 21 d of age. SZ-prevention administered SZ from d 7 to 20, whereas ST-treatment administered SZ from d 22 to 35. The antibiotic treatment group received gentamicin for 3 d after K99 challenge once diarrhea occurred.
- Fecal scores recorded daily, serum and fecal samples collected on d 7, 21, 22, 25, 28, and 35 to measure oxidative stress markers.
- Diarrhea incidence ↓ (29% vs. 47%; P<0.05) before d 21 in SZ-prevention group vs. others.
- From 21 d onward, diarrhea rate ↑ (64% vs. 29%; P<0.05) in K-99 challenged vs. control. Antibiotic trt and SZ-prevention ↓ diarrhea incidence (49% and 27% vs. 64%, P<0.05) while NSD SZ-treatment 21-28 d diarrhea rate (63% vs. 58%) but ↓ 29-35 d diarrhea rate (19% vs. 58%; P<0.05) vs. K99 challenged.
- Serum superoxide dismutase activity ↓ in both SZ regiments compared to antibiotic trt or K-99 challenged only calves (P<0.05. )
- **Take-home** – *Schizochytrium* algae reduces diarrhea and oxidative stress from *E coli* K99

2166 *Evaluation of astaxanthin from* Haematococcus pluvialis *and olive biochar in preweaning Holstein calves: Effects on gut health, metabolic profile and litter emissions*. Scaglia et. al. U of Brescia, Italy. RE-CORD Scarperia, Italy. Dept. of Energy, Italy.

- Astaxanthin *Haematococcus pluvialis* is an antioxidant carotenoid derived from microalgae. Olive biochar is charcoal from olive pomace, a byproduct of making olive oil.
- Female Holstein calves (n=36) were fed either a.) basal diet, b.) basal + 40 mg/d (d 0-28) to 80 mg/d (d 29-56) astaxanthin, or c.) basal + 4 g/d (d 0-28) to 10 g/d (d 29-56) biochar.
- Milk and feed intake and fecal scores daily, BW weekly. Fecal samples analyzed for *lactobacillus* spp and coliform bacteria on d 0, 28, and 56. Blood analyzed for metabolic profile on d 0 and 56. Feces, urine, and straw from control and biochar pooled and measured for $CO_2$, $CH_4$, $N_2O$ and $NH_3$ ($g/m_2$ per hour) emissions for 28 d.
- Feed intake ↑ for biochar calves (P<0.001). NSD in milk intake or BW.
- Diarrhea frequencies ↓ both in calves fed astaxanthin or biochar (-13.5 and -7.1%, P<0.01). Coliform count d 56 ↓ in astaxanthin (P<0.05). NSD in total bacteria and *Lactobacillus* spp. Blood α2 globulin ↑ in biochar vs. control (P<0.01).
- Biochar ↓ d 56 $CO_2$ (-29%) and $CH_4$, ↓ overall $N_2O$ (-20%), $NH_3$ (-46%) but ↑ overall emissions of $CO_2$ and $CH_4$ (P<0.05).
- **Take-home** – Both astaxanthin and biochar modestly reduced diarrhea frequencies. Astaxanthin reduced coliform in feces d 56. Biochar reduced ammonia.

2165. *Plasma cortisol concentrations and association with stress in weaned calves fed bovine plasma proteins in grower grain*. Pister et. al. U of Ill. APC, Iowa.

- 2 experiments w/pooled data: Experiment 1 (n=21 male Holstein calves, outdoor groups of 3 from 10-14 wks of age, 1-wk wean). Experiment 2 (n=40 male and female Holstein x Angus calves; groups of 6 or 7 from 9-13 wks, 2-wk wean).

- Treatments were a.) control grower with no plasma (20% CP, 2.4% fat, 32% starch) and b.) grower with plasma (inclusion rate not reported; 20% CP, 2.9% fat, 32% starch). Both trt were ad lib w/ 2.5% chopped wheat straw.
- In experiment 1 grain was withheld at 5 pm on d 0 to introduce added stress. In experiment 2 calves completed weaning on d -1 and were moved to group housing on d 0. Blood was collected on d 0, 3, and 7 (experiment 1) or d -1 and 6 (experiment 2).
- NSD of trt on feed intake, BW, ADG, or cortisol concentrations (1.07 vs. 1.05 ± 0.03 ng/ml, plasma vs. control).
- **Take-home** – In this study, dietary plasma protein did not affect growth or cortisol concentrations in stressed weaned calves.

2045. *Supplementation of naturally sourced caffeine from green tea extract, on vigor, health, and lying behavior of Holstein heifer calves*. Lutz et. al. U Guelph.

- Holstein heifer calves (n=120) supplemented either a.) 15-ml dose of green tea extract (327.6 mg caffeine; Calf Perk, TechMix), b.) 30-ml 2x dose (655.2 mg caffeine) or control (15-ml placebo). Trts given orally before colostrum (w/in 2 hr of life; 4 L of CR, 300 g of IgG).
- Blood sampled for serum IgG at 0, 2, 6, 24, 48, and 72 hr, and vigor scored at 0, 2, 24, 48, and 72 hr of life (Calf VIGOR Scorer, UW Madison; higher = better). Health scored at 24 and 72 h and then 2x/wk to 28 d (Calf Health Scorer, UW-Madison; lower = better). Lying behavior monitored (HOBO data loggers) to 28 d.
- Single-dose calves ↑ avg serum IgG (14.2 vs. 13.8 ±0.24 mg/mL, P=0.01) vs. control, whereas 2x dose green tea extract did not differ (13.8 ±0.24 mg/ml; P=0.34).
- VIGOR scores ↑ (23.7 vs. 23.1 ±0.23) and health scores ↓ (4.7 vs. 4.3) for calves fed 2x dose green tea extract vs. control (P≤0.04). NSD for single dose.
- Both 2x dose and single dose ↓ lying time vs. control → increased vigor (P<0.001).
- **Take-home** – single dose caffeine improved IgG absorption and a double dose improved overall vigor and health scores. Authors hypothesized that green tea extract supplementation might be particularly impactful for calves experiencing low vigor due to birth complications.

2164. *Effect of plane of nutrition and inclusion of direct-fed microbials on calf performance and fecal pathogen counts in transportation-stressed calves*. Forgues et al. ISU. **see Nutrition → CMR milk feeding rates and strategies.**

2032. *Effects of weaning pace and probiotic supplementation on mRNA abundance of inflammation-related genes in rumen and liver tissue of male Holstein dairy calves.* Malekkhahi et al. U Idaho. **see Management → Weaning**

**CMR milk feeding rates and strategies (11 abstracts)**

2033. *Offering 750 g of milk replacer at 16.5% or 12.5% dry matter does not affect the intake and performance of Holstein calves*. Diavão et al. Empresa Brasileira de Pesquisa Agropecuaria

- Male and female Holstein calves (n=30) housed individually received either a.) 6 L/d 12.5% solids or b.) 4.5 L/d, 16.7% solids. In both instances calves were fed 750 g/d CMR (21.4% CP and 14.8% fat, Nurture Prime)

- Water, grain (20.7% CP, 3.2% fat) and CMR intake monitored to d 60. Nutrient digestibility was determined during d 30-34 and d 52-56 of age using individual metabolic cages. Total feces collected to estimate DM, OM, CP, EE and NDF digestibility. ADG measured weekly.
- The 12.5% solids solution ↑ (gross energy digestibility on d 30 – 34 (97.4% vs. 96.5%, P<0.05). NSD in any other measure → ADG = 1.46 vs. 1.43 (12.5% and 16.7%)
- **Take-home** – In this study, 50 g/d of CMR was fed at either 12.5% or 16.7% solids with no true performance differences.

1175. *Assessing consistency in solids and temperature of milk replacers fed via automatic milk feeding devices*. Silvestrelli, et. al. U Bologna

- Two farms located in Catalonia (5 automatic feeders [AMF] each w/ 4 teats) were visited 3x/week to collect CMR from each teat and feeder over 3 hr (n=302 observations).
- Target solids were 13.5% (Farm A) and 14% (Farm B). Each feeder had two lines close (5.9 ft) and two far (9.8 ft) from the mixing device. At each meal, CMR temp and DM at each teat were measured.
- Farm A CMR temp was similar across AMF, but colder in teats far (88.9 °F) vs. close (95 °F) to AMF. Temp varied between AMF → CV ranged 10-28% regardless of teat distance. Farm B CMR temp varied between and across AMF → CV ranged 1.35 to 7.8%, regardless of line length.
- In Farm A % solids (DM) varied between AMF (13.5 and 11.9 ± 0.3% solids) → CV ranged 3.7 to 8.8%. In Farm B % solids (DM) in 2 AMF were ↑ (11.9 ±0.5%) vs. others (8.4 ±0.7%), both well below the target of 14%. Distance from the AMF had no effect on % solids.
- **Take-home** – "…dry matter content and CMR temperature prepared by automatic feeders varied between and within automatic feeders over time." "…the origin of variation in temperature of CMR is the machine, not the line assembly."

2152. *Fecal dry matter in Holstein bull calves fed high-solids milk replacers*. Pister et. al. U of Ill.

- Holstein calves (n=8) were fed CMR with either a.) low (13%) or b.) high (17% or 18%) solids with different nutritional additives in a Latin square design. Fecal scores recorded 2x/d. ~ 50 g feces collected daily from each calf via rectal palpation.
- Expt 0: a.) low solids and low DMI, b.) low solids and high DMI, c.) high solids and low DMI, or d.) high solids and high DMI.
    - Results: Fecal DM% ↓ in scouring vs. non-scouring calves (17 vs. 22%, P<0.001). Fecal DM% ↑ for low solids and low DMI vs. low solids and high DMI (P=0.06).
- Expt 1: a.) low solids MR, b.) high solids MR, c.) high solids with salt, d.) high solids with psyllium, or e.) high solids with casein.
    - Results: Fecal DM% ↓ in scouring vs. non-scouring calves (22 vs. 24%, P<0.001). NSD of trt on fecal DM%.
- Expt 2 (n=10): a.) low solids, b.) high solids, c.) high solids with mineral mix, d.) high solids with psyllium, or e.) high solids with guar gum.
    - Results: Fecal DM% ↓ in scouring vs. non-scouring calves (15 vs. 19%, P<0.001). Fecal DM% ↑ for calves fed low solids compared to high solids CMR (P=0.05). Fecal DM% ↑ 3 to 5% for calves fed high solids w/ either mineral mix, psyllium or guar gum.
- Expt 3 (n=21): a.) low solids, b.) high solids, c.) high solids with casein, d.) high solids with psyllium, or e.) high solids with both casein and psyllium.

    - Results: Fecal DM% ↓ in scouring vs. non-scouring calves (14 vs. 19%, P<0.001). NSD of trt on fecal DM%.
- **Take-home** – "Fecal scores correctly classified degree of scouring as confirmed by fecal dry matter %."

2155. *Effects of increased concentrations of dried cheese byproduct in milk replacer on growth, feed intake, and scouring frequency of dairy calves for 7 wks preweaning and 1 week postweaning*. Plumski et. al. U of MN Waseca; Actus Nutrition

- Holstein calves (n=104) in 4 groups received a 24:20 CMR composed of either a control diet w/ whey protein and fat (tallow, lard, cheese, and coconut oil) or w/ dried cheese product replacing whey at 4.38%, 8.75%, or 17.5% inclusion in CMR. All calves fed 1.5 lbs./d of CMR d 1-42 and 0.75 lbs./d d 43-49. BW was measured biweekly, hip height d 1, 49, and 56, CMR and starter intake daily, fecal scores daily.
- ADG d 29-42 and hip height gain d1-49 ↑ for 8.75% vs. 4.38% dried cheese fed calves (1.79 vs. 1.45 lbs./d, P=0.04; 10.6 vs. 9.3 cm, P=0.09), other trts were intermediary (NSD).
- Fecal score linearly ↓ from d 29-42 by ↑ dried cheese inclusion (P=0.002). NSD CMR intake.
- **Take-home** – Dried cheese byproduct can replace whey at 8.75% inclusion in CMR resulting in "modest improvements in ADG and scouring in the preweaning period."

2164. *Effects of plane of nutrition and inclusion of direct-fed microbials on calf performance and fecal pathogen counts in transportation-stressed calves.* Forgues et. al. ISU

- Holstein calves (n=76) were fed either a high (2.3 lb CMR/d) or low (1.5 lb CMR/d) plane of nutrition with or w/o DFM inclusion (*L. plantarum, B. subtilis)* as a 2 x 2 factorial design.
- Every 5 d calves (2-7 d of age) were transported for 16 h. BW and fecal samples collected at birth, before and after transport, and at 8, 24, and 72 h post transport, then weekly to d 70.
- High-plane calves ↑ prewean BW (130.2 vs. 122.3 lbs.; P≤0.01), but NSD of DFM. NSD of DFM or plane of nutrition on ADG.
- Starter intake ↓ (1.7 vs. 2.1 lbs./d; P<0.01) and CMR refusals ↑ for high-plane calves. NSD from DFM, and no interaction effects.
- **Take-home** – High plane of nutrition improved BW and postweaning calf performance. DFM had no effect on performance or health regardless of plane of nutrition.

2172. *Growth performance and health of calves fed milk replacers formulated with tailor-made soy protein concentrate*. Zou et. al. Bunge NA, Mapleview Agri, Animix.

- Male calves (n=192) were assigned to one of three 26:20 CMR a.) all milk CMR, b.) 5% soy protein concentrate (SPC) formula, or c.) combination 5% SPC and 5% bovine plasma.
- Calves fed 100 lbs. of CMR in step-up, step-down fashion peaking at 8 L/d and weaning d 63. Ad lib grain (20% CP, 4% chopped straw) was offered. Calves followed to 12 wks, weighed weekly with health monitored daily.
- NSD in 21-d, pre-wean, post-wean or 84-d ADG (2.45, 2.29, 2.45 lbs./d). 84-d BW ↓ in SPC vs. other trt (301.4 vs. 305.1 and 307.8 lb, P<0.05). Feed:gain ↓ in SPC+plasma vs. all-milk (2.21 vs. 2.14, P=0.05).
- SPC + plasma tended ↓ scours vs all-milk and all-milk ↓ BRD incidence vs. SPC (P<0.10). By chance, FPT was 29.7%, 43.8%, and 28.1% (P=0.12) and FPT correlated w/ growth (P<0.001).
- Mortality was 12% due to a *Histophilus somni* outbreak. NSD between trt (P=0.58).

- **Take-home** – 5% PurePro SPC in CMR fed at modern feeding rates (2 bags/calf) and in a commercial setting with stressed calves had minimal impact on health and performance.

1172. *Growth performance of neonatal calves fed milk replacer 2 versus 3 times per day*. Casper et. al. Casper's Calf Ranch, NC A&T.

- Holstein bull calves (n=50) were fed either a.) 2x/d CMR, or b.) 3x/d CMR. CMR fed at 15% solids at 0630 and 1800 (3rd feeding 1200 h). D 1-14 calves fed 1.25 lbs./d, then ↑ to 1.9 lbs./d for 2x/d and 2.8 lbs./d for 3x. Calves fed 3x/d more gradually weaned (↓ to 2x at wk 6) and then both groups received 1x/d feeding at wk 7 w/ complete weaning after d 49, monitored to 63 d.
- NSD of total BW gain (+98 and 93 lbs, P>0.30) but BW ↑ for 3x/d on wk 4, 5, and 6 (P<0.04), and final BW tended ↑ for 3x (199.1 vs. 192.7 ± 6.4 lbs.; P<0.10)).
- Starter intake ↓ wks 5, 6, and 7 for 3x/d (P<0.04). NSD in feed conversion.
- **Take-home** – "Providing an additional MR feeding that increases both MR feeding volume and intake demonstrated minimal BW gains."

1176. *Growth performance, metabolic, and hematological response of preweaning Fleckvieh dairy calves fed milk replacer or whole milk*. Sfulcini et al. Universita Cattolica del Sacro Cuore Piacenza.

- Fleckvieh calves housed in individual hutches (n=18) were fed either whole milk (29.1% CP, 27.3% fat, 37.3% lactose; 5.25 Mcal/kg of DM) or CMR (22.9% CP, 19.1% fat, 51.73% lactose; 4.76 Mcal/kg DM). Both fed at 13% solids, 3 L 2x/d to d 53 then 3 L 1x/d to d 60 wean.
- NSD of trt on total DMI. Calves fed whole milk ↑ BW, ADG, and feed efficiency (P≤0.07). From d 21-60 calves fed whole milk were 8.8 lbs. heavier (P<0.01)
- Calves fed whole milk ↑ plasma glucose (6.2 vs. 5.6 mmol/L), urea (3.7 vs. 2.0 mmol/L), cholesterol (3.4 vs. 2.8 mmol/L), alkaline phosphatase (446 vs. 312 U/L), and paraoxonase (64.6 vs. 53.7 U/L; P≤0.10) and ↓ bilirubin (3.0 vs. 5.3 micromol/L; P<0.01).
- Calves fed whole milk had ↓ circulating lymphocytes (51 vs. 56%; P=0.02) and at 21 and 28 d ↑ leukocyte counts, neutrophil counts, and red cell distribution width (P<0.01).
- **Take-home** – Calves fed higher protein, higher fat whole milk outgained and had increased metabolic nutrients in blood compared to calves fed lower protein, lower fat CMR.

1180. *Impact of early-life feeding strategies on growth and health in Holstein and crossbred calves*. Wang et al. U of Guelph. Mapleview Agri, Palmerston, Ontario. U of VT, Burlington, VT.

- Male calves (n=128; 41 Angus x Holstein + 87 Holstein) were fed CMR composed of either a.) low-fat (26:17), b.) high fat (26:24), or c.) high fat (26:24) w/ CR as 18% of the formula.
- Trt diets were fed at 6 L/d for the first 21 d, then all transitioned to low-fat CMR (26:17) at 8 L/d from d 21-42, then gradually weaned to d 63. Calves monitored to d 84 (IgG and BW weekly, health parameters 2x/d).
- NSD of trt on ADG, but Holstein ↓ ADG vs. Holstein x Angus calves (-0.29 lbs./d, P<0.01).
- NSD of trt on BRD odds, but calves w/ >26.0 g/L IgG ↓ odds of BRD than those <16.4 g/L IgG at d 1 (P=0.01). Holstein calves ↑ incidence of diarrhea vs. crossbred (P=0.04) and calves with <16.4 g/L of IgG on d 1 ↓ incidence of diarrhea vs. low fat CMR when fed colostrum (P=0.001).
- **Take-home** – "extended colostrum feeding reduced diarrhea in calves with low IgG but breed also plays a crucial role in growth and disease resistance."

2401. *Do milk replacer labels measure up? Predicting calf growth based on milk replacer feeding recommendations*. Woodrum Setser et al. U of VT.

- 52 CMR products from 12 brands sold in VT were evaluated. Label contents including nutrient composition, mixing instructions and suggested feeding rates were analyzed.
- 35 of the 52 provided adequate details to estimate daily metabolizable energy from CMR.
- ME for each was used to predict ADG using CalfSim Software (go.uvm.edu/calfsim; based on 2021 NASEM). Estimates used 81.6 lbs. birthweight carried though 56 d. Thermoneutral environment and ad lib access to 22% CP grain was assumed. Predicted ADG was assessed on each product with a standardized goal of doubling BW by wean (i.e., 1.45 lbs./d ADG).
- CMR label feeding guidelines ranged from 1.) locked-in feeding rate, 2.) range from low to high feeding rates, or 3.) feeding rates based on calf age.
- Estimated ADG ≠ doubling BW if suggested feeding rate was locked in or a range from low to high feeding rates. If the suggested feeding rate was based on calf age (phase feeding) the predicted ADG was at or exceeded the goal of 1.45 lbs./d (doubling BW).
- **Take-home** – The author asserts "many CMR suggest feeding levels that negatively affect calf welfare and performance, indicating misalignment between label instructions and scientific or industry standards."

*2413. CalfSim tool: A predication assessment study of performance predication of dairy calves.* Da Silva & Costa. UVT **see Management → Growth**

## Starter grain & forage feeding (12 abstracts)

2147. *Performance and health of calves fed calf starters varying in physical form during the preweaning and early postweaning period*. Dufour et. al. Hubbard Feeds.

- Holstein heifer calves (n=108) were fed either a.) complete pellet (20% CP, 24.1% starch), b.) texturized (21.7% CP, 29% starch), c.) meal with steam flaked corn (21.5% CP, 26% starch), or d.) meal with fine ground corn (21.5% CP, 28.2% starch).
- All calves were fed a 24:20 CMR in a step-up, step-down fashion peaking at 1.5 lbs./d and a 6-d weaning period ending d 49. BW measured biweekly, Hip height measured d 1, 56, and 84. Fecal scores measured weekly and feed intake measured daily.
- NSD of trt on CMR intake, hip height or scouring frequency.
- Steam flaked corn meal ↑ post-wean ADG (d 50-56) vs. pelleted starter (2.73 vs. 2.27 lbs./d, P=0.02). Texturized and the meal with fine-ground corn starter intermediary.
- Meal diets ↑ post-wean starter intake was vs. pelleted (5.45 both vs. 4.77 lb/d, P=0.02) w/ texturized intermediary.
- **Take-home** – "Overall, only slight differences occurred in the postweaning phase of this study, suggesting the different physical forms of calf starter presented in this study can be viable options for raising pre and post weaned calves when diets are properly balanced."

2006. *Does hay improve performance in pair-housed dairy calves?* Plaugher et al. PSU

- Female Holstein calves (n=32 pairs; 64 calves) were enrolled at pairing (5 ±3 d of age) and offered either no hay or pelleted timothy hay. The hay group had a trough with pellets until d 59 and then transitioned to loose timothy hay until d 70. Starter, hay, orts recorded daily.

- All calves received 2.2 lbs/d milk solids (13.5%, 22:20 CMR) until d 56, half rate d 57-62 and weaned d 63. BW measured 2x/wk until d 30 and then weekly to d 70.
- Calf pairs fed hay ↑ BW d 22-55, d 56-62 an d 63-70 vs. controls (P≤0.02). Final BW on d 70 ↑ for calves fed hay (226 vs. 211 ±12 lbs.; P=0.001).
- NSD of trt on ADG (2.1 vs. 1.9 lb/d), starter DMI, or feed efficiency (0.73 vs. 0.65).
- **Take-home** – Offering "pelleted timothy hay improved BW gains without compromising calf starter intake."

1551. *Does fiber make a healthy gut? The case of providing forage for calf diarrhea*. Plaugher et al. PSU.

- Same experiment as 2006, now assessing fecal scores. Calves fecal scored daily to d 30. Pairs with at least one calf with fecal score = 2 (loose) for 2 d or a score = 3 (watery) for 1 d were deemed "diarrheic" or "severe" if fecal score = 3 for 3 d. Diarrhea was deemed "resolved" if no diarrhea occurred for 4 consecutive days.
- Diarrhea found in n=27 pairs (hay: n=14 [6 severe]; control: n=13 [10 severe]).
- Control calves 5x more likely to have a severe case of diarrhea (OR 5.05; 95% CI 1.45 – 17.6; P=0.01) vs. hay-fed calves. NSD of trt on odds of diarrhea duration or multiple cases of diarrhea (trends: P≤0.09; OR for duration =0.33, OR for multiple cases = 3.8).
- **Take-home** – "Offering timothy hay pellets reduces the severity of diarrhea in pair-housed dairy calves."

2162. *Evaluation of crude protein content and rumen unprotected protein sources in diets fed to postweaning heifers*. Thompson et. al. Miner

- Holstein heifers (n=60; 67 ±2 d of age) housed 5/pen with 4 pens/trt were fed one of three pelleted compounds as grain, a.) 22% CP, low rumen undegradable (RUP, 30% of CP; RDP, 70%), b.) 26% CP, low RUP source (30% of CP), c.) 26% CP, higher RUP source (37% of CP).
- Dry hay (16% CP) and respective grain were offered ad lib for 11 wks. Pen feed intake was recorded daily, BW and stature was measured weekly.
- NSD of trt on grain intake, BW, ADG, G:F, BCS, hip height, or body length, and minor (but significant) ↑ in hip width and heart girth for the 26% CP, low RUP calves.
- Hay intake ↑ for either 26% CP trt vs. 22% CP trt (1.37 [both] vs. 1.08 lbs./d, P=0.04). Grain:hay ratio ↑ for 22% CP formula (P=0.02) → driven by "different neutral detergent fiber between CP contents in the compound feed (NDF = 25% vs. 20% for 22% vs. 26% CP), also perhaps improved nitrogen efficiency with different protein supply."
- **Take-home** – "Sources of RUP, which are often a higher cost, did not seem to affect growth of post weaned heifers when total CP in the compound feed was 26%. With ad lib intake, there did not appear to be an additional benefit of feeding higher CP content."

2146. *Combinations of different liquid and solid diets and behavior of dairy calves around weaning*. Bittar et. al. U of Sao Paulo.

- Holstein calves (n=60) fed in a 2 x 2 factorial design, either a.) CMR (22:17, 15% solids) or b.) powdered whole milk (24.5:26.5,12.5% solids) + 25 g/L CMR (15% solids) and grain (22% CP, 10% ADF), fed as a.) micropellet (ground corn, soybean meal, soybean hulls), or b.) texturized grain (ground corn, soybean meal, extruded corn, steam-flaked corn, and shelled oats).
- Calves were individually housed and fed 8 L/d until d 21, then 6 L/d until d 56, then gradually weaned (-1 L/d) on d 63. Calves were offered ad lib grain and hay offered (wk 7+). Behavior

was evaluated by focal sampling w/ 5-min intervals at wk 7, 8, and 9 for 10 h between the liquid diet feeding schedule."

- Effect of time on behavior: as calves aged ↑ time standing, eating concentrate, grazing, and vocalizing and ↓ time lying, self-grooming, and exploring ($P<0.02$). NSD of age on drinking water, ruminating, non-nutritive suckling, and urinating/defecating.
- NSD of factorial trt on behavior, but feeding CMR ↑ lying but not sleeping time ($P<0.05$). Feeding texturized grain ↑ ruminating time and time eating concentrate ($P\leq0.07$).
- **Take-home** – "Age was more effective in changing behavior; however, the more complex starter improved time eating and ruminating, which may influence performance during the transition period."

2168. *Combinations of different liquid and solid diets and the performance and health of dairy calves*. Bittar et. al. U of Sao Paulo.

- Further data reporting from abstract 2146, now focusing on calf growth and health.
- NSD of main effects trts on CMR and hay DMI, but texturized grain ↑ total DMI ($P<0.01$). Calves fed CMR x texturized grain ↑ grain and total diet DMI vs. calves fed whole milk x micropellet ($P<0.05$).
- NSD of diet on final BW, but whole milk x texturized grain ↑ ADG was observed for vs. CMR, regardless of starter fed ($P<0.05$). Orthogonal contrast of liquid diets showed calves fed CMR ↓ ADG, hip width, and withers height and heart girth ($P\leq0.07$). NSD of trt on G:F.
- Calves on CMR ↑ scours regardless of starter fed ($P<0.003$).
- **Take-home** – Whole milk powder + 25 g/L of CMR combined with texturized grain noted best performance.

2168. *Combinations of different liquid and solid diets: Rumen fermentation and gastrointestinal tract development*. Bittar et. al. U of Sao Paulo.

- Further data reporting from abstract 2146, now focusing on rumen and GIT development.
- Rumen content sampling using oro-esophageal tube 2 hr post-feeding at wk 7, 8, and 9 was conducted on n=8 calves/trt, and n=4 calves/trt were slaughtered wk 9.
- Rumen pH ↑ in calves fed whole milk vs. CMR, regardless of starter fed ($P<0.001$).
- Molar concentration of VFAs ↑ w/ age. Molar proportion of propionic acid ↑ for CMR x micropellet calves vs. whole milk x texturized grain calves.
- NSD of trt for GIT compartment weight or % of BW, GIT fill, and avg n of papillae per $cm^2$.
- **Take-home** – Difference between diets in "fermentation profile were not enough to affect gastrointestinal tract development."

2167. *Feeding behavior of dairy calves fed forage sources in total mixed ration.* Toledo et. al. U of Sao Paulo

- Individually housed calves (n=48) were fed a.) starter (no forage, control), b.) TMR w/ 7.5% DM Tifton hay (medium quality), c.) TMR w/ 7.5% DM Tifton hay (low quality), or d.) TMR w/ 7.5% DM corn silage.
- Calves fed 6 L/d whole milk and a commercial starter w/ no forage until d 28 when the solid diet was changed to respective trt. Calves gradually weaned d 56 and followed until d 70. Behavior was recorded. TMR intake and the orts following 10 hr of feed access were measured on d 49 (preweaning) and 70 (postweaning).

- NSD of trt on total TMR intake. Provision of forage ↑ NDF intake vs. control and addition of hay regardless of quality ↑ NDF vs. corn silage at d 49 and 70 (P≤0.08). NSD of trt on TMR intake variation at wk 7, but provision of forage ↓ variability at wk 10 vs. control (P<0.07).
- On d 49 forage provision ↑ time spent chewing, meal n, and avg time spent on each meal. Same effect on d 70 except corn silage ↑ avg time spent in each rumination cycle (P≤0.05).
- **<u>Take-home</u>** – "…fiber source in the TMR influences the intake capacity and the ingestive behavior of dairy calves before and after weaning." And solid feed intake variation prewean suggests early exposure to forage is crucial to support transition.

1179. *Effects of starter crude protein levels and methionine supplementation on immunity in postweaning Holstein dairy heifers*. Valarezo et al. UW-Madison. Vita Plus.

- Holstein heifer calves (n=60) d 3-84 were fed starter composed of either 14%, 16%, or 18% CP with or w/o supplemental methionine. All calves fed CMR (25:25) from birth to d 49 weaning. Blood was collected on d 56 (1 wk post-wean) and d 77 (3 wk post-wean).
- In vitro cell proliferation capacity of bovine peripheral blood mononuclear cells were isolated and incubated. Models were used to determine T cell proliferation.
- NSD of trt on T cell proliferation were observed on d 56. On d 77, methionine x 14% CP and methionine x 16% CP ↑ γδ T cell proliferation (↑ division, proliferation, replication, and expansion indices; P<0.03). NSD of interaction w/18% CP.
- NSD of trt effects on proliferation of $CD8^+$ and $CD4^+$ T cell subsets.
- **<u>Take-home</u>** – "…supplementation of methionine in starter diets with lower CP levels (14% and 16%) positively influences cell-mediated immune competence … might provide a framework to reduce excess protein feeding while improving health."

1599. *Effects of starch inclusion level in a starter diet for milk-fed beef-on-dairy calves on growth performance and gastrointestinal health*. Rivas et al. KSU.

- Castrated male dairy beef cross calves (n=20) received either a.) high starch (44%) or b.) low starch (24%) starter grain fed ad lib from d 10 onward. Refusals measured daily.
- CMR was fed at 4 qt/d dail, increased to 6 qt/d d 10-40 and then stepped down to 2 qt/d until weaned d 54. Calves were weighed d 10, 40, 51, 54, and 80. Fecal scores 5x/wk, d of electrolyte therapy used as a tracker for diarrhea.
- NSD of trt for prewean ADG, fecal score, d of electrolytes, or postwean BW (P≥0.29).
- NSD in starter DMI on d 40 (i.e., milk stepdown) or postweaning (P>0.05), but low starch ↑ DMI on d 54 vs. high starch (i.e., weaning, 1.96 vs. 1.65 kg/d, P<0.01).
- **Take-home** – "low starch increased starter DMI during the milk stepdown phase; otherwise starch content of the starter grain had minimal effects on intake, growth," or GI tract health.

*2000. Effect of milk replacer and starter composition on health and immune responses of Holstein-Angus calves. Kovics et al. U of Guelph* **see Nutrition → Fats & oils nutrition.**

*2399. Effect of milk replacer and starter composition on intake, growth and intestinal permeability in Holstein-Angus crossbred calves. Chapelain et al. U of Guelph.* **see Nutrition → Fats & oils nutrition**

**Fats and oils nutrition (10 abstracts)**

2000. *Effect of milk replacer and starter composition on health and immune responses of Holstein-Angus calves.* Kovacs et al. U Guelph; Holstein Canada; Trouw Nutrition

- Male Holstein x Angus calves (n=68) in a 2 x 2 factorial design: fed CMR composed of either low-fat high-lactose (18:51) or high-fat low-lactose (29:38) and starter grain w/ low (3%) or high fat (7%). CMR fed at 15% of arrival BW until wk 3 and 18% thereafter until gradually step-down weaned between wk 6 and 10. Starter introduced wk 5, offered ad lib.
- At wk 5 (pre-grain),13 and 21, cell-mediated immune response was measured using phytohemagglutinin (PHA) and PBS injections on either side of tail fold. Skin fold thickness was measured at 0, 2, 4, 8, 12, and 24 hr to measure cell-mediated immune response.
- High-lactose calves tended ↑ change in localized immune response to PHA vs. high-fat CMR (P=0.07) at wk 5. High-lactose CMR x low-fat grain ↑ and high-fat CMR x low-fat grain ↓ cell-mediated immune response at wk 21. NSD week 13.
- Between wk 5 and 13, high-fat CMR x high-fat grain tended ↑ BRD vs. high-fat CMR x low-fat grain (P=0.07).
- **Take-home** – Diet composition (fat/lactose concentration in CMR, fat concentration in grain) influences immune response. Association between diet and health is less clear.

2399. *Effect of milk replacer and starter composition on intake, growth and intestinal permeability in Holstein-Angus crossbred calves*. Chapelain et al. U of Guelph, Trouw.

- Same experiment as 2000, now focused on performance and GIT. Wk 4 and 12, calves orally dosed with Cr-EDTA, and blood taken at 1, 2, 3, 4, 6, 8, and 10 hr to assess gut permeability.
- NSD of CMR trt on ADG or BW, but high-fat CMR calves ↑ CMR intake the first 2 wk (P=0.01).
- Low-fat grain calves ↑ grain intake, ADG, and post-wean BW (P≤0.06).
- High-fat CMR calves ↑ wk-4 gut permeability at 3, 4 and 6-hrs but area under the curve was similar across trt. High-fat starter calves ↑ wk-12 gut permeability vs. low-fat grain (P=0.01).
- **Take-home** – CMR energy source had limited impact on performance. Fat supplementation in grain reduced intake, reduced post-wean growth and increased gut permeability.

2150. *Effects of medium-chain fatty acid source in milk replacer on dairy calf performance and health for 7 weeks preweaning and 1-week postweaning*. Plumski et. al., U of MN, Actus Nutrition

- Holstein calves (n=116) received 24:20 CMR with protein encapsulated fat containing either a.) 50% lard-tallow and 50% palm oil, b.) 45% lard-tallow, 45% palm oil, and 10% coconut oil, c.) 45% lard-tallow, 45% palm oil, and 10% palm kernel oil, d.) 38% lard-tallow fat, 38% palm oil, and 24% coconut oil OR palm kernel oil.
- Calves fed 1.5 lbs./d CMR until d 42 and then 0.75 lbs. 1x/d until weaned d 49. 18% CP calf starter offered ad lib. BW measured biweekly, hip height recorded d 1, 49, and 56. Daily intake of CMR and starter calculated. Fecal scores daily.
- Early-life ADG (d 0-14) ↑ for calves fed solely lard/tallow/palm (i.e., no medium chain FA) (390 g/d),10% coconut oil (400 g/d), or 24% palm kernel oil (390 g/d) vs. calves fed 10% palm kernel oil (360 g/d) or 24% coconut oil (360 g/d).
- NSD of trt on hip height gain, CMR intake, or grain intake during pre-weaning or to d 56.
- **Take-home** – "the response of MCFA concentration in CMR on calf performance and health appears to be dependent on MCFA source."

2157. *Effects of milk replacer fat ratios of coconut oil and palm oil on feeding intake and performance of male dairy calves*. Lovatti et. al. UVT

- Male Holstein calves (n=119) were fed 26:21 CMR with protein encapsulated fat composed of either a.) 20% coconut and 80% palm oil, b.) 35% coconut and 65% palm oil, or c.) 50% coconut and 50% palm oil.
- CMR was fed 2x/d in a step-up, step-down fashion with peak intake of 2.3 lbs./d and with a 3-wk gradual wean at 63 d. Starter grain offered ad lib. BW, CMR, and grain intake recorded weekly to 12 wks.
- Prewean ADG ↑ for the 35% coconut:65% palm formula (1.76 vs. 1.65, 1.61lbs./d. for 35:65, 20:80, and 50:50, P=0.03). Weaning ADG also↑ for the 35:65 formula (3.2 vs. 2.8, 3.0 lb/d, P<0.01). NSD of trt for post-wean ADG.
- 84-d BW ↑ for the 35:65 formula ( 312.2 vs. 299.6, 302.4 lbs., P<0.01). Total DMI (CMR + grain) ↑ for 35:65 across all phases (P<0.001). Fat ratios did not affect G:F or calf health.
- **<u>Take-home</u>** – "We found that calves fed 35% coconut oil:65% palm oil had increased performance, based on a better balance of MCFA (medium chain fatty acids) and LCFA (long chain fatty acids), by increasing calf starter intake."

2173. *Effects of adding of ethyl esters of polyunsaturated fatty acids of linseed oil or linseed oil to milk replacer on nutrient digestibility in dairy calves*. Baba et al. U of Ag Krakow

- Holstein calves (n=36) were fed CMR either a.) with no source of PUFA, b.) linseed oil [LO] added at 30 ml/d to CMR, or c.) ethyl esters [EE] added at 30 ml/d over two phases - 1 and 2 mo - with 6 d adaptation period and 4 d of fecal collection in each. No further details of CMR or grain feeding rates provided.
- Total DMI tended different between groups (2.47, 2.56, and 2.79 lbs./d for control, LO and EE, respectively, P=0.10). NSD in ADG (1.39, 1.47, and 1.62 lbs./d) or F:G (0.56, 0.58, 0.59, respectively). DM digestibility tended different (87.7%, 85.1%, 90.1%, P=0.09)
- **<u>Take-home</u>** – adding ethyl esters of polyunsaturated fatty acids of linseed oil may increase DMI and CMR digestibility.

2396. *Effects of fat content of high-protein milk replacer on plasma metabolite concentrations of dairy calves in summer and winter*. Fukami et al. Hiroshima U.

- Holstein heifer calves (n=80) 7 d age were fed in a 3 x 2 study: either a.) low fat (21%), b.) middle fat (26%) or c.) high fat (32%) CMR in either summer (June-Aug) or winter (Oct-Dec).
- All CMRs contained 29% CP. Diets were 40%, 35%, and 30% lactose; 4.7, 5.0, and 5.3 Mcal/kg ME; and 478, 424, and 376 mOsm/kg osmolarity (low, mid, high fat). Feeding rate started at 1.32 lbs./d, up to 2.64 lbs./d wk 3-6, stepped down to complete wean d 56. Calves fed CMR 2x/d. Calf starter and chopped hay offered ad lib d 7 onward.
- Blood samples collected immediately before AM milk feeding. The avg temp was 80.6 °F and 38.7 °F for summer and winter.
- NSD of trt on plasma triglyceride or NEFA concentrations. Total cholesterol ↑ as fat level ↑ and in winter vs. summer (P=0.01). Urea N ↓ as fat levels ↑ (P=0.02) but NSD between seasons. Glucose conc. ↑ in winter vs. summer (P<0.01) but NSD of fat levels.
- **<u>Take-home</u>** – Urea N decreased at higher fat, and NEFA and glucose at high fat decreased in summer. Authors hypothesized that protein catabolism increased to generate energy for calves fed low fat CMR in winter.

1598. *Evaluating the effects of fat and colostrum supplementation in milk replacer on gut permeability, hematology, and performance of non-replacement calves*. Pisoni et al. U Guelph

- 48 male calves (24 Holstein and 24 Holstein x Angus) were fed either a.) low-fat (26:17) CMR, b.) high fat CMR (26:24), or c.) high fat (26:24) + 140 g of colostrum replacer. Fat (26:24) and colostrum trt fed for the first 21 d and then transitioned to low fat (26:17) CMR until 28 d.
- Calves were fed 6 L/d of CMR during the entire study period and offered ad lib grain. BW, grain intake, blood samples, and gut permeability test (Cr-EDTA) collected weekly.
- NSD of trt on calf BW, ADG, and solid feed intake groups ($P \geq 0.15$), but beef x dairy calves ↑ 28 d BW vs. Holsteins (140 vs. 130.4 lbs, $P=0.01$).
- White blood cell count ↑ in calves fed high fat vs. low fat CMR ($P=0.03$). Calves fed colostrum were intermediary. NSD of trt on gut permeability ($P=0.26$), but Cr-EDTA concentrations ↓ 3.5x from wk 1 to 4 (887 vs. 245 ppb).
- **Take-home** – no differences noted from supplementing colostrum. CMR with added fat increased white blood cells w/o influencing gut permeability or performance.

1173. *Effects of fortifying whole milk with a tributyrin-containing fat concentrate on growth, feed intake, and health in calves*. Wilms et. al. Trouw Nutrition. **see Nutrition → Additives in CMR, whole milk, or starter grain.**

2409. *Effect of tributyrin and tricaproin in a low-fat milk replacer on feeding behavior and growth in 2-wk-old calves*. Chapelain et al. U of Guelph. **see Nutrition → Additives in CMR, whole milk, or starter grain.**

2159. *Effects of sodium butyrate supplementation on performance and rumen fermentation in dairy calves*. Gheller et. al. U of Sao Paulo. **see Nutrition → Additives in CMR, whole milk, or starter grain.**

**<u>Protein and amino acid nutrition/supplementation (2 abstracts)</u>**

1179. *Effects of starter crude protein levels and methionine supplementation on immunity in postweaning Holstein dairy heifers*. Valarezo et al. UW-Madison. Vita Plus. **see Nutrition → Starter grain & forage feeding**

2162. *Evaluation of crude protein content and rumen unprotected protein sources in diets fed to postweaning heifers*. Thompson et. al. Miner **see Nutrition → Starter grain & forage feeding**

**<u>Carbohydrate nutrition (2 abstracts)</u>**

2415. *Metabolic and endocrine responses to different carbohydrates as substitute for lactose in milk-fed calves*. Gross et al. U of Bern

- Calves (n=38; 15 M/23 F, 16 d of age, 118 lbs. initial BW) were offered 8 kg/d of whole milk from d 1-3 then 8 kg/d from d 4- 6 of a formula w/ heavy cream, milk-based protein powder, added carbohydrates, and water (4.0% fat, 3.4% protein, and 4.7% carbohydrates); added carbohydrates were either a.) lactose, b.) glucose, c.) galactose, d.) glucose + galactose, or e.) xylose. Natural lactose was 6.5 g/kg of formula (13.8% of carbohydrates [47 g])

- Blood samples were taken on the last d of trt before formula feeding in the morning (T1), then 2 (T2) and 7 (T3) hours later. Concentrations of plasma glucose, NEFA, BHB, triglycerides, insulin, and glucagon were determined.
- Plasma glucose ↑ at T1 if the calf was fed added glucose but not other sugars ($P<0.05$). NEFA tended ↑ at T2 when calves were fed galactose ($P=0.06$). BHB and triglyceride ↑ from T1 to T2 in all groups ($P\leq0.09$).
- Insulin ↑ from T1 to T2 (glucose, glucose + galactose $P\leq0.09$) whereas glucagon ↑ at T2 (xylose and gluose, $P\leq0.08$) and T3 (all sugars, $P\leq0.06$) compared with T1.
- **Take-home** – Insulin response differs (it's greater) for calves fed glucose + galactose despite glucose concentrations being similar between glucose + galactose and the lactose only fed calves. "Xylose is absorbed but not metabolized" missing post-meal insulin response and increased glucagon concentration. "Lactose and galactose provide longer lasting carbohydrate source intermediary metabolism."

2416. *Effects of acepromazine maleate on glucose metabolism in 12-week-old dairy heifers*. Blair et al., LSU.

- Acepromazine maleate (ACE) is a common tranquilizer used in veterinary medicine. This research explored its use as a chemical restraint during metabolic research procedures. Holstein heifers between 12 and 15 wk old (n=10) were pretreated with ACE (0.02 mg/kg BW, IV) or saline control 30 min prior intravenous insulin tolerance test or intravenous glucose tolerance test.
- In the insulin test, calves received an IV bolus of 75 mIU/kg of BW of insulin followed by serial blood sampling every 10 min (-10 to 60 min) relative to insulin infusion. Blood glucose immediately measured → ACE did not alter glucose response to insulin.
- 24 hr later ACE was re-administered and this time the calves underwent an intravenous glucose tolerance blood sampling every 5 to 10 min (-30 to 35 min) relative glucose infusion.
- After a 7-d washout blood samples pulled (control vs. ACE) → NSD for total area under the curve and area of positive peaks.
- **Take-home** – "these findings suggest that ACE may be used as an acceptable form of chemical restraint during either intravenous insulin tolerance tests or intravenous glucose tolerance tests w/o significant interference in the response to treatment."

## Vitamins and trace minerals (4 abstracts)

2151. *Health and growth of preweaning Holstein cross calves fed varying amounts of B vitamins in milk replacer*. Brost et. al. U Illinois

- Holstein x Angus calves were assigned one of three CMR trts: basal CMR w/ no added B-vit (CON), CMR w/ B vit above basal (BP), and CMR w/ B vit above NASEM (NP).

| Trt | $B_1$, mg/kg | $B_3$, mg/kg | $B_6$, mg/kg | $B_{12}$, µm /kg |
|---|---|---|---|---|
| BP | 4.27 | 3.86 | 0.54 | 18 |
| NP | 28.8 | 18.6 | 9.17 | 254 |

- CMR fed in a step-up step-down protocol peaking at 2.5 lbs./d and weaned at 56 d. Starter offered ad lib on d 43. Health scores and CMR intake recorded 2x/d, starter intake, attitude score, and fecal intake daily, and frame growth and BW weekly through d 56.

- BP supplemented calves ↑ wk 1-8 BW, ADG, hip height, and withers height (P≤0.07) calves vs. control calves. NP supplemented calves ↓ body length vs. control (P=0.01).
- NP ↑ wk 7-8 starter intake vs. control (P=0.03) while CMR intake did not differ.
- NP ↑ d w/ ocular events wk 1-8 vs. control (P=0.05).
- BP and NP ↓ electrolytes used during scours and/or fever in wks 1-3 vs. control (P≤0.06). BP ↑ d with abnormal colored feces vs. control (P=0.04). NSD of trt on attitude and coprophagia.
- Authors caution – "final BW did not differ, and few health benefits were observed."
- **Take-home** – "greater growth" was noted when the lower levels of B-vits were supplemented, and to a lesser extent the higher levels. "This, combined with greater starter DMI, may suggest improved calf well-being and digestive tract maturity with added B vitamins. Increasing B-vitamin addition above NASEM levels provided no additional benefit"

2161. *B-vitamin-related metabolites in plasma from calves fed milk replacers varying in B vitamin concentrations*. Brost et. al. U Illinois.

- Experiment the same as 2151, reporting metabolites from blood samples drawn from n=36 calves on d 0, 8, 15, 29, and 43 (composited). 51 metabolites related to B vit were analyzed.
- Ile, 3-methylhippuric acid, 2,4-dimethyl nicotinic acid, and glycine ↑ for BP vs. control (P<0.10). His-Ile, Trp, pyroglu-Val, thyroxine, nicotinamide riboside cation, Asp-Pro, and Gly-Pro ↓ for BP vs. control (P<0.10).
- Ile, taurocholic acid, Met, sarcosine, urate, and pyroglu-Trp ↑ for NP vs. control (P<0.10). No metabolites ↓ for NP vs. control.
- **Take-home**: Authors hypothesized that "greater metabolites may indicate added B vitamins are available for metabolism of proteins, fatty acids, and carbohydrates. However, lower metabolite concentrations may suggest utilization by the animal, potentially contributing to improved growth and health."

*2348*. *Liver gene expression profiles in Holstein cross calves fed various concentrations of B vitamins*. Brost et al. U Illinois.

- Experiment the same as 2151. Liver biopsies performed on n=15 calves at 39 d of study.
- NP ↓ liver *IL-10*, *NFKB*, *SLC19A2*, and *BHMT2* (P≤0.10) vs. CON → immunity, inflammation, thiamine transport, methionine production. NP ↑ liver *CAT* and *SHMT* → antioxidant, cell growth and DNA synthesis. NSD of BP vs. CON for target genes.
- **Take-home** – Feeding B-vitamins above NASEM levels might benefit beef x dairy calf immune function and metabolism in the liver.

2395. *Performance and health of dairy calves fed organic vs. sulfate trace mineral forms in milk replacer during the pre- and post-weaning periods*. Lopez-Bondarchuk et al. UVT, Mapleview Agri.

- Two experiments were conducted w/ same trt: CMR w/ inorganic (sulfate) or organic (Zinpro) sources of Zn, Mn, Cu, and Fe.

| Exp | Trt | Zn, ppm | Mn, ppm | Cu, ppm | Fe, ppm |
|---|---|---|---|---|---|
| 1 | Inorganic | 83.9 | 81.5 | 1.26 | 93.5 |
| 1 | Organic | 65 | 65 | 4.45 | 93.1 |
| 2 | Inorganic | 73.5 | 51.9 | 3.47 | 85.1 |
| 2 | Organic | 74.2 | 64.7 | 4.66 | 93.6 |

- Exp 1 (UVT): n=43 calves (25 M/18 F) and Exp 2 (Mapleview Agri) n= 127 male calves. In both, calves individually housed indoors, fed 7 L/d CMR (Exp 1 = 27:10, Exp 2 = 24:20) then 3.5 L/d (weaning, 63 to 70 d or 56 to 64 d). Weekly BW, calf starter intake, serum metabolites and TM status, liver TM status, and health were monitored in both studies.
- Exp 1: NSD of trt on BW, ADG, starter intake, feed efficiency, or serum TM status. No effect on serum metabolites except potassium ($P<0.05$).
- Exp 2: NSD of trt on BW, ADG, starter intake, feed efficiency, or serum or liver TM status. NSD in incidence of BRD or enteric disease. NSD in serum metabolites except urea ($P<0.05$, ↑ for organic TM).
- **Take-home** – No effect in either study on health, performance, serum or liver concentrations of trace minerals or in most blood metabolites from substituting sulfate Zn, Mn, Cu, and Fe sources for Zinpro TM's in CMR.

**Maternal-fetal (46 abstracts)**

**Genetics (7 abstracts)**

*1249. Preliminary genetic parameters for metabolizable energy intake, metabolic body weight, and average daily gain in Holstein calves.* Phillips et al. U Guelph.

- Daily feed intake records (n=44,512) were collected from n=908 calves to employ two models to (1) estimate genetic parameters and variance of daily metabolizable energy intake (MEI) and (2) establish correlations between MEI, metabolic BW, and ADG pre- and post-weaning.
- MEI heritability = 0.16 ± 0.03; repeatability = 0.45 ± 0.02; genetic correlation -0.39 to 0.99 likely depending on stage of gut maturation.
- Heritability for MEI, MBW, and ADG = 0.33, 0.54, and 0.20 pre-weaning; 0.38, 0.51, and 0.20 post-weaning. Positive correlation for MEI and MBW (0.72), MEI and ADG (0.86), and MBW and ADG (0.76) pre-weaning → lower post-weaning (0.44, 0.45, and 0.72)
- **Take-home**: Study helps understand the relationship between typical calf feed efficiency metrics and traits in both pre- and post-weaning.

*2641. Genetic parameters for birth weight, weaning weight, average daily gain, and serum total protein in Holstein calves.* Rott et al. U of MN.

- Holstein calves (n=3,966) born 2003 to 2023 and raised in southern MN were assessed for the heritability 4 traits: birth BW, weaning (56 ± 2 d)BW, ADG, and STP.
- Birth BW: mean = 38.7 ± 4.3 kg, heritability = 0.69 ± 0.03. Genetic correlation w/ weaning BW = 0.79, w/ ADG = 0.49, and w/ STP = -0.18.
- Weaning BW: mean = 76.4 ± 9.6 kg, heritability = 0.62 ± 0.06. Genetic correlation w/ ADG = 0.97, w/ STP = -0.13.
- ADG: mean = 0.67 ± 0.14 kg/d, heritablity = 0.39 ± 0.06. Genetic correlation w/ STP = 0.47.
- STP: mean = 5.74 ± 0.83 g/dL, heritablity = 0.13 ± 0.03
- **Take-home**: There is genetic variation for growth and intake traits which can be used to make management decisions for efficient, healthy dairy calves.

*1568. Genetic analysis of feed efficiency in Holsteins: From calves to lactating cows.* Hermisdorff et al. U Guelph.

- Feed intake and feed efficiency were estimated from calf (n=792) and first-lactation cow (n=708) data (n=443 both stages). Feed intake was MEI1 (wk 1 to 3, ad lib CMR) or MEI2 (wk 7 to 9, i.e. starter) for calves and DMI (wk 9 to 44) for cows. Feed efficiency = residual intake (RMEI calves, RFI cows)
- Genetic correlations: mod for MEI2 vs. DMI (0.54±0.15) and RFI (0.48±0.21) but low for MEI1 vs. DMI and RFI (≤0.12). mod. for RMEI2 vs. RFI (0.64±0.34) but low for RMEI1 vs. RFI (-0.37)
- **Take-home**: The weak associations of “wet-calf” and moderate associations of weaned calf feed efficiency with 1$^{st}$ lactation outcomes are likely due to stage of rumen development.

*1412. Colostrum yield is associated with cows’ performance in subsequent lactation and udder conformation indexes in Italian Holsteins.* Costa et al. U Bologna

- Assessed correlations of colostrum yield (CY) with milk yield and protein content (15-60 DIM, peak, and first 150 DIM) and official genomic indices of n=2,280 cows. Model included parity, season, and IgG class (low, med-low, med-high, and high → <3, 3-4, 4-6, and >6 L).

- All three milk tests affected by CY: highest milk yield and lowest protein content w/ high CY.
- Genomic indices (n=215 records) associated with CY: aggregate udder index (-0.28) and conformation index (morphology, udder support, depth, and attachment -0.22 to -0.27).
- **Take-home**: Could dam's "colostrability" be selected through genomic indices?

*1413. Advancing dairy calf health: Integrating diarrhea and respiratory health information into US national genetic evaluation.* Neupane et al. AGIL-ARS-USDA

- All-breed calf records for diarrhea (n=207,602, 3-60 d of age) and BRD (n=681,741, 3-365 d of age) were analyzed to develop a US genetic evaluation for calf health traits (binary).
- Incidence rate = 14.5% diarrhea, 16.1% BRD, Jersey ↑ risk vs. Holstein. Median age = 10 d diarrhea, 68 d BRD. Heritability = 0.025 diarrhea, 0.021 BRD.
- Reliability of genomic PTA > traditional PTA, and younger sires had high reliability estimates → potential genetic improvements in calf health.
- Genetic correlation for diarrhea vs. BRD = 0.22. Correlation w/heifer livability = 0.13 diarrhea, 0.35 BRD. All other health trait correlations were low.
- **Take-home**: It's feasible to include diarrhea and BRD records in the US genetic evaluation system to potentially enhance calf health through genomic selection.

*1414. Introduction of calf health traits into Canadian genetic evaluations for Holsteins.* Lynch et al. Lactanet

- Same basic strategy as 1413 but for Canada (available starting Aug 2025, part of national selection indexes April 2026). Holstein calf records for diarrhea (n=130,027) and BRD (n=316,932) were analyzed.
- Incidence rate = 21.1% diarrhea, 19.5% BRD, Heritability = 0.044 diarrhea, 0.054 BRD.
- No genetic trend of sires → direct selection on calf disease traits
- Genetic correlation for diarrhea vs. BRD = 0.53. All other health trait correlations were low.
- **Take-home**: Lactanet proposing index weighting of 70% for diarrhea and 30% for BRD due to economics, mortality rates and role of diarrhea as pre-cursor to BRD.

*2636. Assessing the genomic relationship of beef-on-dairy calves in Canada.* Lopes et al. U Guelph.
**see Non-replacement calves → Beef x dairy**

**Maternal contributions to calf outcomes (14 abstracts)**

*1245. Characterization of maternal and fetal vitamin D metabolism during pregnancy in Holstein cows.* Martin et al. UF

- Holstein dams (n=6/trt) were supplemented in a 2x2 factorial: vitamin D form (cholecalciferol vs. calcidiol) and dose (0.2 vs. 1 mg) at 42 to 96 d gestation
- Maternal blood collected at d 0 and 35 of trt, slaughtered on d 36 for plasma (fetal) and renal tissue (fetal and maternal) for vit D metabolites and renal gene expression
- Calcidiol ↑ maternal and fetal 25(OH)$D_3$; calcidiol x 1 mg dose ↑ maternal 1,25$(OH)_2D_3$ and fetal 24,25$(OH)_2D_3$ ($P \leq 0.03$).
- Calcidiol x 1 mg dose ↓ fetal expression of kidney *CYP27B1* (vit D enzyme); NSD for maternal.
- **Take-home**: Dam-supplemented calcidiol more strongly impacted vitamin D metabolism in a dose-dependent manner compared to cholecalciferol.

1250. *Blood epigenetic signatures of early-life nutrition in dairy calves: Exploring the implications on immune system.* Costa Monteiro Moreira et al. Université Paris Saclay

- Heifers (n=10+) were fed to target optimal (OPT, 1,000 g/d) or conventional (CON, 800 g/d) ADG, and blood was collected at 1, 6, 9, 12, and 18 mo of age over 1st and 2nd generations (G1 and G2) for methylation analysis of OPT vs. CON at (i) 6 mo G1, (ii) 9 mo G1, and (iii) 6 mo G2.
- 333 differentially methylated cytosines shared for i. and ii (persist over age), 169 DMCs shared for i. and iii. (persist over generations), and 77 DMCs for all three.
- Among the 77 DMCs: hypermethylated DMC in *F2RL1* gene (inflammation and immunity) and hypomethylated DMC in *OSBPL3* gene (lipid metabolism)
- **Take-home**: Study contributes to knowledge base of epigenetic regulation of early-life nutrition on immune and metabolic pathways.

2040. *Prepartum anti-inflammatory treatment effect on calf type1/type2 immunity ratio using a rapid blood test.* Sorto et al. PSU

- Prepartum dams treated w/ 125 g/d acetylsalicylic acid (ASA) or control (PLC) 14 d before expected calving, and calves from each group (ASA-CLF=43, PLC-CLF=41) had blood pulled at 3, 7, 14, 21, and 28 d to assess type1/type 2 immunity ratio w/ the D2Dx test.
- At 3 d old, ASA-CLF ↑ type1/type2 immunity ratio vs. PLC-CLF (0.08 vs. 0.06, P<0.001). NSD of trt on other days, but type1/type2 immunity ratio ↓ over time.
- **Take-home**: Supplementing dams with an anti-inflammatory before calving alters neonatal calf immunity.

2402. *The gastrointestinal microbial communities of weaned bull calves are negatively impacted by dam nutrient restriction during late gestation.* Costello et al. UW-Madison

- Bull calves born from nutrient-restricted (LE, n=11) or high-energy fed dams (HE, n=5) were euthanized for GIT samples at 67 to 73 d of age after weaning at 48 d w/ a texturized starter.
- HE calves ↑ large intestine microbial diversity but ↓ abomasal community diversity (P<0.05).
- In the rumen, cecal, or large intestine digesta, HE ↑ abundance of *Methanobrevibacter*, *Eubacterium coprostanoligenes*, and *Monoglobus* (P<0.01) but ↓ abundance of *Bifidobacterium* in rumen, cecum, and abomasum.
- In the rumen digesta, HE ↑ expression of FA biosynthesis genes but ↓ expression of abx-resistance genes (P<0.05).
- **Take-home**: Maternal nutrient restriction impacts offspring GIT function and microbiome after weaning.

2749. *Effects of maternal dietary energy during late gestation in Holsteins on changes in growth, intake, and methane emissions of female offspring from birth until lactation*. Wu et al. UW-Madison

- Multiparous Holstein cows (n=80) received either high-energy or low energy rations (1.82 vs. 1.57 Mcal/kg of DM, respectively) during late gestation. Calves (n=18/trt, female) were monitored from birth to 1st lactation measuring BW and dimensions, enteric methane emissions at 6, 12, and 18 mo of age and at 35, 65, 110 and 250 ±10 DIM.
- NSD between dam trt on calf BW or dimensions were noted.
- NSD between dam trt on heifer methane emissions (methane production, residual methane intensity or residual methane yield, P>0.70), but a time effect whereby residual methane

yield ↑ correlation at later stages (between 12 and 18 mo) → residual methane yield fluctuates over time, particularly in early growth phases.
- **Take-home** – no differences occur between high and low energy late gestation maternal diets in how they affect offspring growth or methane emissions.

*1248. Effect of in utero heat stress and rumen-protected choline on Holstein heifer development.* de Bari et al. UF.

- Late-gestation dams (n=15-19/trt) enrolled in 2x2 factorial: rumen protected choline (RPC) vs. not and heat-stressed or cooled (shade vs. shade, fans and soakers). Calves (n=6-9/trt) managed similarly then euthanized at 60 ± 13 d for organ collection.
- Heat stress ↓ gestation length, calf birth BW, ovary and thymus weight ($P \leq 0.07$), ↑ adrenal weight. NSD of RPC main effect on outcomes (incl. colostrum yield).
- **Take-home**: In utero heat stress impairs calf whole body- and organ growth, and while RPC does not mitigate the effects, it could be contributing to epigenetics.

*2658. In utero heat stress affects the ovarian proteome of dairy calves at weaning.* Butenko et al. Volcani Institute.

- Dams were heat-stressed (shade) or cooled (shade, fans, soakers) during 56-d dry period, calves were born as either IUHT or IUCL (n=8/trt), managed similarly, then euthanized 1 wk post-weaning to harvest ovaries for proteomic analysis (n=5/trt).
- Total of 8,327 proteins ID'ed w/ 145 proteins differentially abundant in IUCL vs. IUHT ovaries.
- Proteins of interest (related to ovarian function): IUCL ↑ PDK4 (fold change = 1.80; delays oocyte aging and improves mitochondrial activity) and CDH1 (FC=1.23, $P \leq 0.04$; establishes germ cells and oocyte growth) vs. IUHT.
- IUCL ↓ AHR (FC=-1.83; cell response to oxidative stress) and ARG1 (FC=-6.01, $P \leq 0.04$; modulates nitric oxide availability) vs. IUHT → upregulation in IUHT could indicate production of reactive oxygen species.
- **Take-home**: This study describes the ovarian proteome of dairy calves and highlights the impact of intrauterine insult (i.e., heat stress) on ovarian function and oxidative stress.

*2672. Effects of prenatal heat stress on dairy heifer calf birth weight in a humid continental climate.* Brower et al. U Guelph.

- Dams (n=66) were enrolled during close-up dry period (-21 d) in May to Aug 2024, and calves were weighed at 0-3 d of age to run regression analysis for impact of THI on calf birth BW in a continental climate.
- Loggers measured 1-min interval ambient temp and relative humidity to calculate THI during close-up period (avg daily THI, max THI, and h/d where THI > 62, 65, 68, or 72).
- Averages: daily THI = 67, max THI = 73, h/d above THI thresholds = 19, 16, 12, and 6 hrs. Calf birth BW = 42 kg.
- For every 1-unit ↑ in daily or max THI, calf birth BW ↓ 0.77 or 0.90 kg ($P<0.01$), and for every 1-hr ↑ in time THI exceeded thresholds, calf birth BW ↓ 0.4, 0.4, 0.5, and 0.9 kg ($P<0.03$).
- **Take-home**: In a climate with more intermittent heat stress, calf birth body weight is still impacted by dam exposure to elevated temp or extended higher temps.

*1247. Third-generation impacts of heat stress on mammary gland growth and development.* Larsen et al. UW-Madison.

- Late-gestation heat stress impacts dams ($F_0$) and offspring ($F_1$, $F_2$) – what about $F_3$? Dams (n=82) heat-stress or cooled last 54 d of gestation → $F_1$ (n=36-37/trt) and $F_2$ (n=12-17/trt) managed similarly → $F_3$ (n=9-10/trt) born and raised to 70 d.
- Growth and external MG measures (i.e., teat length and teat distance) taken 1, 28, 56 and 70 d. MG ultrasound on 28 and 70 d for mPAR and mFP area, MG biopsy at 70 d.
- NSD in growth measures and external and ultrasound MG measures (P>0.20). Heat-stressed $F_3$ calves ↑ non-luminal structures, ↓ luminal area, ↓ cell proliferation in d 70 mPAR.
- **Take-home**: This study provides evidence that some stressors, like heat stress, are truly transgenerational, emphasizing importance for maternal heat abatement.

*2676. Maternal late gestation heat stress modifies skin characteristics of great-granddaughters.* Davidson et al. UW-Madison.

- Same experiment as 1247, now assessing $F_3$ (n=6/trt) heifers' hair and skin biopsies at 70 d.
- NSD for trt on hair length or diameters, epidermis thickness or area, depth of shallow sweat glands, number and size of sweat glands, depth of sebaceous glands, or dermis thickness.
- HT $F_3$ heifers w/ fewer and smaller sebaceous glands (P≤0.02) and a tendency for shorter distance from skin surface to deepest sweat glands (P=0.07) vs. CL $F_3$ heifers.
- **Take-home**: Thermoregulatory mechanisms, including skin characteristics, may be impacted transgenerationally after in utero heat stress exposure.

*1541. Effects of prepartum dam characteristics on colostrum and heifer calf development.* Wang et al. Wageningen

- Dams (n=62) monitored 4 wk preconception to parturition (stages: preconception; 1st, 2nd, 3rd trimester) and their offspring monitored birth to 100 DIM (stages: weaning, rearing, 100 DIM) with dam, calf, and colostrum variables in linear regression model per life stage.
- ↑ milk lactose (preconception, 1st, 2nd trimester) = higher offspring BW at rearing and 100 DIM.
- ↑ BCS (3rd trimester) = ↓ [] lactoferrin, IGF1, and TGFβ in colostrum = ↓ offspring weaning NEFA
- ↑ DMI and energy balance (prepartum) = ↑ colostrum antibodies = ↑ offspring plasma antibodies at weaning and rearing.
- **Take-home**: Colostrum was an intermediary in the dam variable to offspring variable relationships.

*2327. Association of maternal experience and morbidity with daughter performance in dairy cows.* Akbar et al. U of Lahore.

- Retrospective data from Holstein heifers (n=216, 2016-2023) was assessed for maternal characteristics: parity (1st, 2nd, and 3rd+ lactation; P1, P2, P3) and morbidity (clinical disease after calving but before next pregnancy or not). Heifer morbidity up to 120 d of age, BW, repro, and 1st lactation performance also recorded.
- Heifers from P1/P2 dams ↑ BW from 11 to 17 mo, ↑ pregnancy % and time to pregnancy vs. heifers from P3 dams (P≤0.05).
- Heifers from dams w/ postpartum morbidity ↓ BW and hazard or pregnancy (P<0.01) but NSD on calf morbidity, milk yield or 1st lactation repro.

- Early-life calf morbidity ↑ morbidity up to 300 DIM (72% vs. 36% if no 120-d morbidity), survivability (22 vs. 7% leaving herd), pregnancy rate/hazard of pregnancy → extended days open during 1st lactation (P=0.03). But NSD on BW, heifer repro, or 1st lactation milk yield.
- **Take-home**: In this cohort, dam morbidity and early-life heifer morbidity greatly impacted heifer performance and heifers from younger dams performed better.

*1529. Impact of in vitro embryo production on the performance of the next generation of dairy cows*. Lafointaine et al. UQAT Notre-Dame-du-Nord.

- Retrospective cohort study (n=317,888 animals, n=601,939 lactation records) to compare IVF-derived cows vs. cows conceived via artificial insemination (AI).
- NSD for milk production over 3 lactations, but IVF cows slightly ↓ fertility, ↑ gestation, distinct disease incidence patterns.
- IVF ↓ genetic improvement (2012-2019) by half vs. AI → potential "epigenetic penalty"
- **Take-home**: This study underscores the challenges and progress in IVF to minimize epigenetic dysregulation.

*1258. Transmission of gut virome in cow/environment-to-calf model and its regulatory influence on the microbiome*. Zhao et al. China Ag University. **see Physiology → Gut and gut microbiome**

## Colostrum, colostrum replacers, and transition milk (25 abstracts)

*2675. Precalving nutritional factors affecting colostrum quality and yield in Eastern Canadian dairy herds*. Fischer-Tlustos et al. U Montreal.

- Multiparous cows (n=364, n=51 herds) were blood sampled at -33 to 0 d pre-calving and colostrum samples were collected to determine metabolic, demographic, and management factors impacting colostrum IgG content.
- Colostrum yield = 5.9 ± 3.9 kg, IgG = 56.1 ± 23.7 ng/mL and Brix = 24 ± 5%, w/ IgG and Brix leading to same final model. Models including diet, cow, and herd management factors above explained 34-47% of colostrum yield, IgG, and Brix variability.
- Plasma NEFA, time to calving, and first milking + correlated to colostrum yield. Longer dry period length (>65 vs. <51 d; 6.7 vs. 5.7 kg, P=0.08), ↑ dietary energy, and ↓ pre-partum fiber, ash, and certain minerals ↑ colostrum yield (P<0.05).
- Mineral and protein supplements – correlated w/ colostral IgG, commercial energy supplements + correlated (P<0.01). ↓ time to colostrum harvest = ↑ colostral IgG (P<0.01).
- **Take-home**: Management factors and nutrient profiles can partially explain variability in colostrum and IgG yield.

*2012. Characterization of dry-period mammary acetate and glucose metabolism and their association with colostrum production in multiparous Holstein cattle*. Fischer-Tlustos et al. U Guelph

- Cows (n=11 2nd parity, n=10 3rd parity) were followed every 4-14 d from dry period (58 d pre-calving) to calving to assess the impact of mammary acetate and glucose on colostrum yield.
- Mammary acetate and glucose arteriovenous difference/uptake and serum acetate and glucose were measured (tail + milk vein serum samples, Doppler ultrasound for blood flow).
- Mammary acetate uptake ↑ 1 wk pre-calving, glucose ↑ @ calving.

- Far-off mammary acetate uptake and previous lact peak milk ↓ colostrum yield ($R^2$ = 0.10, 0.36, linear term = -0.14, -0.29, P≤0.06). Also negative correlation between far-off acetate and colostrum yield (r=-0.54 to -0.70), but no relationship with close-up acetate.
- **Take-home**: Acetate may impact mammary development and colostrum production, particularly far-off (focus on dry period length).

2149. *Encapsulated magnesium butyrate influences dairy cow colostrum composition and may facilitate IgG absorption in the neonatal calf*. Bach et. al. U of Lleida, ICREA

- Holstein cows (n=167; multiparous) fed TMR (1.2 Mcal NEL/kg, 54.5% NDF, 13% CP) w/ MgB encapsulated magnesium butyrate (Rumen-Ready, Palital Feed Additives) at either a.) 0 g/cow/d, b.) 100 g/cow/day, or c.) 150 g/cow/day until calving.
- Colostrum volume and composition were measured. Each calf (n=141) was fed 4 L of colostrum from a cow on the same trt as its dam and intake recorded. Calf BW measured and 24 hr serum concentrations of IgG, insulin, and glucose were determined.
- NSD of trt on calf birth BW (90.2 ±1.8 lbs.), colostrum yield, colostrum IgG yield, colostrum protein, colostrum intake, serum IgG, serum insulin, or %AEA of IgG.
- MgB ↓ colostrum IgG conc. (121.0, 101.2, 108.3 mg/mL for 0, 100, and 150 g, P=0.03), tended to ↓ IgG intake (443, 388, 379 g, P=0.08), and ↑ colostrum fat %, colostrum insulin, and insulin intake (P<0.01).
- Serum IgG (r=0.41) and AEA of IgG (r=0.28) were positively correlated with insulin intake.
- **Take-home** – supplementation of encapsulated magnesium butyrate to the dam during dry period decreased colostrum IgG concentration and decreased IgG intake by the calf. It also increased insulin intake which may be positively linked to %AEA of IgG.

2400. *The effects of graded amounts of nicotinic acid on primiparous cow health, colostrum yield and quality of prepartum multiparous Jersey cows and growth in their subsequent calves*. Valentine and Erickson. UNH.

- Multiparous Jersey cows (n=30) were fed 0, 8, or 16 g/d of nicotinic acid in a -40 DCAD diet starting 28 d prior expected calving date. Cows sampled weekly for urine, blood, and BW.
- Calves (n=27) removed before suckling, weighed and blood sampled for serum IgG within 30 m of birth, enrolled if dam produced ≥2 L colostrum. Calf BW measured 1x/wk until 42 d.
- NSD in dam prepartum BW (542, 541, and 538 kg, for 0, 8, and 16 g/d) or postpartum cow BW (535, 536, and 533 kg).
- Quadratic effect of trt for prepartum and postpartum ketone conc w/ ↓ value at 8 g/d trt (prepartum 0.54, 0.42, and 0.61; postpartum 0.52, 0.44, and 0.58 mmol/L; P<0.04)
- NSD in colostrum yield, colostrum Brix, initial and weekly BW, and skeletal measurements. There was trend for quadratic effect on calf blood ketone conc w/ ↓ value at 8 g/d trt
- **Take-home** – a correct dosage has not been determined.

2609. *Association of colostrum yield, immunoglobulin, and mineral concentrations with dyscalcemia in multiparous Holsteins*. Gottwald and McArt. Cornell.

- Colostrum was harvested within 8 hr of calving in multiparous Holstein cows (n=45). Colostrum was weighed and analyzed for IgG & mineral concentrations.
- Dam blood samples were collected at 4 days in milk and tested for calcium and classified as Eucalcemic (n=33; total Ca ≥2.2 mmol/L) or Dyscalcemic (n=12; total Ca <2.2 mmol/L).

- Dyscalcemic cows produced ↓ colostrum (-5.1 lbs., P=0.30) and ↑ IgG concentration (+15 g/L, P=0.09vs. eucalcemic counterparts controlling for parity and calf BW
- Dyscalcemic cows produced colostrum with 15 g/L more (P=0.09) IgG than eucalcemic counterparts.
- Dyscalcemic cows produced colostrum with higher concentration of Mg, K, Cu, and Fe when controlling for parity and colostrum yield.
- **Take-home** – Dyscalcemic (lower blood calcium) cows produced numerically less colostrum with higher concentrations of IgG and several minerals but not calcium.

*2649. Immunoglobulin G accumulation during the prepartum period in the individual mammary glands of Holstein cows.* Klein et al. U Guelph

- To determine if quarter-specific IgG accumulation indicates colostrum IgG content, prepartum mammary secretions were collected from dry Holstein cows (n=19, dry at -58 d from calving) by stripping each quarter biweekly from -35 to -7 d then every 2 d until calving.
- Individual quarter colostrum was then collected w/in 1.4 hrs post-calving. All samples were tested for IgG using a radial diffusion assay.
- NSD between quarters for pre- or postpartum IgG concentration, but there was a time effect where IgG was lowest at d -35 (26 g/L) and greatest at d -5 (176 g/L), declining by ~50% in colostrum (85 g/L, P<0.001).
- Avg IgG in prepartum secretions was moderately correlated to colostral IgG (r=0.39 to 0.56).
- **Take-home**: Quarter-specific IgG is not a good indicator of quarter-specific colostrum quality, but this study helps identify key time windows for better IgG content.

1400. *Does a supraphysiological oxytocin injection after parturition affect blood-milk-barrier closure and IgG transfer into milk in dairy cows?* Kessler et al. U Bern.

- Multiparous Holstein cows (n=28) were either, a.) given 50 IU oxytocin i.v. 30 min after the first milking, b.) injected 50 IU oxytocin i.v. 120 min before the second milking, or c.) untreated.
- Blood and milk samples collected at the first 2 milkings after parturition (6.7 hrs post-calving and 11.5 hrs later). Milk yields were recorded. Milk was analyzed for fat, protein, lactose, IgG, serum albumin, electrolytes, and lactate dehydrogenase activity. Blood plasma was measured for alpha-LA.
- In all trt, concentrations of protein, IgG, SA, and LDH in milk ↓ from $1^{st}$ to $2^{nd}$ milking (P>0.05). NSD on milk yield and fat content. Concentration of alpha-LA in plasma tended to ↓ over time
- "Treatment did not affect changes in blood and milk from $1^{st}$ to $2^{nd}$ milking."
- **Take-home** – a single injection of oxytocin either 30 min after the $1^{st}$ milking or 2 hrs prior the $2^{nd}$ milking did not retard the closure of the blood-milk-barrier in dairy cows. Oxytocin did not prolong IgG transport from blood to milk after the $1^{st}$ milking.

1403. *Impact of butyrate and monensin supplementation in colostrum on passive immunity transfer.* Keshavarz et. al. U Alberta

- Newborn male calves (n=36) received either a.) no CR and slaughtered at 1 hr of life, b.) 1.3 L of CR (200 g IgG) w/ 150 mg/kg BW acetaminophen, c.) trt (b) + 2.5% wt./vol sodium butyrate, or d.) trt (b) + 1 mg/kg BW monensin. The three trt were administered at 1 hr w/ slaughter at 12 hr of life. Saline standardized all CR's to 400 mOsm/kg osmolarity.

- Blood samples were taken every 30 min from 2 to 8 hr and hourly from 8 to 12 hr. Blood and tissues (i.e., small intestine [SI], liver) harvested at slaughter for analysis.
- NSD in serum IgG concentration between control, monensin, and butyrate groups (P=0.60).
- Control (no CR) calves ↓ SI villi to crypt ratio vs. other groups. Monensin ↓ SI villi length vs. CR w/ no supplement (P≤0.001). SI crypt depth ↑ in proximal and distal jejunum for calves fed CR w/ butyrate vs. monensin (P<0.05).
- Control calves ↑ liver glycogen (P<0.01) vs. other trt. NSD in abomasal emptying rate.
- Monensin ↑ max plasma acetaminophen conc (5.1 ±1.2 µg/mL), ↑ time to peak concentration (562.5 ±47 min) and ↑ acetaminophen recovery (P≤0.02).
- Take-home – "...although serum IgG levels remained unchanged, monensin treatment showed signs of delayed intestinal maturation."

2171. *Differences in colostrum and milk replacer supply influence gastrointestinal permeability in young Holstein calves*. Echeverry-Munera et. al. Trouw

- Male Holstein calves (n=180) enrolled in 2 x 2 factorial: fed either 2 L (Failure; 100 g of IgG) or 6 L (Successful; 300 g of IgG) of CR then assigned to either a.) moderate (0.25 Mcal of ME/kg of arrival $BW^{0.75}$) or b.) low (0.135 Mcal of ME/kg of arrival $BW^{0.75}$) CMR intake [fail x mod, fail x low, success x mod, success x low, n=45/trt]
- Calves individually housed, fed 2x/d until d 42 and gradually weaned over 2 weeks (d 57). Ad lib access to straw and from d 22 onward ad lib pelleted calf starter. GIT permeability assessed wk 3, 6, and 12 via oral dose Cr-EDTA (n=15/trt).
- At wk 3, success x mod calves ↓ serum chromium values and area under the curve (P=0.05) while success x low ↑ chromium area under the curve and peak chromium concentration (P=0.04). Shorter time to peak serum chromium concentration for "successful" calves vs. "failure" calves.
- Time effect: chromium area under the curve, max chromium and the time to peak chromium were affected by age (P<0.01) w/ ↑ values at 3 wks.
- **Take-home** – "colostrum and CMR feeding supply can influence gut permeability in young calves, with potential implications for nutrient absorption and gut barrier function." "Permeability follows developmental decline, with treatment effects becoming less pronounced with age."

1402. *Effects of feeding colostrum volumes proportional to birth body weight on efficiency of IgG absorption and gastric emptying in Holstein calves*. Frederick et al. Cornell

- Female Holstein calves (n=88) received colostrum volumes at either 6, 8, 10, or 12% of their birth BW and a subset (n=32) received colostrum with a gastric emptying marker acetaminophen (ACE) at 150 mg/kg metabolic BW.
- Colostrum administered at ≤2 h after birth via esophageal tube feeder. Blood was collected prior feeding and then at 2, 4, 6, 8, 10, and 48 hrs. ACE conc. were determined via colorimetric assay. IgG conc. was measured using RID and AEA of IgG was calculated at 24 hr.
- Mean birth BW = 88.1 lbs. Median pooled Brix value = 24.2%, IgG concentration = 86.7 g/L, median colostrum volumes = 2.3, 3.1, 4.0, and 4.8 L (for 6, 8, 10, and 12% BW).
- 24-hr serum IgG peaked at 10 and12%: 28.8, 37.4, 41.1 and 43.4 g/L
- AEA % was highest at 6 and 8% then declined: 47.8, 46.2, 41.0, and 36.3%

- Plasma ACE ↑ in 6% vs. 12% calves (25.3 vs. 20.9) with NSD between other groups.
- **Take-home** – "feeding a single colostrum meal at 8% to 10% of birth BW within 2 h after birth optimizes IgG absorption. Feeding at 12% provides only slight increase in IgG and reduces AEA and gastric emptying."

*2229*. *Effects of colostrum feeding frequency on passive transfer immunity and growth in Holstein calves*. Murillo et al. U Idaho.

- Calves were fed >22% Brix pasteurized colostrum 1x (CF1, n=27, 3-4L) w/in 4 hr or2x (CF2, n=28, 1.5 to 2 L) w/in 10 hr and assessed for growth, health, and TPI.
- NSD of trt on BW, withers height, ADG (0 to 45 d), morbidity (18 vs. 15%), or mortality.
- CF2 ↑ STP (7.5 vs. 7.1 mg/dL) and Brix % (10.9 vs. 10.4%) at 3 d of age and had less of a rate of decline of STP to d 7 (7.4 vs. 6.5 mg/dL) compared with CF1.
- **Take-home**: A second feeding of colostrum did not influence early-life health or growth but improved PTI, though both trt groups' cutpoints were "Excellent" PTI.

*2390*. *Preliminary exploration of the effects of extended colostrum feeding on calf behavior, growth, and diarrhea*. Tipton et al. CSU.

- Holstein and Limousin cross calves (n=26) were fed 1st and 2nd feedings of 4L colostrum before enrollment in one of two trt: CMR + CR (COL, 44 g Premolac, ~14.5% Brix) or only CMR (CON, 12.2% Brix) for 14 d.
- Behavior (accelerometers @ 1, 2, 3, and 8 wks), health (fecal scores), and growth monitored.
- NSD of trt on lying time or bouts, 2-wk or pre-wean ADG, or diarrhea incidence (P >0.39).
- **Take-home**: In this study there were no health or growth benefits to extending colostrum through the typical diarrhea window using CMR.

1404. *Randomized clinical trial comparing doses of colostral IgG to maximize transfer of passive immunity in calves*. Hapukotuwa et al. U of Sydney Camden

- Cows were milked w/in 2 hr of calving, colostrum pooled, and pasteurized in 40-L batches. Calves fed a single 4L colostrum feeding at 2 hr after birth at varying IgG doses: 200 (n=45), 250 (n=125), 300 (n=123) or 350 (n=107) grams.
- Calf serum was collected at 48 h and tested for IgG using radial immunodiffusion (RID).
- Serum IgG ↑ linearly w/ higher IgG dose (24.8, 29.6, 32.5, and 36.5 g/L for 200, 250, 300, and 350 g colostral IgG).
- The maximum practically feasible dose of IgG was 320 g/calf when feeding 4 L of colostrum. 118 kg of IgG were shared among 368 calves and most colostrum batches (89%) would be able to deliver 320 g when accounting for batch concentration (282 – 482 g) and dose (≤4 L)
- **Take-home** – "Producers should aim to feed as much IgG as practically possible." It was feasible to feed a single dose of 320 g in 4 L within 2 h of birth on this farm.

1405. *Comparing the correlation between serum total solids and serum IgG in Holstein and Angus crossbred newborn calves*. Hapukotuwa et al. U of Sydney

- Continuation of abstract 1404, now comparing breeds (n=274 Holstein, n=126 Angus cross).
- Calf blood was tested via refractometer for serum total solids at 48 hr and RID for serum IgG.

- Mean serum IgG = 32.1 vs. 30.2 g/L (Holstein vs. Angus cross); mean serum total solids = 61.0 vs. 57.1 g/L. Holstein calves +3.1 g/L serum total solids vs. Angus cross after adjusting for colostrum dose, time to feeding, and volume fed. Serum IgG was similar.
- Area under the curve and cut-point analysis showed that "a lower cut point of >59 g/L may be necessary to predict a calf serum IgG ≥25 g/L for Angus X calves, compared with the >62 g/L recommendation proposed for Holsteins in the literature."
- **Take-home** – Angus X calves have a lower concentration of non-IgG proteins in serum.

*2329*. *Exploring the role of inflammatory microRNAs in bovine colostrum.* Peres Prietsch et al. TX Tech.

- Colostrum samples collected from n=10 multiparous Holstein cows w/in 4 hr post-calving for miRNA quantification of specific inflammatory primers.
- Top miRNAs identified: let-7a-5p and miR-21-5p (immune regulation during intramammary infection); miR-101-3p (calf development, neonatal immunity); miR-29 and miR-142 (lactation and mammary gland health).
- **Take-home**: Future studies should investigate how these miRNAs regulated pathways and how they may impact calf early-life programming and immune development.

1406. *Colostrum's role in shaping immune function in neonatal dairy calves*. Cid de la Paz et al. U of Wisconsin-Madison.

- Holstein calves (n=24) received either a.) fresh colostrum, b.) frozen colostrum, or c.) were deprived of colostrum. Colostrum (≥22% Brix) was fed at 8% BW w/in 3 hr of life and 6% BW at 8-12 hr. Calves deprived of colostrum were fed CMR (26:20). All received CMR thereafter.
- Blood samples were collected d 0, 2, 7, 14, and 28. $CD4^+$, $CD8^+$, γδ T cells, and memory marker CD45RO cells were measured.
- NSD between trt on d 0 and 2. On d 7 and 14, colostrum deprived calves ↓ γδ T cells (-14%) and ↑ $CD4^+$ T (+52%, +38%) and $CD8^+$ T (+37%, +26%) cells vs. colostrum fed calves (P=0.07).
- On d 28, calves provided fresh colostrum ↓ proportion of memory marker CD45RO in γδ T cells vs. those provided frozen colostrum (-28%, P=0.05).
- γδ T cells are the predominant lymphocyte subset in systemic circulation in neonatal calves, "but progressively decline over the first 6 mo of life."
- **Take-home** – depriving colostrum results in expansion of lymphocytes T-cells, I assume compensating for the missing IgG's while reducing activation of γδ T cells. Also, freezing colostrum enhanced earlier memory T cell development.

1407. *The effect of colostrum depravation on the gut microbial dynamics of beef-on-dairy calves*. Santos et al. TX Tech

- Newborn crossbred beef x dairy calves (n=24) were enrolled in 2 x 2 factorial design: either colostrum deprived or fed, and either were or were not orally inoculated w/ *Salmonella typhimurium* at 8 d of age
- Meconium samples were collected on all calves w/in 24 hrs of birth. At d 7, 8, 9, 10, 11, 14, and 21 rectal swabs were collected for metagenomics analysis.
- Colostrum deprived x inoculated ↓ microbial richness (Shannon Diversity) vs. colostrum fed x inoculated (P=0.02). ↑ abundance of *Fusobacterium mortiferum* and *Lachnospiraceae* in colostrum deprived calves (P<0.01), regardless of inoculation.

- *Firmicutes* and *Bacteroidetes* ↓ in colostrum deprived x inoculated calves after inoculation (P<0.01).
- **Take-home** – "colostrum feeding affects specific microbial taxa that influences gut health."

1600. *Intestinal integrity and inflammatory markers in neonatal beef x dairy calves exposed to* Salmonella *infection*. Migl et al. TX Tech

- Same experiment as 1407, now focusing on GIT gene expression. RNA extracted from ileum for gene expression analysis (RT-qPCR) and histological assessments.
- At 72 hr, post-inoculation, the colostrum-fed x inoculated calves tended ↑ *CLDN1* expression vs. control. NSD of trt on *CLDN4* expression.
- At 23 d age, colostrum-fed x non-inoculated ↑ *NFKB* expression vs. colostrum-deprived x non-inoculated (P=0.07). NSD of trt on *TNFα* or *IL10*.
- Epithelial necrosis, villi blunting, and absence of goblet cells occurred in ileum of colostrum-deprived vs. colostrum fed calves at 72 hr post inoculation.
- **Take-home** – Dairy x beef cross calves deprived of colostrum have systemic inflammation and epithelial damage.

1401. Effects of freezing on the microbiome of bovine colostrum from organic and conventional dairies. Miranda et al. Cal Poly Pomona; Western U.

- Colostrum samples (5 samples/100 cows, max 20 samples/dairy) collected at first milking from conventional (n=15; CA) and organic dairies (n=5; CA, CO, TX; 100-20,000 cows).
- Colostrum quality was measured by Brix refractometer. Then each sample was split, and one was processed immediately and the other frozen (-20 C) for a period of 24 to 122 h.
- From both samples, DNA was extracted and qPCR run on colostrum to determine bacterial abundance and characterize the microbial community. Aerobic plate counts compared bacterial concentrations.
- Organic dairy colostrum ↑ Brix vs. conventional dairies (P<0.01). The colostrum microbiome community varied significantly by dairy and dairy type (organic vs. conventional; P<0.01).
- NSD of freezing on the composition of the colostrum microbiome or the number of viable cells as measured by qPCR or aerobic plate counts.
- **Take-home** – "these findings suggest that freezing is a viable method for colostrum storage without altering its microbial composition or viability."

2163. *An analysis of colostrum products on the market in the United States and Japan*. Owada et. al. ZEN-NOH Ag Coop, Miner

- 16 different colostrum products labeled as "colostrum replacers" and sold in either the USA (n=7) or Japan (n=9) were divided into two types according to their ingredients: a.) colostrum powder (n=4) made by drying colostrum, or b.) colostrum mixed (n=12) made from multiple ingredients. IgG content was ≥60 g/unit in all products.
- All products were analyzed for fat, protein, minerals, fatty acids, amino acids, and vitamin A.
- Crude protein ranged from 42% to 60%, fat content from 10% to 20%, and IgG content per bag from 60 to 150 g.

*1180. Impact of early-life feeding strategies (including supplementing powdered colostrum the first 21 days) on growth and health in Holstein and crossbred calves.* Wang et al. U of Guelph. **see Nutrition → CMR milk feeding rates and strategies.**

*1598. Evaluating the effects of fat and colostrum supplementation in milk replacer on gut permeability, hematology, and performance of non-replacement calves*. Pisoni et al. U of Guelph **see Nutrition → Fats and oils nutrition.**

*1412. Colostrum yield is associated with cows' performance in subsequent lactation and udder conformation indexes in Italian Holsteins.* Costa et al. U Bologna **see Maternal-fetal → Genetics**

*1541. Effects of prepartum dam characteristics on colostrum and heifer calf development.* Wang et al. Wageningen **see Maternal-fetal → Maternal contributions to calf outcomes**

*2766. In vitro assessment of different types and fractions of colostrum as an additive to modulate rumen microbial fermentation after weaning.* Muñoz-Grein, et al. U de Zaragoza. **see Physiology → Rumen development**

**Health (37 abstracts)**

**Respiratory disease (BRD) (7 abstracts)**

*1251. Associations of preweaning lung consolidation on the periparturient peripheral leukocyte transcriptome in primiparous Holstein dairy cows.* Richmond et al. WSU

- Calves (n=121) were evaluated via lung ultrasonography until 12 wk, then managed similarly until 1st lactation cows (n=25) where they were divided retrospectively into "healthy" (no pre-weaning lung consolidation, n=10) or "chronic" (≥1 lung lobe consolidated for (≥3 wks, n=15).
- Leukocytes isolated from cow (DIM = ?) whole blood for RNA-sequencing and functional enrichment analysis (i.e. gene clusters)
- 1,370 upregulated and 786 downregulated DEG (chronic relative to healthy). Downregulated clusters (n=9) → cell migration and natural killer cell regulation. Upregulated clusters (n=27) → stress response signaling, proinflammatory cytokines
- **Take-home**: Pre-weaning disease could have long-lasting consequences and could influence how we manage transition cows.

*2037. Dairy calves from a lower-morbidity farm exhibit a more activated lung immune transcriptome in the preweaning period.* Jakes et al. CSU

- Broncheoalveolar lavage fluid (BALF) was collected from clinically healthy calves from a low BRD morbidity farm (n=10, 10%, LowM) and a high BRD morbidity farm (n=9, >20%, HighM) at unknown age for transcriptomic analysis.
- HighM calves ↑ 2.2x odds of developing clinical BRD pre-weaning and 6.2x odds of developing lung lesions detected via ultrasound (P≤0.06) vs. LowM
- LowM calves had 277 upregulated and 173 downregulated genes in BALF (FDR <0.05, fold change > 2). Differently expressed pathways upregulated in LowM included leukocyte migration, T cell activation, and cellular adhesions (*LCK*, *VCAM1*, *CCL5*).
- **Take-home**: Healthy calves from a farm with lower clinical BRD rates exhibited a lung immune transcriptome with more activation, potentially in pathogen defense (more farms should be tested).

*2052. Analysis of gene sets enriched with respiratory disease in Holstein calves.* Herrick et al. WSU.

- To identify genomic regions associated w/ BRD pre- and post-weaning, pre-weaned healthy control (n=3,681) and diseased (n=520) calves up to 60 d of age and post-weaned healthy (n=3,212) and diseased (n=2,016) aged 61 to 421 d of age were genotyped.
- Phospholipid metabolism gene set (n=86 leading edge genes) enriched in pre-weaning BRD (normalized enrichment score [NES] ≥ 3) 7 gene sets (n=162 leading edge genes) enriched in post-weaning BRD (NES ≥ 3) → immune cell development, cell communication, disease response, and inflammation.
- Leading edge gene *COL4A3BP* enriched for BRD in both pre- and post-weaning.
- **Take-home**: These gene sets can be used to better understand BRD mechanisms, resistance, and treatment at different heifer stages.

*2043. Computer vision for automated calf respiratory health scoring.* Xu and von Konigslow Cornell.

- Holstein heifer calves (n=100) were live BRD health scored 3x, followed by a facial picture for computer-vision automated BRD health scoring (80% training and 20% testing).

- The full pipeline was compared w/ other detection models → better classified BRD health indicators vs. baseline models.
- Ocular discharge automated scoring: F1-score=0.86, precision=0.87, recall=0.85; nasal discharge automated scoring: F1-score=0.88, precision=0.86, recall=0.89; ear posture classification: F1-score=0.82, precision=0.75, recall=0.90.
- **Take-home**: This computer vision detection could help objectively and efficiently ID BRD issues, improving calf health outcomes.

1300. *Exploring challenges and key outcomes for the diagnosis of respiratory disease in preweaning dairy calves: A mixed-methods analysis*. Churchill et al. U of Guelph.

- A pool of 12 global researchers w/ ≥25 relevant publications in the last 10 years on the topic of BRD diagnosis in pre-weaned calves were interviewed to "rank diagnostic methods and outcomes, suggest additional outcomes, and identify priority challenges for diagnosis."
- "... most acknowledged clinical scoring systems as faster" ... many also mentioned their "suboptimal accuracy."
- "When asked to prioritize diagnostic outcomes from the literatures," 100% ranked lung consolidation as the top priority, cough second (59%) with preference to spontaneous (42%) over induced (17%). Body temp (58%), nasal discharge (58%) and resting respiratory rate (50%) were also frequently mentioned.
- Experts also highlighted need for "clear, standardized instructions" and "importance of contextual factors (e.g., climate, facility type, and nearby calf comparison)."
- **Take-home** – experts "highlighted the value of combining lung ultrasound with clinical scoring systems to refine diagnosis and treatment decisions."

1309. *Development of an antibiogram report for bovine respiratory disease: Factors affecting culture-positivity, antimicrobial susceptibility, and multi-drug resistance of 2 pathogens in California dairies.* Monteiro et al. UC Davis **see Health → Antimicrobial resistance**

1310. *Comparison of virulence and resistance genes in Mannheimia haemolytica and Pasteurella multocida from dairy cattle with and without bovine respiratory disease.* Garzon et al. UC Davis **see Health → Antimicrobial resistance**

## Enteric disease (7 abstracts)

*1207*. *Association of personality traits and the expression of sickness behavior in dairy calves with neonatal diarrhea*. Welk et al. U Guelph

- Calves (n=30) were housed in an automated feeder (up to 15 L/d CMR), scored daily for diarrhea until 21 d of age, and monitored for feeding and activity behavior at d of diarrhea.
- Tested for personality (novel environment and object, startle stimulus, and social isolation) from 24 to 28 d of age and ID'ed as shy, fearful, active, and explorative.
- Shy calves: ↓ milk intake, ↑ lying bouts vs. bold calves ($P<0.02$); fearful calves: ↓ milk intake vs. all other groups ($P=0.01$); active calves: ↓ steps ($P=0.06$). NSD drinking or lying time.
- **Take-home** – Calf personality can impact perception of sickness behaviors during scours, particularly for feeding behaviors of shy and fearful calves.

*2041. Association between activity behavior and neonatal calf diarrhea in group-housed dairy calves.* Welk et al. U Guelph

- Same experiment as 1207, now assessing healthy/diarrheic pairs (n=19 pairs) for leg accelerometer activity differences before and after diarrhea diagnosis (d -3 to 5).
- Diarrheic calves ↓ steps by 50% and larger reduction in steps d-1 before diarrhea. Diarrheic calves also ↓ lying bouts vs. healthy calves (P≤0.004 all).
- **Take-home** – Diarrhea limits calf activity and activity levels could detect diarrhea earlier before clinical signs.

*2442. Genetic diversity of bovine rotavirus in dairy calves with and without diarrhea in New South Wales, Australia*. Kida et al. University of Technology Sydney Ultimo, Dairy UP

- Calf rectal samples (n=593; 349 healthy, 154 diarrheic, 42 w/ BRD, and 48 both or unspecific symptoms) were collected across 72 farms to sequence rotavirus genotypes.
- Most common rotavirus genotypes: G6P[5] (n=25 farms) and G10P[11] (n=44 farms).
- Less frequent genotypes: G24 (n=2 farms), P[33] (n=1 farm), and rotavirus B (n=5 farms).
- Almost all farms had at least one rotavirus + calf. Multiple co-infections w/ different genotype combinations also observed (i.e. G10+G6 on 9 farms, P[11]+P[5] on 4 farms).
- *Nonstructural protein 3* and *viral protein 7* on genotypes G10 and G6 w/ strong, significant association w/ diarrhea
- **Take-home** – The two dominant rotavirus genotypes G10 and G6 are associated with clinical and subclinical enteric disease infections.

2039. *Factors associated with diarrhea recovery in non-replacement dairy calves*. Gibson et. al., U Guelph.

- Calves (n=116) raised at a calf-rearing facility assessed for diarrhea factors. Upon arrival, STP and BW measured. Scour scores were taken 2x/d and calves were enrolled at diarrhea onset. Fecal samples tested via PCR for coronavirus, rotavirus, and *Cryptosporidium parvum*, and cultured for *Salmonella*.
- Mean STP = 5.36 ±0.72 g/dL. 61.2% developed diarrhea in wk 1 and 38.8% in wk 2. Pathogens: 87% rotavirus, 66% crypto, 37% rotavirus, and 6% salmonella.
- Diarrhea resolved on avg 4.49 ±2.88 d. Calves that developed diarrhea in wk 2 recovered faster vs. wk 1(P<0.001).
- 64% treated w/ an antimicrobial. Calves with STP >6.2 g/dL at arrival ↓ hazard of treatment vs. those with STP <5.1 g/dL (P=0.03). 37% were treated for BRD after diarrhea and those who experienced diarrhea during wk 2 ↓ hazard of respiratory treatment vs. wk 1 (P=0.04).
- "No pathogens were associated with diarrhea resolution or antimicrobial use."
- **Take-home** – "early-life factors, particularly timing of diarrhea onset and STP levels at arrival, may be more important in influencing diarrhea resolution and antimicrobial use than the pathogen type."

1307. *Evaluation of the efficacy of an evidence-based algorithm for antimicrobial treatment of neonatal calf diarrhea*. Zakia et al. U of Guelph.

- A blinded, randomized controlled trial (n=?) compared:
    - a.) an evidence-based algorithm where calves received trimethoprim-sulfadoxine 16 mg/kg q12 h for 3d only if they showed 2 or more of the following symptoms – rectal

temp >101.8 F @ 12 hr post anti-inflammatory medication, inability to stand, absent suckle reflex, sunken eyes, or scleral injection (bloodshot eyes)
    - b.) control group where all calves received the same antimicrobial at onset of diarrhea.
- All received fluids for duration of diarrhea and meloxicam (0.5 mg/kg) at onset of disease.
- NSD in diarrhea duration, BRD treatment, d with clinical signs of BRD, weekly BW, or ADG ($P \geq 0.22$). Control calves required ↑ rescue therapy w/ a secondary antimicrobial ($P=0.02$) and tended ↑ odds of mortality ($P=0.07$).
- **<u>Take-home</u>** – scours duration, weight gain, and BRD incidence were not affected by an evidence-based algorithm in assessing use of antimicrobials, however, use of an evidence-based algorithm tended lesser mortality and resulted in less rescue medications used.

*1305. Association of severe diarrhea and BRD with ADG, feed intake, milk replacer refusal and mortality, in preweaning Holstein and BxD calves.* **see Health → General morbidity and mortality.**

*1603. Assessing an ex vivo assay with gastrointestinal tissue sections to investigate mucosal immune responses in dairy calves.* McDonald et al. MSU **see Physiology → Gut and gut microbiome.**

**<u>Disease prediction & prevention (7 abstracts)</u>**

*2030. Evaluating a rapid immunity test to predict dairy calf mortality risk.* Roper et al. UGA
- Serum was collected at 2 d of age from Heifer calves from a low-mortality (3% mortality, n=849) and high-mortality (12%, n=698) farm to assess novel D2Dx humoral immunity test and Brix. Compared calves that died at 3 to 30 d of age vs. those that did not at each farm.
- At both farms, calves that survived ↑ Brix (9 vs. 8.5, 9.3 vs. 9) and ↑ D2Dx score (0.03 vs. 0.004, 0.034 vs. 0.029) vs. dead calves, and D2Dx was associated w/ Brix ($p=0.42$, $P<0.001$).
- D2Dx ↑ sensitivity (96 vs. 48%) and area under the curve (0.87 vs. 0.69) vs. Brix to predict calf mortality on the low mortality farm, not great prediction at high mortality farm.
- **<u>Take-home</u>** – D2Dx could be used to predict calf mortality risk, esp. at well-managed farms.

1302. *Associations of oral temperature with disease outcomes and inflammation in preweaning dairy heifers*. Gottwald et al. Cornell.
- Female Holstein calves (n=150) from one NY farm were followed for 28 d with health assessments (UW Health Scoring app), oral and rectal temps monitored d 1 and every other d from d 2 to d 28, and blood samples (n=55; 2, 8, 16, and 24 d + fever days) to evaluate relationship between oral temp, health, and inflammatory biomarkers.
- Age and BRD were associated w/ ↑ oral temps while diarrhea was associated with ↓ oral temps ($P<0.01$).
- IL-10 was negatively associated with oral temp, while IFN-γ was positively associated with oral temp ($P \leq 0.04$). TNFα showed no association.
- **<u>Take-home</u>** – "a similar relationship between inflammation and oral temperature was observed as is known to exist with rectal temperature." Oral temperature is useful in monitoring health of pre-weaned dairy calves.

1303 *Evaluating the association between calf health scores and disease detection*. Xu et al. Cornell.

- Same experiment as 1302, now evaluating treatment records vs. manual health scores. "Treatment records were used as a proxy for morbidity as determined by farm staff and included the assessment of calf activity and feeding behavior."
- A model was established to analyze assessments (n=1,941; health scores and treatment records; n=881 health, n=363 BRD, n=514 diarrhea, n=183 "other")
- Model achieved 87% accuracy, 96% precision and 95% recall for diarrhea; 81% accuracy and 75% precision for BRD.
- Fecal score was the "most influential feature, followed by nasal discharge and attitude."
- Nasal discharge had the highest correlation w/ BRD incidence; fecal score → diarrhea detection; naval condition → "other" conditions. Eye and eye scores had moderate correlation w/ BRD. Rectal temps and joints had weaker associations w/ disease detection.
- **<u>Take-home</u>** – "these results highlight the importance of visible health indicators for disease detection in group housing supporting the need for automated surveillance using computer vision, and AI."

1308. *Evaluating the utility of a digital postmortem to determine the cause of death in preweaning dairy calves*. Umana Sedo et al. VT

- Dairy calves that died on-farm (n=24) were transported to the U of Guelph and were either:
  - a.) subjected to a complete gross postmortem examination conducted by a board-certified pathologist
  - b.) a standardized set of 25 photographic images was taken, and 4 veterinarians independently reviewed the images to ID affected systems and provide a diagnosis.
- The pathologist ID'ed an abnormality in 42% of lungs, 21% of forestomachs and abomasa, 38% of intestines, and 33% of other organs. A disease process involving the whole body (septicemia or dehydration) was found in 13% of calves.
- The corresponding % agreements between the certified pathologist and the veterinary practitioners reviewing images was 78.8% for intestines, 72.5% for other organs, 70.2% for forestomachs and abomasa, 59.8% for lungs, and 38.2% for whole-body conditions.
- **<u>Take-home</u>** – there was moderate agreement between in-person pathologist post-mortem assessment and practitioners examining photographs of organ systems, but poor agreement in assessing whole-body conditions like septicemia or dehydration.

*2029*. *Machine learning-driven thresholds to identify newborn calves with enlarged umbilical stumps.* Rico et al. UC-Davis

- Calves (n=667, n=17 dairies, Holstein and Jersey, 4 d old) had umbilcal stumps measured to establish thresholds for defining enlarged navels (for establish future machine learning).
- A subset were measured 3x by 1 observer (n=157) or 1x by 3 observers (n=44) for inter/intraobserver reliability. Intraobserver CV = 5.94% (very good), interobserver agreement ICC = 0.76 (fair to good).
- Optimal thresholds: 16.6 mm for Holstein (Se = 0.95, Sp=0.38), 12.6 mm for Jersey (Se=0.95, Sp = 0.61). Positive predictive value = 0.99: 19.7 mm Holstein and 14.6 mm Jersey
- **<u>Take-home</u>** – Stump diameter measurement is precise and has discriminatory power for future machine learning for enlarged navel detection.

*2405. Diarrhea and fever prediction in Holstein calves using machine learning.* Diavão et al. Empresa Brasileira de Pesquisa Agropecuária**. see Behavior and welfare → Feeding and activity behavior.**

*1600. Intestinal integrity and inflammatory markers in neonatal beef x dairy calves exposed to* Salmonella *infection.* Migl et al. TX Tech **See Maternal-fetal → Colostrum, colostrum replacers, and transition milk**

**Immunity, inflammation, and general morbidity (14 abstracts)**

2406. *Exploring how diarrhea, respiratory disease, and other variables impact feed efficiency in dairy calves*. Vandewiel et al. U Guelph

- Dairy calves (n=726 Holstein, 40 crossbred; 3-10 d of age) were monitored for diarrhea (scored, first 4 wks) and BRD (12 wks). BW collected at arrival, then weekly.
- CMR fed 2x/d peaking at 2.3 lbs./d in 8 L w/ a step-down 2 wk wean starting d 49. CMR refusals and calf starter intake measured.
- Mean feed efficiency = 6.82 ±0.88 kg of feed per kg of BW gain.
- Calves w/ 1-3.5 d diarrhea and ≥2 d BRD required +372 g of feed per kg of BW gain (P=0.02) vs. those w/o diarrhea and <2 d of BRD. Those with ≥4 d w/ diarrhea or ≥2 d with respiratory disease required +290 g of feed per kg of BW gain (P=0.05).
- Calves weighing >111.8 lbs. upon arrival required +150g of feed per kg of BW gain (P=0.05) compared to calves weighing <99.9 lbs. Holstein calves required +300 g of feed per kg of BW gain (P=0.02) compared to dairy beef calves.
- **Take-home** – Diarrhea and respiratory disease negatively impact feed conversion. Heavier calves at arrival have poorer feed conversion compared to lighter ones. Holstein calves have poorer feed conversion compared to crossbreds.

1305. *Association of severe diarrhea and BRD and ADG, feed intake, milk replacer refusal and mortality, in preweaning Holstein and BxD calves*. Moreira et al. TX Tech.

- Newborn calves (n=114 Holsteins, n=126 beef x dairy) were enrolled between Sep 2023 and Mar 2024, and monitored for health events: diarrhea (watery feces + dehydration) and BRD (clinical signs: cough, eye discharge, abnormal respiration, nasal discharge, ear droop or head tilt, and rectal temp ≥102.6 F)
- Calves were housed individually, bottle-fed 6 L/d CMR, and offered ad lib grain. BW was taken at enrollment and 56 d later.
- ADG: beef x dairy = 0.93 (with) and 1.32 lbs./d (without diarrhea); Holstein calves = 0.99 (with) and 1.12 lbs./d (without diarrhea; P = ?). BRD-associated ADG ↓ only in Holstein calves (0.97 vs. 1.17 lbs./d, w/ or w/out BRD; P<0.01). NSD in beef x dairy calves (P=0.60).
- CMR refusals ↑ for calves diagnosed with BRD (P=0.05). Correlation between CMR refusals and diarrhea ↑ in crossbred vs. Holstein calves (refused 2.7 vs. 1.25 L; P<0.01).
- Diarrhea and BRD were both linked w/ reductions in grain intake (P<0.05). Only diarrhea was linked to increased mortality (P<0.01).
- **Take-home** – disease affected performance in pre-wean calves, and it “may be conditional to breed.”

2036. *Factors impacting electrolyte usage, morbidity, and mortality rates in non-replacement dairy calves at a commercial calf rearing facility*. McCarthy et al. U of Guelph.

- Calf records (n=6,879; 5,807 Angus x Holstein, 735 Holstein, and 337 other; 4,241 steers and 2,638 heifers) were analyzed to determine effects of breed, sex, arrival BW, and source on electrolyte usage, BRD, and mortality during 11 wks at a calf rearing facility in Ontario.
- Calves were fed 2.8 L of milk 2x/d from d 1 to wean (d 63) with ad lib access to grain. Orts recorded after each feeding and electrolyte given to all calves with orts; antimicrobial treatment administered to calves diagnosed with BRD. Sources: direct farm pick-up calves from Ontario, Quebec and Maritimes and auction calves from S. Ontario and Quebec.
- Odds of BRD ↑ for calves from S. Ontario auctions (1.4x), whereas Quebec routes had lowest odds (0.9x). Calves from Maritimes routes and Quebec auctions had ↑ odds of receiving electrolytes vs. S. Ontario route calves.
- Every 1 kg ↓ in BW ↑odds of BRD, electrolytes and mortality by 1.5% to 2.7% (0.973).
- Holsteins ↑odds of BRD and mortality (2.0-2.1x) vs. Angus x Holsteins, and heifers ↓ odds of BRD vs. steers (0.79).
- **Take-home** - heavier Angus x Holstein heifers have the lowest odds of BRD, mortality, and electrolyte usage." BRD morbidity seems related to calf source and electrolyte use may be linked to transport distance.

2174. *Monitoring the effects of oxidative stress on the growth of Holstein bull calves using Diquat*. Casper et al. Casper's Calf Ranch

- Holstein bull calves (n=12) 70 d of age received either a.) injection of sterilized saline, b.) 6-, c.) 8-, or d.) 10- mg/kg of Diquat (herbicide?) injection to induce oxidative stress.
- BW, ADG, fecal scores, body dimensions, fecal pathogen count and blood markers for oxidative stress were measured. Blood collected on d 0, 6, 12, 18, and 24.
- ADG and BW w/ a cubic response: initially ↓ then ↑ w/ higher Diquat dosages (P<0.01). Frame measured linearly (P<0.01) ↓ with ↑ Diquat dosages.
- Fecal score and diarrheic calf ratios w/ a quadratic response: scores rise at a diminishing rate as Diquat dosage increased (P<0.02).
- Serum aspartate aminotransferase, glutathione, total antioxidant capacity, catalase, malondialdehyde, cortisol, and noradrenaline concentrations noted linear ↑ from ↑ Diquat dosage (P<0.01), whereas alanine transaminase, superoxide dismutase, and glutathione peroxidase w/ quadratic response (P<0.02).
- Fecal *E. coli* w/ cubic response, *Staphylococcus aureus* and *Salmonella-Shigella* noted linear ↑ with increasing Diquat dosages (P<0.01).
- **Take-home** – Injecting Diquat induces oxidative stress that reduces calf performance and health. Response persists up to 24 days. Optimal dose is 8 mg/kg BW. This model can be used to "evaluate future technologies aimed at reducing, eliminating, or preventing oxidative stress."

*2035*. *Optimizing serum IgG and total protein cut points by age for predicting morbidity and mortality in Holstein calves.* Goetz et al. U Guelph

- Blood collected daily from calves (n=199) for 1 to 7 d, measured for serum IgG and STP to determine day-specific cut points (maximizing sensitivity [Sn] and specificity [Sp]) to predict

BRD, diarrhea, and mortality. Health assessed to 49 d and classified as low or high (≥19% of d w/ BRD, ≥20% of d w/ diarrhea) prevalence.

| | | At 1 d serum collection | | | | At 7 d serum collection | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Serum** | **Outcome** | **Cut point** | **Sn** | **Sp** | **AUC** | **Cut point** | **Sn** | **Sp** | **AUC** |
| IgG | Mortality | 24.55 g/L | 0.64 | 0.55 | 0.59 | 14.05 g/L | 0.50 | 0.52 | 0.51 |
| STP | Mortality | 5.55 g/dL | 0.59 | 0.55 | 0.57 | 4.55 g/dL | 0.71 | 0.38 | 0.54 |
| IgG | Low BRD | 24.35 g/L | 0.69 | 0.40 | 0.55 | 11.85 g/L | 0.69 | 0.43 | 0.56 |
| STP | Low BRD | 5.65 g/dL | 0.54 | 0.49 | 0.51 | 4.65 g/dL | 0.67 | 0.40 | 0.54 |
| IgG | Low diarrhea | 24.85 g/L | 0.66 | 0.47 | 0.57 | 14.25 g/L | 0.56 | 0.70 | 0.63 |
| STP | Low diarrhea | 5.65 g/dL | 0.53 | 0.48 | 0.51 | 4.95 g/dL | 0.46 | 0.70 | 0.58 |

- **Take-home**: STP and IgG decline from d 1 to 7, thus reference values should reflect this when predicting morbidity and mortality risk. (this should be translated to the field where we recommend blood pulls at 1 to 7 d of age for STP).

*2225. Evaluation of organic dairy calf health traits.* Schultz et al. PSU.

- Calf BW collected from n=2 organic dairies during first 2 wk of age (n=138 calves), and 1, 2, and 3 mo (n=88-110 calves), and STP collected from n=47 calves for correlations.
- Farm differences: Farm 1 ↑ BW, ADG, and STP vs. farm 2
- STP significantly correlated w/ 1-mo BW and ADG (P<0.05). Calves that survived to end of trial had ↑ STP (6.3 vs. 5.6 g/dL, P<0.10).
- **Take-home**: STP improved growth and survival and it varies by farm. Maternity management should be a priority for all dairies but particularly organic dairies.

*2446. Microbial diversity using meta-transcriptomics in dairy calves: An insight of the resistome and virulome in health and enteric disease.* Abedien et al. U of Technology Sydney Ultimo, Dairy UP

- Same experimental design as 2442 (enteric disease section). Rectal swabs assessed for bacterial taxonomy, diversity, and gene expression.
- Calf rectum is a "complex microbial landscape" w/ ~1000 bacterial genera. Top genera = *Anaerovibrio*, *Prevotella*, and *Segatella*. Healthy calves ↑ diversity vs. symptomatic calves.
- Calves w/ diarrhea or symptomatic ↑ abx resistance gene and virulence factors vs. healthy/asymptomatic calves.
- **Take-home**: The calf rectal microbiome is diverse and influenced by diarrhea (and potential antimicrobial treatment).

*1446. The enteric and respiratory viral diversity of calves in health and disease—A state-wide metatranscriptomic study.* Brito et al. U of Technology Sydney Ultimo, Dairy UP

- Calves (n=918, <49 d of age) were sampled for nasal and rectal swabs from n=72 farms in New South Wales to conducted RNA sequencing for untargeted metagenomics and pathogen detection. A calf management survey was also conducted at n=52 farms.
- At least 22 viral species were identified; rotavirus and bovine kobuvirus (69 farms) most strongly associated w/ diarrhea; bovine rhinitis (30 farms) most strongly associated w/ BRD.
- Some viral infections (calciviruses, picornaviruses) strongly associated with age categories.
- **Take-home**: Study helps better identify viral variants associated with Australian calf disease, aiding in the development of more specific/sensitive diagnostic tools.

*1301. Changes in BLV antibody status of dairy calves aged 0 to 6 months*. Willoughby et al. U Guelph

- Bovine leukemia virus (BLV) is highly prevalent in N. American dairy cattle. Calf seropositivity reflects either BLV infection or colostral transfer of antibodies w/o infection. Prevalence and transmission between youngstock is not well understood.
- Holstein heifer calves (n=586) on 9 dairy farms in Ontario were enrolled every 21 d and re-tested every 21 d until 6 mo old (mean age at enrollment = 15 d, mean samples per calf = 9)
- Serum ELISA measured antibodies to BLV; seropositivity: ≥45% inhibition, seronegativity: <35% inhibition, in between: "suspicious"
- 58% of calves were seropositive for BLV at first sample and 50% became seronegative. 39% were always seronegative. 6% were always seropositive. 5% crossed positive/negative thresholds multiple times or had first or final value classified as suspicious. At 6 mo, 7% of calves were seropositive.
- There was tremendous variation between farms (i.e., 7% to 83% were consistently seronegative; P<0.01)
- **Take-home** – "… early life seropositivity is likely attributable to maternal antibodies against BLV acquired via colostrum. Further testing using RT-qPCR to detect BLV pro-virus will confirm if the apparent positives are "true" infections."

2044. *The effect of bovine leukemia virus infection on dairy calf health and growth*. Broadfoot et al., U of Guelph (Ontario Veterinary College); U of Calgary, Alberta; Mapleview Agri Ltd, Ontario.

- Study conducted between May 2023 and May 2024 on a commercial calf facility in SW Ontario and included 768 calves (726 Holstein, 42 crossbred).
- Blood samples were collected on d 1, 30, and 84 post arrival and DNA used to determine BLV (bovine leukosis, a.k.a. leukemia, virus) proviral load via BLV SS1 qPCR assay.
- Calves were fecal and respiratory scored 2x/d and weighed upon arrival and weekly through 84 d.
- 43 (5.6%) tested positive for BLV.
- BLV-positive calves had greater (P<0.001) risk of respiratory disease score >5 and lower risk respiratory scores of 0 (P=0.007) (UC-Davis respiratory disease scoring system).
- NSD between BLV and ADG, feed efficiency, or diarrhea.
- **Take-home** – "BLV positivity was associated with an increased risk of respiratory disease and a reduced likelihood of having no clinical signs of respiratory disease."

1409. *Association between dam factors and Salmonella Dublin positivity in dairy cales in early life*. Lyn et al. U of Guelph; Trent U, Ontario; Michigan State U.

- Calves (n=460, 4 dairies in BC w/ confirmed positive *S. Dublin* in serial bulk tank milk sample) were monitored for disease presence. Blood samples were taken from the calves at a mean of 3 ±2 days of life and concurrently from dams at 11 ± 9 DIM (plus milk sample).
- The PrioCHECK *S. Dublin* test kit was used to analyze serum and milk samples, with a cut point of 35% positivity. Calf serum was assessed using a Brix refractometer.
- 24.5% of calves were positive and12.3% of dams were positive in both milk and serum, (1.7% only serum and 40.2% only milk)
- For every 1% ↑ in serum Brix, odds of *S.* Dublin positivity was 2.83x ↑ if the dam was milk *S. Dublin* positive and 6.1x ↑ if dam was milk and serum *S. Dublin* positive (P≤0.005).

- **Take-home** – calf *S*. Dublin positivity increased in calves from milk ELISA-positive dams. The association between Brix % and *S*. Dublin positivity indicates transfer of maternal *S*. Dublin antibodies.

1408. *Epidemiologic risk factors for the PCR-based identification of Salmonella Dublin on dairy-beef farms*. Arevalo et al. OSU

- A cross-sectional study beef x dairy calf rearing farms (n=63, 7 states, Jun '23 to Nov '24). Environmental boot swabs (n=243) were collected from pre-weaned alleyways, milk mixing rooms and postweaned pens.
- Multiplex PCR targeting S. Dublin analysis was conducted, in addition to a questionnaire pertaining to "farm demographics, management, calf movement, and biosecurity."
- *S*. Dublin was detected in 33.3% of farms and 19.8% of environmental samples. Most positive farms (56.5%, 13/23) had only one positive sample. "The similar prevalence (~20%) observed across sample locations suggests widespread environmental contamination."
- Final multivariable analysis found frequent calf introduction and sourcing animals from auctions or calf dealers ($P \leq 0.001$) as leading *S*. Dublin risk factors. No correlation of S. Dublin and farm size or location.
- **Take-home** – *S*. Dublin is prevalent in dairy beef farms. Calf sourcing practices are a leading spreader of the disease.

*1135*. *Transmission of highly pathogenic avian influenza H5N1 to calves fed unpasteurized milk from experimentally infected cows*. Sarlo Davila et al. USDA-ARS, Ames, IA.

- Older Holstein calves (n=4, 7 to 11 wks old) were fed 1 L, 2x/d unpasteurized milk from experimentally inoculated H5N1 virus-positive cows to determine if HPAI could be transmitted to calves.
- Calves had mild clinical symptoms of HPAI including nasal discharge, mild fever, mild lethargy, loose feces, and ↑ respiratory effort for 5-6 d.
- Viral RNA detected via nasal swabs (but no other fluids) up to 4 d post-inoculation, detection in other tissues including lungs, lymph nodes, and tonsils.
- **Take-home**: Preliminary results suggest feeding calves unpasteurized milk from H5N1-positive cows can transmit the pathogen to calves with moderate clinical outcomes

*1304. Health indicators associated with growth and body weight at slaughter in non-replacement Holstein calves.* **see Non-replacement calves → Beef x dairy**

## Antimicrobial resistance (2 abstracts)

*1309*. *Development of an antibiogram report for bovine respiratory disease: Factors affecting culture-positivity, antimicrobial susceptibility, and multi-drug resistance of 2 pathogens in California dairies*. Monteiro et al. UC-Davis

- Calves, heifers, and cows from n=3 CA dairies nasopharyngeal swabbed monthly (n=301) for *P. multocida* (*PM*) and *M. haemolytica* (*MH*) to apply the cumulative antimicrobial susceptibility testing (CAST) framework for calf BRD.

- Odds of culture-positive both pathogens: age x season interaction (did not state which age or season). Odds of culture-positive *MH:* farm effect.
- Odds of antimicrobial non-susceptibility *PM:*: ↑ farm management (all drugs except penicillin), age (calves and heifers). Odds of non-susceptibility *MH*: ↑ farm management (tilmicosin and tetracycline), age (heifers).
- Multi-drug resistance for both pathogens: farm effect (one farm largest perpetrator at 90-100% of all isolates presenting multi-drug resistance).
- **Take-home**: Farm management, age and season influence antimicrobial resistance and treatment; these factors should be considered when collecting data.

*1310. Comparison of virulence and resistance genes in Mannheimia haemolytica and Pasteurella multocida from dairy cattle with and without bovine respiratory disease.* Garzon et al. UC-Davis

- Same study as above, assessing n=149 *PM* and n=68 *MH* isolates to characterize virulence factors, establish associations between genetics and disease status
- Antimicrobial resistant genes: n=20 for *PM* (10 antimicrobial classes); n=11 for *MH* (7 classes); virulence genes: n=28 for *PM*, n=15 for *MH* → large genetic diversity = not able to ID unique genetic markers for disease status or age.
- Whole-genome sequencing prediction of phenotypic antimicrobial resistance w/ variable accuracy → moderate level of overall agreement
- **Take-home**: Viruses too diverse to use genetic markers as predictions of disease status.

**Physiology (9 abstracts)**

**Gut and gut microbiome (4 abstracts)**

*1258. Transmission of gut virome in cow/environment-to-calf model and its regulatory influence on the microbiome.* Zhao et al. China Agricultural University.

- Rumen fluid and fecal samples collected from n=37 cows at 21-d pre-parturition and 0 d post-parturition; meconium (and oral swabs?) collected from offspring at 30 min post-parturition (pre-colostrum). Environmental samples (wastewater and soil) collected too.
- DNA virome diversity ↑ cow rumen fluid, feces, and calf oral cavity vs. calf gut.
- Fetal feces: virome derived from oral cavity, enriched with eukaryotic viruses; high similarity with post-parturition rumen fluid (vs. pre-parturition) and wastewater.
- Fetal oral cavity: virome derived from post-parturition rumen fluid/soil, ↑ phage abundance
- ↑ proportion of lytic phages in fetal feces and oral cavity, distinct phage- host correlations between cow and calf.
- **Take-home**: This study helps us understand gut virome dynamics and cow/calf transmission avenues to potentially improve calf health.

*2394. Assessment of the symbiotic bacterium Clostridium butyricum on the development of small intestine villi and the health of dairy calves.* Vazquez-Flores et al. Technologica de Monterrey.

- Calves (n=144, 6 blocks) fed either *Clostridium butyricum* (Clb, 4 g/d in CMR) or control (Con) for 57 d w/ a subset of bulls (n=6?) euthanized at 28 d to assess intestinal development.
- Clb ↑ GIT eosinophils and jejunal villi but ↓ mitosis, duodenal and ileal villi ($P \leq 0.08$).
- NSD in diarrhea, *Salmonella*, or *Rotavirus* infection rates, but Clb ↑ *Cryptosporidium* prevalence and ↓ overall disease reports ($P \leq 0.04$).
- Clb ↑ starter intake wk 1 to 8 (except wk 4), but NSD in BW or height at 57 d.
- **Take-home**: Clb supplementation influenced gut development and disease reports with increased starter intake but poorer feed efficiency.

1603. *Assessing an ex vivo assay with gastrointestinal tissue sections to investigate mucosal immune responses in dairy calves*. McDonald et al. MSU

- Sections (22 $mm^2$) of ileum and mid-jejunum from male dairy calves (n=3; 8 – 10 d old) were collected and placed mucosal side up in a 24-well plate for stimulation with: medium only (control), bovine rotavirus ($TCID_{50}$ ~1.8 x $10^7$ per well) or *E coli* (1 x $10^7$ per well; field isolate) to simulate diarrhea. RNA was isolated and supernatants analyzed from post incubation explants for cytokine expression.
- Pathogenic stimulation ↑ expression *TNFα* (undetected in 7/18 samples) and *IL6* (undetected in 2/18 samples) above control ($P>0.05$), but NSD by pathogens, tissue locations or interactions (all $P>0.40$).
- Both tissue segments noted detectable release of numerous cytokines in the supernatant, particularly in the ileum. Disease did not alter the rate of release.
- **Take-home** – intestinal explants release detectable concentrations of numerous cytokines. Bacterial and viral enteric pathogens do not amplify release, at least not in explants of GI tract.

*2402. The gastrointestinal microbial communities of weaned bull calves are negatively impacted by dam nutrient restriction during late gestation.* Costello et al. UW-Madison. **see Maternal-fetal → Maternal contributions to calf outcomes.**

**Rumen development (2 abstracts)**

2766. *In vitro assessment of different types and fractions of colostrum as an additive to modulate rumen microbial fermentation after weaning*. Muñoz-Grein, et al. Universidad de Zaragoza, Spain.

- Colostrum from ovine, bovine, and reconstituted bovine was each fractionated sequentially into 4 components – whole colostrum, fat-free colostrum, Ig-free colostrum (filtered at 100 kDa) and protein-free colostrum (filtered at 10 kDa). Each was tested at 3 supplementation levels (0%, 0.4%, and 2% volume).
- Rumen inocula from 4 post-weaned lambs were used as experimental units. Incubation was conducted in batch cultures w/ concentrate-rich diet, and fermentation parameters were measured after 24 hr incubation at 39 °C.
- Similar effects occurred with each of the three types of colostrum.
- Dietary supplementation with 2% colostrum volume, regardless of source, resulted in ↑ gas production, ↑ methane output, and ↓ pH ($P<0.05$).
- NSD of trt on total VFA conc, but whole colostrum or fat-free colostrum ↑ branched-chain VFA, ↓ propionate molar proportion, and ↑ ammonia-N conc ($P<0.05$)
- **Take-home** – supplementing colostrum with or w/o fat fraction post-wean may boost microbial rumen fermentation due to lipids, Ig, lactoferrin, lactose & small peptides.

1555. *Impact of early-life milk secretory immunoglobulin A (SigA) on ruminal microbial colonization in dairy calves*. Schrag et al. UF

- Holstein female calves (N=45) were fed CMR either with a.) no SigA or with b.) 7.2 mg of SigA per d (d 2-28), or c.) 7.2 mg of SigA + fresh rumen fluid from adult cows (d 2-28).
- Rumen samples collected on d 4, 14, 28, 56, and 180.
- Calves supplemented SigA with or w/o rumen fluid ↑ rumen fluid richness on d 28 vs. control (Chao 1 index, $P=0.04$). SigA + rumen fluid ↑ rumen microbial diversity vs. control or SigA alone (Shannon index, $P<0.01$).
- SigA+ rumen fluid ↓ *Bacteroidota* vs. SigA alone and control ($P=0.03$). *Verrucomicrobiota* ↑ at d 4 and 28 for SigA + rumen fluid and SigA fed calves ($P=0.01$). *Fibrobacterota* ↓ in Sig A and *Proteobacteria* ↓ in SigA + rumen fluid fed calves ($P<0.05$). *Euryarchaeota* and *Spirochaeta* ↑ in both Sig A and SigA + rumen fluid fed calves ($P<0.01$).
- **Take-home** – Milk secretory immunoglobulin A modulates rumen microbial colonization.

**Mammary development (3 abstracts)**

*2403*. *Identification of early mammary ultrasound predictors for first-lactation performance.* Vang et al. UW-Madison.

- Holstein heifers were fed low (LM, n=48, 1.9 L/meal of 22:15 CMR) or high (HM, n=48, 3.78 L/meal of 27:20 CMR) milk for 7 wk. Ultrasound images were collected for mammary parenchyma (PAR) and fat pad (FP) every other wk for echogenicity and area.

- Calves managed the same to 1st lactation; energy corrected (ECM) milk was recorded and cows were defined as low or high production cows (LP/HP).
- HM calves ↑ 3 to 11 wk BW, PAR area at 11 wk, and FP area at 9 to 11 wk ($P<0.05$). PAR and FP echogenicity peaked around 5 wk then declined (time effect, not trt).
- ECM tended to be positively associated w/ early-life PAR area and negatively associated w/ FP area ($P<0.08$). LP animals ↑ pre-weaned FP echogenicity and LM-LP animals ↑ pre-weaned FP area and PAR echogenicity vs. LM-HP animals ($P<0.05$).
- **Take-home**: Low-performing cows had ↑ FP metrics at 11 wks of age. Higher planes of milk pre-weaning improved whole-body and mammary growth.

*1246. The impact of preweaning plane of nutrition and heat abatement on mammary gland development of dairy calves.* Guenther et al. UW-Madison. **see Management → Environment.**

*1247. Third-generation impacts of heat stress on mammary gland growth and development.* Larsen et al. UW-Madison. **see Maternal-fetal → Maternal contributions to calf outcomes.**

**Management (35 abstracts)**

**Housing (5 abstracts)**

*2300*. *Effect of providing inadequate space when pair-housing in young dairy origin calves.* Langenkamp and Gawthrop CalfCare.

- "Producers commonly place 2 calves in a pen sized for 1 calf."
- Sale barn crossbred heifer calves were either housed individually in a single wire pen (CON, n=37 calves, 102 x 121 cm) or double occupied in a single wire pen (D, n=22 calves, 122 x 122 cm) from 3-7 d to 49 d (i.e., weaning) then assessed until group-housed postweaning (66 d).
- D calves ↓ BW at weaning (-5.2 kg) and post-weaning (-7.6 kg, P=0.03) but NSD for treatment costs ($2.99 vs. $2.81) or mortality (0% both).
- **Take-home**: Double-housing calves and limiting square footage impairs growth.

*2303*. *Effects of preweaning social housing of dairy calves on long-term performance and first-lactation milk yield.* Lindner et al. UF

- Calves were housed individually (IH), in pairs (PH), or small groups of 10 (GH,n=54-60/trt) until 9 wks of age, then managed similarly until 100 DIM when reproductive, productive, and milk records were collected.
- NSD age at first calving, but PH ↑ calving BW vs. IH (619 vs. 600 kg, P=0.03).
- PH and GH ↑ milk yield vs. IH (38.3 and 38.6 vs. 36.6 kg/d, P=0.05), especially for the cool calving season (trt x season P=0.10, +7.0 kg for cool main effect)
- **Take-home**: The study suggest long-term advantages in milk yield for pre-weaned social housing over individual housing.

*1141*. *Joint ABW and Forages and Pastures Symposium: Societal and Production Implications of Pasture Access for Dairy Heifers - Pasture versus confinement for dairy heifers: Testing assumptions about well-being based on interpretations of behavior.* Hall et al. USDFRC, Madison, WI

- What is stress? Is there good stress? Do current assessments of stress (i.e., steotypy, vocalization, and cortisol) agree with each other?
- Heifers (n=62, n=4 pens each) raised either on pasture (rotational, cool-season, grass + grain/VTM) or in barn (free-stall?, TMR) for 5 summer months over 2 years. All heifers housed in barn outside of grazing season.
- Hair samples obtained in May (pre-pasture), June, and August, behaviors human-recorded every 10-min for 12 daylight hrs for 1 d in June and July
- Sterotypy episodes ↑ in barn heifers, vocalization ↑ in pasture heifers year 1 only (particularly around feeding time), and hair cortisol ↑ 3-5x in pasture heifers (P≤0.01)
- **Take-home**: Stress assessments did not agree with each other, some indicate that pasture housing may induce more stress while others suggest barn housing might.

*1143*. *Joint ABW and Forages and Pastures Symposium - Impact of pasture versus confinement rearing on dairy heifer growth and transition period.* Camisa Nova et al. UW-Madison

- Same experimental design as 1140, but for growth parameters (BW, HH, withers height, heart girth, body length, and hip width → logistic growth curve). BW, BCS, and DMI measured -28 or -21 to 21 d relative to calving.
- NDS between trt for BW, WH, HG, BL, or HW. HH logistic growth curve differed between trt.

- BCS ↑ in barn heifers and DMI ↑ in pasture heifers during transition period ($P<0.01$, feed efficiency not calculated).
- **Take-home**: Grazing heifers achieved similar growth to barn-raised TMR heifers, though pastured heifers eat more during transition.

*1144. Joint ABW and Forages and Pastures Symposium- Plasma folate and vitamin $B_{12}$ conc. of heifers raised indoors or on pasture.* Duplessis et al. Agriculture and Agri-Food Canada.

- Same experimental design as 1140, but for circulating B9 and B12 concentrations measured in May (pre-pasture) and July. DMI not measured.
- Plasma B9 ↑ and B12 ↓ in pasture heifers vs. barn ($P\leq0.10$; B9 determined by concentration, B12 determined by % samples below detection)
- **Take-home**: The housing structure combined with necessary dietary differences influenced B-vitamin metabolism, though conclusions are limited as DMI couldn't be assessed.

**Environment (16 abstracts)**

*2667. Validation of a positive pressure tube ventilation system for heat abatement of preweaned dairy heifers.* Guenther et al. UW-Madison.

- Designed and determined effectiveness of a positive pressure tube ventilation system (PPTVS) for summer heat abatement (THI>79) by measuring microenvironment and calf thermoregulatory response from two-wk old calves under system (CL, n=12) or not (HS, n=6)
- Calves were outside w/shade in wire individual hutches. PPTVS pushed air and daytime misting. CL outcomes were measured near, far, and blocked from PPTVS, compared to HS.
- Airspeeds ↑ at 0.3 vs. 0.9 and 1.5 m from PPTVS (3, 1.5, and 1.0 m/s), all were ↑ vs. HS hutch (0.3 m/s, $P<0.01$). CL hutch ↓ microenvironment THI vs. HT, esp. during night time ($P<0.01$).
- NSD of calf outcomes (respiration rate, skin and rectal temp) between "blocked" CL and HS, but calves restricted near PPTVS ↓ respiration rate and skin temp but not rectal temp vs. calves far-restricted or blocked ($P<0.05$).
- **Take-home**: Providing PPTVS for outdoor, individually-housed calves improved hutch microclimate and calf thermoregulatory responses during the summer.

*1254. Impacts of plane of nutrition and heat abatement during the preweaning period on growth of dairy heifers.* Savegnago et al. UGA.

- Individually-housed outdoor heifer calves (n=167) were enrolled in a 2x2 factorial: plane of milk replacer nutrition (CON=4 L/d vs. EN = 9 L/d of 26:20 CMR) and cooled vs. heat stressed (HA = shade + high speed PPTV + misters vs. HS = shade; 0.3 vs. 1.5 m/s) during a GA summer.
- Calves fed 3x/d to 42 d then stepped down to 1x (CON) or 2x to 1x (EN) until weaning at 56 d. Group-housed and pastured from 71 to 180 d.
- HS ↑ respiration rate and rectal temp, ↓ starter intake 57 to 70 d of age ($P\leq0.08$), NSD CMR intake or calf growth.
- EN ↑ rectal temp and CMR intake, ↓ starter intake from 28 to 56 d of age, and ↑ ADG and BW to 180 d of age.
- **Take-home**: Cooling lowered thermoregulation and improved starter intake but did not translate to growth differences or work synergistically with plane of nutrition.

*1181. Effects of heat stress and plane of nutrition on skin morphology of preweaning dairy calves*. Hardy et al. UW-Madison.

- Same experimental design as 1254, except subset of n=6/trt. Neck hair and skin biopsies collected at 62 d of age, evaluated for size and skin properties.
- HS heifers ↑ sebaceous and sweat gland number, ↓ dermis thickness, more superficial sweat glands (P≤0.10).
- HS x CON interaction: ↓ sebaceous and sweat gland size (P≤0.08)
- **Take-home**: Heat stress might prompt thermoregulatory function in calves while low plane of milk replacer might hinder thermoregulatory ability.

*1246. The impact of preweaning plane of nutrition and heat abatement on mammary gland development of dairy calves.* Guenther et al. UW-Madison.

- Same experimental design as 1254. External MG measures and ultrasound (n=16/trt) conducted at 28, 42, and 56 d of age; subset (n=6/trt) euthanized at 62 d to harvest MG for parenchyma (mPAR) and fat pad (mFP)
- EN and HS (main effects) ↑ external MG area and euthanized MG and mFP weights (P≤0.05)
- EN ↑ MG ultrasounded mPAR and mFP area and euthanized mPAR weight (P<0.01)
- **Take-home**: MG development in early-life is impacted by plane of nutrition and heat abatement, though not synergistically.

*2309. Computer vision analysis of dairy calf behavior under different heat abatement and feeding strategies during a subtropical summer.* Saha et al. UGA.

- Same experimental design as 1254 (same model as 1391). A subset of calves (n=39) photographed every 10 s to predict (using computer vision) behaviors in the morning, afternoon, and evening.
- Model: 92% precision, 90% recall, 92% mean average precision, 5,073 hourly observations.
- EN ↑ lying, ↓ standing, eating grain, and drinking water in afternoon and night (P<0.09).
- HA calves ↑ lying in regions near the tube (esp. in afternoon, ~12 min).
- **Take-home**: Computer vision prediction of behaviors could be a valuable tool to detect and mitigate heat stress and nutritional challenges.

*1391. Computer vision-tracked behavior in dairy calves during a subtropical summer.* Saha et al. UGA.

- Individually-housed outdoor heifer calves (n=39, 14 ± 4 d of age) were monitored by camera (10 sec over 6 d) to train a computer vision system (CVS) to detect lying, standing, eating and drinking behaviors under heat stress. HOBO loggers collected microenvironment measures.
- CVS had 92% precision and 90% recall.
- Linear effect of THI on behavior: -1.06 min standing, +0.92 min lying as THI ↑, +0.03-+0.05 for eating and drinking. Weak + correlation for dew point, drinking, and lying (0.08 to 0.15).
- **Take-home**: CVS accurately monitors heat stress behaviors and relationships.

*1392. Using a neural network-based approach to identify dairy calf vocalizations and investigate their relationship with temperature during a subtropical summer.* Medeiros et al. UGA.

- Individually-housed outdoor heifer calves (n=16, age?) were monitored by portable recorders (2 d, 544 hr audio) to train an artificial neural network (ANN) to detect audio features (frequency, entropy, pitch, etc.) under heat stress. HOBO data loggers collected simultaneous microenvironment measures.

- ANN had 98% accuracy, 99% precision, and 98% recall when data was pruned manually based on timestamps, but unlabeled subset had 35% precision.
- Temperature and audio correlations: duration -0.31, range -0.47, kurtosis -0.34, zero-crossing rate -0.31, max amplitude -0.51, intensity -0.39, and pitch 0.35 (i.e., as temp ↑ vocalizations were shorter, lower in intensity, smoother, and higher pitched).
- **Take-home**: This research is a promising avenue for detecting stress events in dairy calves.

*1396. Tracking stress: Changes in salivary cortisol and cortisone levels in preweaning Holstein heifers from thermoneutral to heat stress conditions.* Johnson et al. CSU.

- Individually outdoor-housed calves (n=30, ~14 d old) were sampled for saliva at 0500, 1000, and 1400 h for 2 d during a Colorado summer to test salivary cortisol and cortisone at heat-stress (THI > 65) and non-heat-stress (THI ≤ 65) levels.
- 0500 h samples were thermoneutral (THI = 62±3.9) while 1000 and 1400 were "heat stress" (74±0.4; 78±1.3). Cortisol and cortisone ↑ at 0500 vs. 100 h (0.3 vs. 0.18±0.02 ng/mL, 0.64 vs. 0.45 ±0.05 ng/mL P=?) but NSD 0500 vs. 1400 or 1000 vs. 1400.
- Association between prior d maximum THI and cortisol/cortisone concentration → circadian patterns w/ ↑ levels during thermoneutral time
- **Take-home**: The delay in cortisol/cortisone changes might be due to a delayed adrenal cortex response to thermal stress of previous day.

*2305. Infrared temperature accuracy measured at 2 anatomical sites on dairy calves.* Pister and Drackley U Illinois.

- Bull calves (n=20, 16-18 d of age) were housed individually and infrared (IRT) and rectal temps (RT) were recorded daily at 0700 and 1800 h. IRT collected 2x at 30 cm from neck and rectum surface. Heart rate, respiratory rate, ambient temp, and relative humidity were also recorded.
- There was a weak correlation between RT and neck IRT (r=0.11) and rectum IRT (r=0.13) due to wide IRT range at different daylight and hair coat factors vs. more constant RT.
- No correlation between RT or IRT with heat stress (THI ≥ 79), except between RT at 1800 h and environmental and hutch heat stress (r=0.21, 0.12 respectively).
- **Take-home**: Using variable calf IRT is likely not a tangible solution to replace RT even for heat stress situations.

*2031. Impact of heat stress abatement on cytokine production by immune cells and in the bronchoalveolar lavage fluid (BALF) following bovine respiratory disease in preweaning dairy calves.* Savegnago et al. UGA.

- Holstein bull calves (n=8/trt, 21 d of age) were assigned to 2 trt: non-cooled (outside) vs. cooled (barn w/ shade and fans).
- Blood drawn at 3 and 7 d of experiment for peripheral blood mononuclear cells (PBMC), stimulated for cytokines, Calves inoculated for *M. haemolytica* at 22 d of experiment, then BALF collected 0 to 168 h post for cytokines, then calves were euthanized.
- Non-cooled ↑ serum TNFα and IL1β cytokines at 3 d, ↓ BALF IL1α at 6 hr but ↑ BALF IL1α and TNFα at 168 hr post-BRD challenge (P≤0.06). Non-cooled ↑ lung lesions at euthanasia.
- **Take-home**: Calf heat abatement prompts inflammation resolution and ↓ BRD severity.

*2038. Dexamethasone-induced differentially expressed genes and pathways in leukocytes from heat-stressed Holstein calves.* Mini Ravi et al. UT.

- Heat stress is inflammation inducing and dexamethasone limits inflammation, can it help?
- Bull calves (n=8/trt, 35±0.5 wks, 68.5±1.4 kg) were individually-housed in climate controlled rooms and assigned to a 5-d trt: thermoneutral (TN, 24 hr at 20°C ambient temp + saline), heat stress (HS, 12 hr at 40°C/12 hr at 27°C + saline), or heat stress + dexamethasone (HSD, HS temp + 0.05 mg/kg dexamethasone). Blood was drawn @ 0, 12, and 108 hr for sequencing.
- HS vs. TN = only 2 DEG. HS vs. HSD = 980 DEG (pairwise = 1,789 upregulated and 920 downregulated). 66 upregulated DEG in HSD included 4 interleukins, *TLR*, and CD genes.
- **Take-home**: Compared to HS, HSD upregulated genes associated w/ leukocyte activation phagocytosis, and immune system signaling, which could aid in the HS response.

*1397. Plasma proteomic shifts from thermoneutral to heat stress conditions in preweaning Holstein heifers.* Manriquez et al. CSU.

- Blood was collected from calves (n=10, 7 d of age) at 0500 (thermoneutral, THI=59) and 1400 (heat stress, THI=80) h for proteomic analysis.
- Of the 1,304 proteins identified, 52 had different abundance (46 ↑ thermoneutral, 6 ↑ heat stress, P≤0.05). ↑ thermoneutral proteins = VAMP2 RASGRP2, RTN3 (synaptic vesicle transmission, coagulation, and neuroprotection). ↑ heat stress proteins = H2AC20, BPGM, and PSMC1 (nuclear cell integrity, glucose metabolism, and intracellular proteolysis)
- **Take-home**: The study helps identify pathways of specific cellular damage or functional pathways during transient heat stress.

*1398. Effects of heat stress on physiological indicators and weight gain in preweaning dairy heifer calves in a humid continental climate.* Conrad et al. U Guelph.

- Holstein heifer calves (n=138) on two commercial dairies were monitored and weighed from birth to 10 wk during an Ontario summer, Data loggers collected ambient temp and relative humidity (for avg and max THI, hrs/d where THI > 65/69 threshold).
- Weekly THI avg = 64 ± 6 (50 to 75); weekly max = 77 ± 4 (67 to 88); time > $THI_{65}$ = 12 ± 6 h/d; time > $THI_{69}$ = 7 ± 5 h/d.
- Each 1 h ↑ in time > $THI_{69}$, rectal temp ↑ 0.01°C, respiration rate ↑ 0.7 bpm, and ADG ↓ 0.01 kg/d (P≤0.03). Each 10-unit ↑ weekly avg and max THI, rectal temp ↑ 5 and 14 bpm, and ADG ↓ 0.13 and 0.21 kg/d (P<0.01).
- **Take-home**: Irregular exposure to high temp and humidity in a continental climate still instigates heat stress, as evidenced by changes in thermoregulation and ADG.

*2397. Effect of birth season on Holstein calves' voluntary water intake.* Antenucci et al. U Bologna.

- Water intake (WI) of dairy = calves (n=21-22/season) was randomly observed for first 21 d of life in the spring and summer to determine how max THI affected voluntary WI.
- Calves housed in "igloo" hutches and fed CMR 2x/d. Spring and summer avg temp were 23.6 and 31.3 °C and daily max THI avg was 70 and 81.
- Regardless of season, 20% had voluntary WI in the first week of life.
- Summer season ↑ daily avg (1.9 vs. 1.0 L) and cumulative (16.5 vs. 26.7 L, P<0.01) WI.
- **Take-home**: Calves had early life WI and WI increased under warmer weather; offering water early and often could be a cost-effective, welfare-promoting method for abating heat stress.

*1399. Effects of short-term cold exposure on Bos taurus dairy calves carrying the SLICK gene.* Worth et al. Livestock Improvement Corp.

- SLICK (short hair coat) vs. control calves (n=12/group) were assessed for thermoregulatory responses (i.e., hair length, rectal temp, skin temp, and behavior) under short-term cold stress in a modified refrigerator container at 1 and 5 wks of age.
- Hair length ↓ in SLICK at all locations (18-22 mm vs. 25-27 mm at pin bone, neck, and shoulder). Rectal (-0.12 and -0.22°C) and skin temp (-9.5 and -10.7°C) ↓ under cold in SLICK and control calves (NSD). SLICK ↑ shivering at 1 and 5 wks, but NSD for piloerection or lying.
- **Take-home**: SLICK calves maintained core body temperature despite shorter hair length, though they shivered more.

*2047. Effects of wildfire PM2.5 on calf lung and immune function.* Sarantopulos et al. U Idaho.

- Calves under similar management but different locations were exposed (n=20, WF, Moscow, ID) or not (n=18, CON, Corvallis, OR) to natural wildfire smoke particulate matter ($PM_{2.5}$) and assessed for lung and immune function.
- At 3, 9, and 12 wks of age, lung ultrasounds, health scores, lung function values, blood measures, and trans-tracheal washes (TW, 3 and 12 wk only) were conducted.
- WF calves w/ 24 d of moderate $PM_{2.5}$ (≤41.8 µg/m$^3$) from 3 to 9 wk of age whereas $PM_{2.5}$ was low (≤8.9 µg/m$^3$) for CON calves; NSD THI between groups.
- At 3 wk, WF ↑ TW granulocyte %, but ↑ granulocyte respiratory burst (P≤0.01). At 9 wk, WF ↑ serum albumin and haptoglobin (P<0.02). At 12 wk, WF ↑ haptoglobin, odds of lung consolidation and coughing (OR 17.7, 19.3, P<0.03) but ↓ tidal volume.
- Regardless of time, WF ↑ minute ventilation and serum amyloid A but ↓ white blood cells, lymphocytes, monocytes, eosinophils, and basophils vs. CON
- **Take-home**: Exposure to $PM_{2.5}$ greatly impacted lung function and immune cell populations, though results should be interpreted with caution due to different rearing sites.

**Growth (8 abstracts)**

2170. *Derivation of the maintenance energy requirements in growing Jersey heifers*. Carroll et. al. UNL, MSU.

- Non-pregnant growing Jersey heifers (n=8, 9.5 ±0.1 mo; 527 ± 32 lbs.) were fed maintenance diet estimated from NASEM (NEM [Mcal/d] = 0.10 x $BW^{0.75}$) for 24 d. Energetic measures incl. indirect calorimetry, intake, and total feces and urine excretion were made for 4 d., then heifers were fasted for 4 d with measures taken over the final 24 hrs.
- Heat production from growing heifers fed maintenance NASEM model-calculations avg 9.55 ± 0.61 Mcal/d and fasting heat product was 6.56 ±0.44 Mcal/d resulting in ME models:
  $ME_{maint}$(Mcal/$BW^{0.75}$ ± SD) = 0.157 ±0.0056
  NEM (Mcal/$BW^{0.75}$ ±SD) = 0.108 ±0.0051 x $BW^{0.75}$
- Efficiency of energy conversion of energy for maintenance ($K_M$) averaged 0.684 ±0.041.
- **Take-home** – For 525 lbs. Jersey heifers, "estimates of maintenance support those of NASEM (2021), although they are slightly higher."

2413. *CalfSim tool: A predication assessment study of performance predication of dairy calves*. Da Silva & Costa. UVT

- CalfSim is a "software-based decision support tool" that uses equations from NASEM (2021) as the "foundation for estimating energy and protein requirements," & starter intake. Modifications were implemented to account for "other solid feed intake prediction and nutrition digestibility and metabolization rate through age."
- Study objective: Compare CalfSim accuracy to actual performance of calves in JDS articles (n=24, published 2020-2025, +3 unpublished; n=76 trt, 258 BW observations, 1,585 calves).
- Studies were required to report milk allowance, CMR or milk composition, starter composition and BW at different ages. Calves must have had access to ad lib water and grain.
- Average BW observed and predicted were 161.6 ±51.1 lbs. and 151.2 ±46.4 lbs.
- BW predictions were accurate (β0 = 0 [*P* = 0.660], β1 = 1 [*P* = 0.097]) and precise ($R^2$ = 0.91, CCC = 0.93) → tool w/ high predictive performance.
- The analysis also showed significant study random effects like environment and farm-specific factors that NASEM 2021 nor the CalfSim adapted model could capture (P<0.05).

- **<u>Take-home</u>** – "CalfSim accurately predicts BW gain under typical conditions, aligning with expected growth patterns across nutritional strategies." Also, on-farm variability effects remain a practical concern.

2404. *Extracting individual factors that influence starter intake and growth in dairy calves during pre- and postweaning*. Da Silva, et al. UVt, Guelph

- Data on male Holstein calves (n=480) derived from 4 experiments w/ 12 nutritional intervention trts were disentangled to evaluate grain intake and BW.
- Variables evaluated incl. d on trial (1 – 84), initial BW (105.6 ±8.5 lbs.), STP at arrival (5.6 ±0.63 g/dL), calf source, ME intake from CMR (3 ±1.9 Mcal/d) and occurrences of diarrhea and BRD.
- Starter intake: d on trial, initial BW, ME intake from CMR, and bouts of diarrhea or BRD were significantly correlated (P<0.01; $R^2$ = 0.84). Same for BW gain (P<0.05; $R^2$=0.93)
- Initial BW and ME intake from CMR were positively associated and diarrhea and BRD were negatively associated w/ starter intake and BW.
- **<u>Take-home</u>** – "these findings highlight the importance of nutritional management and health status for optimizing early life growth and starter intake in dairy calves."

2142. *Key factors influencing growth in dairy calves: A retrospective cohort study.* Edwards and Renaud. U of Guelph.

- Calf health records (n=1,810 female Holstein calves, n=8 ON farms) were combined w/ individual calf weights at birth and weaning using electronic scales were analyzed.
- Mean ADG = 1.73 lbs. ±0.28 lbs./d, mean age at weaning = 66.6 ±8.1 d.
- Data screened for univariable analysis: season and time of birth, calving ease, birth and weaning BW, first colostrum volume and total colostrum fed in 24 h, colostral Brix % and colostrum feeding method, STP, weaning age, and incidences of diarrhea, BRD, naval infection, and inappetence. Variables with P<0.20 in the univariable analysis were included in a multivariable mixed effects linear regression model.
- Spring (Mar-May) born calves ↓ADG vs winter-born (Dec-Feb) calves (-18.5 g/d; P=0.05). Calves born in the morning ↓ADG vs. evening (-19.5 g/d; P<0.001).

- Calves fed colostrum w/ 24-25% Brix ↑ ADG vs. ≤23% Brix (+17.3 g/d; P=0.03). Every 0.1 g/dL ↑in STP resulted in +10.4 g/d ↑ in ADG (P=0.01).
- Calves treated for BRD or inappetance ↓ ADG vs. healthy calves (-62.1 g/d, -28 g/d; P<0.001).
- Each +1 d increase in weaning age resulted in lower ADG (-2.5 g/d; P<0.001).
- **Take-home** – In an analysis of health records and BW measures of 1,810 female Holstein calves, incidence of BRD and inappetence reduce prewean ADG. Improving colostrum quality and feeding practices and thus STP improve ADG. Calves born in the winter compared to spring, and in the evening rather than that morning, also report improved ADG.

*1448. The positive associations between calf and lactation performances in dairy cattle.* Legge et al. The University of Sydney Camden

- Holstein heifers (n=1,440) were assessed for weaning BW to measure impact on lactation number, milk yield/lactation, and total lifetime milk yield.
- Birth BW had slight + linear trend, whereas weaning BW strongly influenced milk yield → each lactation +53±8.5 kg milk yield per kg weaning BW, also strong + for lifetime milk yield
- Weaning BW significantly impacted survivability → weaning BW of 50 kg: Pr=0.17 to reach 3+ lactations vs. 100 kg: Pr=0.41 which improves lifetime productivity
- **Take-home**: Early-life calf management influences mature milk production and survival.

*2414. Use of cameras for algorithm generation for the estimation of weight and body measurements of Holstein calves.* Evangelista et al. U Sao Paulo.

- Calves (n=72) weighed 4x by mechanical scale and measured for stature. Video was recorded simultaneously to extract depth and infrared frames to train model for automated calf ID and predictive variables to estimate calf growth parameters.
- High correlation between manual and image growth estimates. BW: r=0.93, $R^2$=0.86. Withers height: r=0.86, $R^2$=0.74. Hip width: r=0.84, $R^2$=0.70. Heart girth: r=0.87, $R^2$=0.74.
- **Take-home**: Imaging technology is a precise, efficient, and automated alternative for manual calf growth measures.

2408. *Associations between visual body condition score and ultrasound measurements in preweaned Holstein calves*. Laznik et al. U of MN

- Preweaned female Holstein calves (n=202) were evaluated for BCS (1-3 scale, FARM program, bi-weekly), BW (bi-weekly), hip height (arrival vs. wean), heifer mass index (kg calf BW/hip height) and ultrasound parameters to determine relationship between growth measures and backfat and muscle thickness.
- Ultrasound images collected between pins, hooks, and left thurl were analyzed to determine back fat thickness (mm from termination of skin to termination of profound fascia) and muscle thickness (mm from termination of profound fascia to termination of gluteal muscle)
- Regression coefficient for BCS on BW = 0.216 ± 0.018. BCS not associated w/ hip height and heifer mass index, but it was associated w/ ultrasound measures of backfat and muscle thickness.
- **Take-home** – visual body condition scoring of pre-wean calves is an appropriate assessment of the calf's nutritional status.

2410. *Estimating body weight of Holstein and Angus x Holstein dairy calves using heart girth tape*. Ferdman et al. U of Guelph; U of Vermont, Burlington.

- Holstein (n=422) and Angus x Holstein (n=260) calves (1-11 wks old) were weighed 1x w/ a calibrated digital scale and 1x w/ a weigh tape (Holstein Calf Weigh Tape, Coburg). Researchers (n=6) assessing w/ tape measures were blinded to the digital scale readings.
- Mean BW = 151.7 lbs. ± 40.1 lbs., ranging from 61.7 to 315.3 lbs.
- Relationship between weigh tape and digital BW scale were analyzed via mixed linear regression, Lin's concordance correlation coefficient (LCC), and Bland-Altman difference.
- The weigh tape overestimated the digital scale measurements by 2.25 lbs. (P<0.001). The Bland-Altmann difference (BW tape - digital scale) was 0.81 ± 10.4 lbs.
- The Lin's CCC between BW tape and digital scale was 0.98 for Holstein and 0.89 for crossbred calves (P<0.001).
- **Take-home** – "BW tape is a useful tool for estimating pre-weaned calves' BW, though accuracy varies by breed."

**Management surveys (2 abstracts)**

*1581*. *CalfWays: The Australian dairy industry sustainable calf management roadmap.* Hancock et al. Dairy Australia.

- CalfWays is a framework for the Australian dairy industry to limit calf loss (1 in 3 slaughtered before d 30, 1 in 10 euthanized by d 1) by keeping in valued market chain and limiting on-farm euthanasia.
- Built after consultations/workshops with 150 industry stakeholders with core 4 themes: stakeholder commitment, capability building, market connections, and fostering partnerships
- **Take-home**: Now in the implementation stage, this program's goal is to create value chains for non-replacement dairy calves.

2392. *Do milk replacer labels measure up? Characterizing management recommendations provided on milk replacer labels*. Woodrum Setser et al. UVT

- What management recommendations are there on the labels of CMR's sold in VT?
- CMR labels (n=52, 12 brands) were scrutinized, examining feeding recommendations, including colostrum, calf starter, water, forage provision, and weaning.
- "43% and 13% of products provided a colostrum volume (median = 3.8 L) and quality recommendation (IgG=200 g/L), respectively."
- 77.8% provided a specific age for starter provision (2-4 d) w/ 19.4% suggesting w/in the first wk. 87.8% encouraged water provision.
- 43.4% provided forage recommendations, of which 95% discouraged hay. 27% suggested a weaned starter intake goal of 3 lbs./d w/ 20.8% suggesting weaning start age at d 48.
- 37.7% provide reccs for cold weather feeding, of which 67% of these suggest consultation with a nutritionist and the others suggest feeding "50% more milk" when <10 C.
- **Take-home** – this study reports the diversity of management strategies included on a CMR label in VT.

**Weaning (4 abstracts)**

2032. *Effects of weaning pace and probiotic supplementation on mRNA abundance of inflammation-related genes in rumen and liver tissue of male Holstein dairy calves.* Malekkhahi et al. U Idaho.

- Holstein bull calves (n=9-10/trt) enrolled in 2x2 factorial: weaning (abrupt vs. gradual) and probiotic or not, then euthanized after weaning for rumen and liver cytokine gene expression
- Abrupt = 3 d step-down at 1.13 L/feeding (54-57 d of age); gradual = 14 d step-down at 0.49 L/feeding (49-63 d of age). Probiotics = *L. agilis*, *L. delbrueckii*, *L. mucasae*, and *L. reutiri* at 1 x $10^9$ cfu/mL in 22:22 CMR for 7 d at 4 d pre-wean to 3 d during wean.
- NSD for weaning main effect on rumen gene expression, but abrupt + probiotic ↑ rumen *IL6*, *IFNγ*, and *ICAM1* vs. abrupt + control (P≤0.09). Abrupt weaning ↓ liver *IL6* and *NFKβ* (P≤0.10).
- **Take-home**: The discrepancy in cytokine expression in rumen and liver suggests abrupt weaning, esp. w/ probiotics, prompts a localized not systemic inflammatory response.

2034. *Effects of calf gut-oriented probiotics and weaning pace on subjective health measures, serum non-esterified fatty acids, and plasma haptoglobin in Holstein dairy calves.* Rasmussen et al. U of Idaho.

- Same experiment as 2032, now assessing health and metabolites.
- Health scored daily using 1-4 scale (1 = healthy, 4 = debilitated): cough severity, feces discharge, depression of ears, fecal consistency, joint and navel inflammation and attitude; hydration status and perineal cleanliness were measured weekly. Serum NEFA and plasma haptoglobin measured at d 3 and 7 of age, at onset of treatment and 1 d post-wean.
- NSD in plasma haptoglobin with concentrations ranging between 0.161 to 3.3 mg/ml. NSD in NEFA concentrations or subjective health scores.
- **Take-home** – Neither weaning pace nor administration of probiotic noted any detectable effects in hematological or other health measures.

2391. *Effects of weaning age on the growth and metabolic status of dairy and dairy x beef crossbred calves.* Pinkerton et al. Purdue

- Bull calves (n=32; 16 Holstein and 16 Angus x Holstein) were either a.) weaned at 42 d [early], or b.) 56 d [late]. Calves were fed 3 quarts CMR 2x/d until either d 35 or d 49 when the AM feeding was removed for a 1-wk step-down to complete wean.
- All calves individually housed and offered ad lib texturized calf starter. Starter intake measured daily, individual BW weekly. Blood collected weekly from wk 3 to 8 and analyzed for glucose, NEFA, and insulin concentrations.
- Starter intake ↑ during wk of step-down for the late-weaned calves (P<0.01). NSD of trt or breed for BW or ADG between either the wean strategy.
- From wk prior step-down through wean, feed efficiency ↑ in early-weaned calves (0.76 vs. 0.62) and in crossbred vs. Holsteins (0.74 vs. 0.63, P≤0.02)
- NEFA and insulin ↑ at wk 5 and 6 for early wean vs. late, and glucose ↑ at wk 5 for late wean.
- **Take-home** – Although feed efficiency was higher in early vs. later weaned calves, "early wean calves may have experienced increased metabolic stress at step-down and weaning."

1306. *Effects of weaning age on health and hematological measures in dairy and dairy x beef crossbred calves*. Pinkerton et al. Purdue.

- Same experiment as 2391, now for health measures. Calves were assessed daily for diarrhea and BRD. Blood was collected wk 4 to 8 and analyzed.
- NSD of trt or breed on neutrophil:lymphocyte ratio, hematocrit, or counts of white blood cells, lymphocytes, red blood cells, monocytes, eosinophils, basophils or platelets.
- NSD in the frequency of diarrhea in weaning age (6 or 8 wks; P=0.89) or between Holstein and crossbred calves (P=0.94). Frequency of BRD was low.
- **Take-home** – in this small study early weaning had no negative impacts on calf health, regardless of breed.

**Behavior and welfare (22 abstracts)**

**Transport (2 abstracts)**

*1253*. *Short- and long-distance transportation: Survival and growth of dairy and dairy-beef cross calves.* Schuenemann and Pineiro, OSU.

- Dairy (n=125,901) and beef x dairy (n=266,111) calves managed similarly (n=15 dairies, 3.8 L of colostrum, and 4 2-L milk meals before transport) were retrospectively analyzed for survival and ADG based on transportation duration (0.5, 8, 17, or 24 h).
- Calves were assessed as "healthy" before transport, and disease at arrival to weaning was recorded. Birth measures and calf metrics also recorded (i.e., sex, breed, etc).
- Mortality at arrival = 0.01%, NSD between transport duration (P=0.13). Mortality at weaning = 2.5% (3.6%, 1.0%, 2.2%, 1.6% for 0.5 to 24 h transport, P<0.05)
- ↑ arrival mortality associated with sex, breed, parity, birth season and year, dystocia, age at transport, FPT, and health (P<0.05). ↑ weaning mortality associated with gestation length, FPT, calf disease, female dairy heifers born to heifers, and season (summer).
- NSD for ADG in beef x dairy calves, but ↑ ADG for dairy calves transported 24 hr vs. 0.5 hr (confounding effect of parity).
- **Take-home**: Extended transport duration did not impact survival or ADG (though there were confounding factors that could influence result interpretations).

*2164. Effect of plane of nutrition and inclusion of direct-fed microbials on calf performance and fecal pathogen counts in transportation-stressed calves. Forgues et al. ISU.* **see Nutrition → CMR milk feeding rates and strategies.**

**Pain management (3 abstracts)**

*2311*. *Effects of caustic paste application method on wound healing in dairy calves.* Yoo et al., UBC.

- Holstein heifer calves (n=20) were caustic paste disbudded at 4 to 6 d through two strategies to determine healing time: paste area (large vs. small [22 vs.12 mm]) and paste thickness (thin vs. thick [1 vs. 2 mm], w/in calf). Pain mgmt. was sedation, nerve block, and NSAID drug.
- Large and thick trt ↑ caustic paste amt (0.32-0.39 vs. 0.15-0.22 g for small and thin, P<0.001) and ↑ wound size (356-495 vs. 178-316 $mm^2$, P≤0.003).
- Necrotic tissue detached earlier in small and thin trt, thus wounds healed more quickly (13-15 vs. 16-19 wks, P≤0.04), but scurs were present in 18/18 small trt and 0/14 large trt horns.
- **Take-home**: Although smaller and thinner paste application improves wound size and healing, the smaller diameter (12 mm) is insufficient to successfully impair horn growth.

*2312*. *Disbudding dairy calves with caustic paste: Assessing the effect of contact duration on the healing process.* Drwencke et al., UC Davis.

- Holstein calves were assigned to one of two trt (n=15/trt): "normal" caustic paste disbudding method (0.2 mL paste to shaved horn bud, left to dry) vs. "wiped" (same protocol but paste removed after 1 hr) to determine if paste contact duration impacts healing or regrowth.
- Paste rubbing prevalence observed at 1 and 4 hr (normal), wound diameter measured at 1 d and 5 wk later, and horn regrowth measured weekly to 21 wk.

- NSD between trt for paste rubbing, wound diameter at 1 d (19 and 20 mm) and 5 wk (23 and 22.7 mm), or for wound healing stages at 21 wk (40 vs. 33% fully healed, normal vs. wiped).
- Wiping trt tended ↑ horn regrowth (P=0.07) vs. normal.
- **Take-home**: Wiping paste after 1 hr of application did not benefit wound size or healing and increased risk of regrowth.

*2665*. *Effect of calf age at castration on health and performance in young dairy origin calves*. Langenkamp and Gawthorp, CalfCare.

- Beef x dairy sale barn calves (n=130) were enrolled at custom raising facility at 3 to 7 d of age into 1 of 4 trt to assess age of castration on health and performance: negative control (CON, heifer calves, n=59); bull calves castrated upon arrival (C0), at 21 d of age (C21), or at weaning/42 d of age (CW, n=24/ea.).
- Meloxicam for pain management was given prior to castration, and castration protocol was standard. There were no differences in STP at arrival, but CON calves were smaller from arrival to d 49 (heifers vs. bulls).
- NSD between trt for BW gain to 66 d of age. C0 had numerical (but not statistical, P=0.25) ↓ total treatment costs ($0.41 vs. $1.63-$3.47). NSD for mortality outcomes (0% mortality).
- **Take-home**: This study indicates there is no impact of castration age on calf outcomes – more power is needed.

**Feeding and activity behavior (10 abstracts)**

*2158*. *Calf feeding behaviors after vaccination when fed ad libitum milk from automated milk feeders*. Bone et al., PSU.

- Transported beef x dairy calves (n=22 pairs) were pair-matched as vaccinated (Bovilis Bovivac at 7 d post-arrival and 21 d) vs. not. They were managed under ad lib milk in an automated feeder to measure feeding behaviors d -2 to 4 relative to booster status.
- Vaccinated calves ↑ milk intake d 0, 2, 3, and 4 of booster (P≤0.05) and ↑ drinking speed and rewarded visits vs. control calves.
- There were similar relative change in intake, speed and visits between vaccine and booster periods between groups.
- **Take-home**: Booster vaccination does not negatively influence feeding patterns and prompts higher intakes.

*2301*. *Relationship between the level of passive immunity transfer and behavior in dairy calves managed in an automatic feeding system during the rearing period*. Morales et al., U de la Republica.

- Calves (n=48) were dam-nursed colostrum and classified as poor (<8.1% Brix), acceptable (8.1-9.5), and excellent (≥9.5%) PTI.
- They were enrolled into an autofeeder at 5 d of age (~4.6 L/d milk, 0.5 kg starter), and activity and feeding behaviors were observed every 5 min for 3 hr in the AM and PM for 2 d every 15 d.
- Excellent TPI calves ↑ lying, milk drinking, licking, standing and eating fiber time vs. poor and acceptable or just poor calves (P<0.01). Poor TPI calves ↑ ruminating lying down time vs. acceptable calves.
- **Take-home**: “Natural” TPI affects calf feeding and lying behaviors pre-weaning.

*2606. Monitoring play behavior in dairy calves using computer vision and accelerometers.* Yang et al. Cornell.

- Accelerometer and video data were collected on n=6 farms for automated pipelines to quantify calf play behavior.
- Accelerometer pipeline: Tri-axial accelerometers trained computer model to play vs. non-play behavior processed 47 hr of data in 4 min w/ area under the curve = 0.87.
- Video pipeline: 63, 33-min videos from 2 farms w/spatial and temporal info to differentiate playing from nonplaying w/ neural network classifier. Accuracy =97% but performance dropped when applied to data from a new farm (larger, more diverse training set needed).
- **Take-home**: These results are promising for detecting general play behavior but further work is needed to improve performance across datasets and detect individual behaviors.

*2638. Artificial intelligence for dairy calf monitoring: A comparative analysis of pose estimation models.* Mussi et al. Purdue.

- Data from n=61 calves trained 2 post estimation models to track 16 or 30 annotated facial features on images of ears, eyes, and nose. Model performance parameters were compared.
- Both models had good recall (0.98) and mean average precision at 0.50 threshold (0.98).
- The 16-keypoint model trained faster (7,900 vs. 9,600 secs) w/ ↑ precision (0.97 vs. 0.96) but had ↑ error (3.5 vs. 2.3) and ↓ mean average precision at 0.95 threshold (0.40 vs. 0.56) vs. the 30-keypoint model → better at detecting visually challenging features.
- **Take-home**: Model selection should be task-specific, depending on dataset characteristics and research objectives, but both have potential to enhance efficiency in calf phenotyping.

*2680. Evaluation of an ear-tag accelerometer sensor for preweaned dairy calves.* Heins et al. U of Mn.

- Calf (n=27) behavior was correlated between an automated feeder (drinking speed, Holm & Lau, 10 L/d milk) and ear-tag accelerometer (rumination, eating, not active, active, and high active; CowManager SensOor).
- Correlation of ruminating and drinking speed = 0.50, eating and drinking speed = 0.41, and not active and drinking speed = -0.51 ($P<0.001$).
- Slope of regression line = 0.21, 0.11, -0.36 for ruminating, eating, and not active behaviors.
- **Take-home**: The ear-tag sensors detect behaviors that correlate decently to automated feeder-detected drinking speeds, which could support calf health detection and management.

*2405. Diarrhea and fever prediction in Holstein calves using machine learning.* Diavão et al. Empresa Brasileira de Pesquisa Agropecuária

- From birth to 60 d, calves (n=29) were tagged with behavior-detecting ear tags (Sensehub, Merck) to collect daily rumination and activity and predict diarrhea and fever vs. visual observation (fecal score ≥ 2 or fever ≥ 39.5°C).
- Model accuracy = 0.65, recall = 0.83, F1-score = 0.69, test power = 70% ($P=0.05$).
- Rumination and activity data w/ significant effect on diarrhea and fever prediction ($P<0.01$).
- **Take-home** – Model is moderately accurate, and the activities monitored are related to morbidity visual observations.

*1391. Computer vision-tracked behavior in dairy calves during a subtropical summer.* Saha et al. UGA. **see Management → Environment**

*2390. Preliminary exploration of the effects of extended colostrum feeding on calf behavior, growth, and diarrhea.* Tipton et al. CSU. **see Maternal-fetal → Colostrum, colostrum replacers, and transition milk**

*1207. Association of personality traits and the expression of sickness behavior in dairy calves with neonatal diarrhea.* Welk et al. U Guelph. **see Health → Enteric disease**

*2041. Association between activity behavior and neonatal calf diarrhea in group-housed dairy calves.* Welk et al. U Guelph **see Health → Enteric disease**

**Cow-calf contact (7 abstracts)**

*2326. Dairy cow health in cow-calf contact systems on commercial farms in North America.* Durrenwachter et al., UVT.

- Cows (n=430) from n=12 farms (dam-calf rearing primary strategy) in US and Canada were assessed for welfare, health, and milk quality (<30 DIM).
- 0% of cows w/ BCS < 2 and 7% w/ BCS ≥ 4 (i.e., over-conditioned). 70% of cows were severely lame, 4% were scored "dirty," and 2% had chapped teats.
- 62% of cows w/ SCC <200,000, 9% between 200-400,000, 2% between 400-750,000, and 21% above 750,000 cells/mL (above saleable limit).
- Elevated NEFA (>0.6 mEq/L) in 15% of cows, 0% w/ elevated BHB (>1.2 mmol/L)
- **Take-home**: Cows from dairies employing cow-calf pairing meet most industry benchmarks, though milk quality is an area of opportunity.

*1343. Udder health and short- and long-term milk yield in Holstein cows with delayed calf removal.* Beard et al., Cornell.

- Primi- and multiparous dams were assigned to immediate calf removal (ICR, n=35) or delayed calf removal after 5 DIM (DCR, n=17).
- Cows were housed in similar conditions, milked 2x/d for 7 d then 3x/d from 8 to 63 DIM. Milk samples were collected at 0 and 7 d and residual milk yield assessed at 3 and 7 d.
- DCR ↓ milk yield at 3-5 DIM (-30 kg, P<0.01), but NSD from 6 to 7 DIM and 14 to 63 DIM. NSD for new or chronic intramammary infections and NSD for residual milk.
- **Take-home**: Maintaining cow-calf contact for 5 d did not alter milk yield outside the window of contact and did not greatly impact mastitis or milk letdown.

*2308. The impact of delaying cow-calf separation on dairy cow behavior.* Callero et al., Cornell.

- Cow-calf pairs maintained contact for 0 (0D, n=6), 3 (3D, n=5), 5 (5D, n=6), and 7 d (7D, n=6) in individual box stalls w/ or w/out solid barrier to calves. Dams were milked 2x/d.
- Audio/video behavior was collected 24 hr before to 24 hr after separation, and heart rate was monitored 4 hr after morning milking on d before and d of separation.

- All trt dams accepted calves, groomed them, and kept them uninjured.
- 5D and 7D dams ↑ vocalizations and 5D ↑ heart rate deviation ($P \leq 0.04$) vs. 0D and 3D.
- **Take-home**: This study suggests there are measurable behavioral responses to delayed separation vs. immediate; how long to pair before these responses are ameliorated?

*2028. Comparison of cow-calf contact or transition milk feeding on calf growth and health scores.* Ewing et al., Cornell.

- Holstein and beef x dairy calves enrolled in 3 trt for 5 d: unrestricted cow-calf contact (n=18), restricted but fed transition milk (n=16), and restricted and fed whole milk (n=20). Milk offered at 10% BW 2x/d. All calves moved to outside hutches at d 5 and managed identically. Health scores, growth, and intake measured 0 to 9 wks of age.
- NSD of trt on health or fecal scores on d 0 to 7 or wk 2 to 9 nor on total ADG (0.81-0.83 kg/d).
- **Take-home**: In this study, there was no impact of rearing calves with cow-calf contact or transition milk for 5 d versus a standard whole milk diet.

*2022. Are cows good moms? Exploring maternal behavior in multiparous versus primiparous cows.* Byrd et al., Purdue.

- Primi- and multiparous cow-calf pairs (n=4/trt) housed in box stalls were monitored for 4 maternal behaviors: touching duration, allogrooming, calf checks, and aggression.
- Multiparous dams tended to touch calves more (13 vs. 7 ± 2 min/24 hrs, $P=0.10$), NSD of parity on any other behaviors.
- Smaller calves received ↑ allogrooming and more frequent checks vs. larger calves ($P \leq 0.09$).
- **Take-home**: Parity did not strongly influence maternal behaviors, but the small sample size and variability limit interpretations.

*2027. The first 24 hrs: Nursing and suckling behaviors of cows and calves, and possible need for human assistance.* DeHaven et al., Purdue.

- Same experiment as 2022, now monitored for 4 suckling behaviors: cow nursing avoidance, suckling duration, teat-seaking attempts, and human assist to suckle duration. Humans intervened with suckling before milking only if they did not suckle independently.
- NSD of parity on any of the suckling behaviors ($P \geq 0.15$), but smaller calves ↓ teat-seeking attempts and ↑ human assistance to suckle ($P \leq 0.06$).
- **Take-home**: Same as above, parity did not strongly influence nursing behaviors, but calf size seems to play a role.

*2302. Effect of serotonin on milk quality, production, and dam activity in a cow-calf contact system.* Teixeira et al., UW-Madison.

- 5-hydroxytryptophan elevates blood serotonin; could it improve dam milk output and activity in a cow-calf system?
- Pregnant dams received a daily single infusion of 5-hydroxytryptophan (5-HTP, dose?, n=11) or saline (n=11) for 10 d prior to expected calving, then cow-calf pairs were housed in pens for 30 d with gradual weaning and 2x/d milking. Activity was monitored w/ accelerometers.
- NSD of trt on milk production or SCC but 5HTP dams ↑ tended to be more active ($P=0.22$).
- **Take-home**: Prepartum 5HTP influenced activity but not milk outcome in a cow-calf system, which could influence maternal tendencies.

**Non-replacement calves (23 abstracts)**

**<u>Beef x dairy (18 abstracts)</u>**

*1395. Calf welfare and husbandry practices on dairy-beef operations in the Midwestern United States*. Schafer et al., Purdue.

- Beef x dairy calves (n=1,436, 3-7 d of age) from 20 calf-raising facilities in IN, OH, WI, and IA were enrolled and assessed for dehydration, hygiene, and disease at 1, 5, and 10 wk.
- Farm-level prevalence varied greatly. At 1 wk, prevalence was 67% diarrhea (14.5 to 100%), 21% BRD, 10% navel inflammation, 8% dehydration. At 5 wk, prevalence was 17% diarrhea, 29% BRD (1-77%), and 10% poor hygiene. At 10 wk, 25% BRD and 16% poor hygiene.
- Common management trends in calf facilities: 30% social housing (14±2 calves/group); beef x dairy 35% of farm pop'n (33% of which were female). Avg milk allowance = 4.8±0.3 L/d, weaning age 44 d (38 to 56 d). ~50% w/ abx in the water at arrival for 9±5 d.
- **<u>Take-home</u>**: There is great variance in beef x dairy husbandry practices and disease prevalence in the Midwest US.

*2001. Condition of calves on arrival at dairy-beef farms in the Midwestern United States.* Schafer et al., Purdue.

- Same experiment as 1395, calves enrolled at 6.4±7.2 hrs after arrival. Health, dehydration, and depression assessed and blood samples collected for FPT w/ a subset (n=327) measured for other metabolites
- Disease and blood parameters at arrival: 48% diarrhea, 36% dehydration, 22% navel inflammation, 19% depression, 22% FPT (STP < 5.1 g/dL), 48% hypoglycemic, 32% ↑ NEFA.
- **<u>Take-home</u>**: Beef x dairy calves arrive at calf-raising facilities w/ FPT, disease, and low energy reserves. We've got some room to improve for both welfare and productivity.

*2003. Association of breed with health and growth performance of preweaning Holstein and beef × dairy calves.* Rocha et al. Texas Tech.

- Holstein (n=54) vs. beef x dairy (n=66) calves were managed similarly (6 L CMR/d and ad lib starter and water) and monitored for key growth and health indicators to compare breeds.
- NSD of breed on diarrhea incidence, BRD, or mortality (P≥0.20), but beef x dairy ↑ 56-d ADG (+0.09 kg/d), ↑ calf starter intake (0.34 kg/d), and ↓ age at starter intake (-4 d, P<0.01)
- **<u>Take-home</u>**: Growth (but not health) performance was improved in beef x dairy calves over Holsteins calves in this study.

*2636. Assessing the genomic relationship of beef-on-dairy calves in Canada*. Lopes et al. U Guelph.

- Genomic data collected from beef x dairy calves (n=4,992), sires (n=86), and dams (n=117,639) to assess relationships of calves and possible parents using a Genomic Relationship Matrix (GRM).
- 28,369 SNPs ID'ed common to all groups, final 311 SNPs from ICAR ID'ed for parentage verification to build GRM.
- Avg diagonal value of GRM for sires and calves = 1.55 (consistent w/ crossbreeding); avg genomic relationship for sires and calves = ~0.46 (-0.17 to 1.19). Both sires and calves had high avg genomic relationship w/in groups (0.56 and 0.60).

- **Take-home**: Better record keeping, more SNPs, and the more common SNPs ID'ed herein could help resolve uncertain parentage for beef x dairy calves to aid in selection decisions.

1511. *The environmental impact of targeted genetic improvement in US beef-on-dairy cattle production*. Lai et al. ABS, Dorest, WI.

- A life cycle assessment (LCA) for genetic improvement of beef x dairy vs. environmental impact was established. Researchers compared sires with indices w/in 0.5 SD from the mean (average) to sires w/ at ≥1.8 SD above the mean (elite). LCA included: individual records for feed efficiency across each phase (n=3,185) averaged w/in each genetic level, and feed composition data. System boundaries: dairy, calf raiser, finisher, and harvester.
- Elite ↓ emission intensity (-6.61%) vs. average genetic level → 15.38 vs. 16.47 kg Co2 equivalent per kg carcass weight, respectively. Lower intensity driven by "fewer d to finish and faster growth, resulting in lower feed intake, enteric fermentation, and manure production..."
- The finishing phase had the largest impact → longer production phase w/ more feed intake vs. other phases.
- **Take-home** – genetic improvements that influence feed conversion in the finisher phase will have the biggest environmental impact.

*1599. Effects of starch inclusion level in a starter diet for milk-fed beef-on-dairy calves on growth performance and gastrointestinal health.* **see Nutrition → Starter grain.**

*1180. Impact of early-life feeding strategies (including supplementing powdered colostrum the first 21 days) on growth and health in Holstein and crossbred calves.* Wang et al. U of Guelph. **see Nutrition → CMR milk feeding rates and strategies.**

*2348. Liver gene expression profiles in Holstein cross calves fed various concentrations of B vitamins.* Brost et al. U Illinois. **see Nutrition → Vitamins and trace minerals**

*1407. The effect of colostrum depravation on the gut microbial dynamics of beef-on-dairy calves.* **see Maternal - fetal → Colostrum, colostrum replacers, and transition milk.**

*1405. Comparing the correlation between serum total solids and serum IgG in Holstein and Angus crossbred newborn calves.* Hapukotuwa et al. U of Sydney **See Maternal-fetal → Colostrum, colostrum replacers, and transition milk**

*1600. Intestinal integrity and inflammatory markers in neonatal beef x dairy calves exposed to Salmonella infection.* **See Maternal-fetal → Colostrum, colostrum replacers, and transition milk**

*2406. Exploring how diarrhea, respiratory disease, and other variables impact feed efficiency in dairy calves.* **see Health → General morbidity.**

*1305. Association of severe diarrhea and BRD and ADG, feed intake, milk replacer refusal and mortality, in preweaning Holstein and BxD calves.* **see Health → General morbidity**

*1408. Epidemiologic risk factors for the PCR-based identification of Salmonella Dublin on dairy-beef farms.* **see Health → Disease prediction and prevention.**

*2391. Effects of weaning age on the growth and metabolic status of dairy and dairy x beef crossbred calves.* **see Management → Weaning.**

*1306. Effects of weaning age on health and hematological measures in dairy and dairy x beef crossbred calves.* **see Management → Weaning.**

*1253. Short- and long-distance transportation: Survival and growth of dairy and dairy-beef cross calves.* Schuenemann and Pineiro, OSU. **see Behavior and welfare → Transport**

*2665. Effect of calf age at castration on health and performance in young dairy origin calves.* Langenkamp and Gawthorp, CalfCare. **see Behavior and welfare → Pain management.**

**Veal/Holstein bull calves (5 abstracts)**

2666. *Holstein sale barn calves evaluated for total serum protein concentrations*. Casper et al. Casper's Calf Ranch

- STP were analyzed from n=1,107 male Holstein calves (16 trials over 5 yrs) using either an optical or digital refractometer.
- Mean STP concentration = 5.36 g/dL (range=2.8 to 8.0 g/dL; CV=14.1%, SD=0.77).
- Mean STP ↑ with year (4.94, 5.40, 5.37, 5.41, 5.58 g/dL for 2020-2024 respectively).
- 37% and 35.5% of samples had heifer immunity transfer status recommendations that were "fair" or "poor", respectively (industry standards: "fair" <20%, "poor" <10%).
- The % of "poor" calves ↓ from 60.0%, 33.3%, 33.2%, 30.1%, and 27.7% for 2020-2024.
- Mortality = 3.6% among these experiments and years.
- **Take-home** – colostrum status of sale barn sourced male Holstein calves is improving but much more work is necessary.

1304. *Health indicators associated with growth and body weight at slaughter in non-replacement Holstein calves*. Goetz et al. U of Guelph

- Male Holstein calves, (n=281) examined 2x/d for fecal scores and BRD incidence and weighed weekly until d 84 then moved to a finishing facility. Here they were reared a further 107 to 248 d (median 137 d) and were monitored for live weight, dress weight at slaughter, and d on feed.
- Calves were categorized into 3 groups: a) no days with abnormal feces or BRD d, b) <4 d w/abnormal feces and <2 d w/abnormal BRD score, c) ≥ 4 d w/ abnormal feces and ≥ 2 d w/ abnormal BRD (median score above and below).
- 58.4% of calves had an abnormal fecal score and 42.0% had an abnormal BRD score at least once at the starter facility.
- Median live weight at slaughter = 728.4 lbs. (range = 640.4-893.5 lbs). Median dressed weight = 419.1 lbs. (range = 345 to 487 lbs).
- Calves with ≥4 d abnormal fecal scores ↓ live weight and dress weight vs. calves w/ 0 d at the starter facility (-19 lbs, -10.4 lbs; P<0.01). Calves with >2 d with abnormal BRD score ↑ d on feed vs. calves w/ 0 d at the starter facility (+8.48, P<0.01).
- Calves sourced from drovers had ↑ live weight vs. calves from auction (+15.2 lbs.; P<0.01).
- Every 1 kg ↑in BW at arrival to the starter facility ↓ d on feed (0.77, P<0.01).
- **Take-home** – calf health early in life can affect live weight and dress weight at slaughter and result in fewer days on feed. Early health improves lifetime performance.

*2039. Factors associated with diarrhea recovery in non-replacement dairy calves.* Gibson et. al., U Guelph. **see Health → Enteric disease.**

*2036. Factors impacting electrolyte usage, morbidity, and mortality rates in non-replacement dairy calves at a commercial calf rearing facility.* McCarthy et al. U of Guelph. **see Health → General morbidity.**

*1581. CalfWays: The Australian dairy industry sustainable calf management roadmap.* Hancock et al. Dairy Australia **see Management → Management surveys**