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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
d = days
DFM = direct-fed microbial
FPT = failure of passive transfer
fdg = feeding(s)
g = gallon or g = gram
hr = hour
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
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.

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Nutrition (38 abstracts):

Additives in CMR, whole milk, or starter grain (18 abstracts):

1052M. *Tyndallized Lactobacillus helveticus (found in Swiss cheese, kefir, fermented foods) at weaning*? *Effects of weaning in general?* BK McNeil et al. U of Guelph; UW Madison.

- Male Holstein calves (n=23), CMR d 34 9L/d to 0.4 L/d day 42, supplemented 5 B cfu/d of this DFM from d 3 to 42 noted trend (P≤0.09) to ↓lying time (24.2 ↓minutes/d) and 9.9 seconds less play duration pre-wean (P=0.04) and 0.05 microgram/dL ↑salivary cortisol (P=0.01), and 0.5°C ↑max eye temperature (P=0.08) during weaning.
- Weaning resulted in 4.3 fewer lying bouts/d, 11.7 minutes longer lying bouts (P≤0.01), 8.9 sec shorter play duration per assessment and 1.1 fewer play counts per assessment (P≤0.01). Play assessed d 33, 37, and 41, for 3 min after adding straw bedding for 30 sec.
- No change in lying time (18.4 hrs/d), maximum eye temperature (98.6 °F), saliva cortisol (0.13 µg/dL; P=0.8), blood serotonin (3986 microgram/mL, P=0.6).
- No effect on cortisol concentrations in colon, ileum, prefrontal cortex, or brain stem.
- **Take-home**: Tyndrallized *Lactobacillus helveticus* had mixed results on weaning. Weaning changed behavior with fewer lying bouts & shorter play duration.

2642. *Tyndallized Lactobacillus helveticus effect on calves at weaning*? M. Olmeda et al. U of Guelph; Lallemand. UW Madison.

- Holstein bull calves (n=44) were supplemented DFM at 2 B cfu/d via CMR to d 42 wean.
- Calves were fed 6 L/d split into 3 meals/d increased to 9 L/d at one week. Calves were weaned via 4 d step-down (d 35 – 42). Starter offered ad lib commencing d 28.
- 19 calves were euthanized d 43 and intestinal tissues sampled at the proximal and distal jejunum and ileum to measure surface area. Blood samples drawn d 35, 42, 49, and 56. Gut permeability measured d 34 and 40.
- DFM did not affect intestinal tissue surface area (P=0.84). NSD in gut permeability between treatments. Weaning, in general, increased gut permeability (P<0.01).
- **Take-home**: Tyndallized *Lactobacillus helveticus* had no effect on health or growth, however, abrupt weaning increased gut permeability.

1635W. *Kefir?* CA Reynolds et. al. Miner Inst. Chazy, NY. Cornell.

- Kefir is a probiotic source. Holstein calves (n=60 farm A, n=40 farm B, n=40 farm C) received either a.) control (60 mL whole milk on farm A, no supplementation farm B or C, or b.) 60 mL Kefir 1x/d in whole milk or CMR for the first 21 d of life.
- "Farm A fed CMR at 13.6% solids. Farms B and C fed salable or pasteurized whole milk, respectively." Kefir was prepared on farm by fermenting milk with kefir grains for 24 h at 68 to 77 F. BW and stature was measured weekly on Farm A, and at d 0, 7, 28, and 56 on farms B and C. Feed intake and efficiency were calculated on farm A. Health measures were taken daily on farm A and weekly at farms B and C.

- Farm A, CMR intake NSD. Calves on kefir noted greater starter DMI at wk 8 (P<0.01) vs. control (2.82 vs. 2.51 lbs. ±20 g/d, respectively). Kefir did not impact G:F. NSD in ADG or BW between treatments on any of the three farms. Calves on kefir on farm B tended greater hip height (P=0.06) and were more likely to reach target weight at wean (P=0.02) vs. control.
- Cumulative d with diarrhea on farm A NSD (7.8 ±0.8; P=0.77). "Likelihood of medical intervention for scours was not different on all farms."
- **Take-home**: "Kefir supplementation during the first 21 d of life did not improve growth, diarrhea incidence, or need for antibiotic use. Early supplementation with kefir resulted in higher starter DMI before weaning …"

1192M Lysophospholipids in starter grain? Baraz et al, U of Kurdistan, Iran.

- Newborn female Holstein calves (n= 48) were offered calf starter with either no or 0.5, 1.0, or 1.5 g/kg lysophospholipids (Lipidol, LPL, Easy Bio Systems Inc.) d 1-63 (weaning).
- ADG and crude protein, ether extract, organic matter and dry matter digestibility was determined. Unfortunately, no poster was presented or posted online, so many research details are missing.
- ADG in all lysophospholipid groups improved (P=0.03) vs. control (1.15 vs. 1.03 lbs./d).
- NSD in digestibility of dry matter or organic matter. However, CP digestibility improved (P=0.05) linearly as lysophospholipid supplementation increased and the average increase in protein digestibility across lysophospholipid groups was +7% (P=0.06). Ether extract digestibility tended (P=0.10) improvement (86.7 vs. 83.4%) compared to control.
- **Take home**: Lysophospholipids suppl. in grain increased ADG and CP digestibility.

1195M. Hydrophilic emulsifier added to CMR and grain? Wood et. al. Animix. Mapleview Agri, Palmerston, Ontario. U of Guelph, Population Medicine. Functional Solutions, Wageningen, NL.

- Male calves (n=160) individually housed in a mechanically ventilated facility and reared as pink veal were offered diets of a) 500 ppm Solumul HE100 emulsifier in CMR, b) 500 ppm Solumul HE100 in both CMR and grain, or c) control, no Solumul HE100.
- All calves fed whey-based 26:20 CMR (86 lbs. over 56 d fed step-up/step-down with 2 wk wean) and *ad lib* texturized starter (20% CP, 4% chopped straw) transitioned wk 8 to corn and pellet grower (18.1% CP, 4% chopped straw).
- Calves were weighed weekly. Individual fecal and respiratory scores taken 2x/d.
- NSD in health between groups. % treated for BRD was 72.2%, 67.9%, and 55.1% for Solumul HE100 in CMR, in CMR + grain, and control, respectively.
- BW d 77 was 270.5^a, 271.8^a, and 263.9^blbs. for Solumul HE100 in CMR, CMR + grain, or control (superscripts P≤0.10).
- Grain intake pre-wean was 80.2^b, 93.0^a, 80.7^b lbs. for Solumul HE100, while grain intake post-wean was 173.5^a, 157.0^a, 180.3^b lb. for Solumul HE100 in CMR, in CMR + Grain, or control (superscripts P≤0.05). Post-wean G:F was 2.16^a, 2.04^a, and 2.57^b for Solumul HE100 in CMR, in CMR + grain, and control (superscripts P=0.004).
- **Take home**: Hydrophilic emulsifier improved feed conversion.

1196M. Enterococcus faecium *669 in pre-wean dairy calves?* BI Cappellozza. Chr. Hansen.

- Holstein calves (n=20, 10 males, 10 females) received either no DFM or 2 billion cfu *Enterococcus faecium 669* (LACTIFERM® Chr. Hansen) per kg of CMR (22:16) for the 42 d pre-wean period with DFM mixed directly into CMR. Starter (21% CP) was offered 1x/d.
- Individual BW was taken d 14, 28, and 42.
- DFM-supplemented calves tended (P=0.10) heavier d 28 and were significantly heavier (P=0.03) d 42. Mean ADG was greater (P=0.04) for DFM vs. Control (1.3 vs. 1.11 lbs./d).
- Control calves noted increased feed intake d 14-28 (P=0.04) but opposite results d 28-42 (P<0.001). No effect on G:F (P=0.59). No health measures reported.
- **Take home**: *E faecium 669* improved ADG.

1739W. How stable was an Enterococcus faecium *669 DFM (Chr. Hansen) blended in either a premix or calf milk replacer when stored at typical ambient over time?* G. Copani et al., Chr. Hansen A/S, Denmark and Milwaukee, WI.

- The probiotic was included in CMR at concentrations that suppl. 2.5 B cfu/head/d. Samples stored at 25 C (77 F) for 12 mo. and analyzed for CFU after 0, 1, 3, 6, and 12 mo.
- The same probiotic was included in a commercial premix (VTM details not provided) to provide 3 B cfu/head daily and samples were stored and tested the same.
- The CMR with probiotic was dissolved in water at 37 C (98.6 F) or 50 C (122 F) and kept at temp for 1 hr or prepared at 50 C, incubated for 1 hr at 25 C (77 F). All preparations sampled and enumerated for *E faecium* after 0, 15, 30, 45, and 60 m of incubation.
- *E. faecium* was recovered on average at 108% in the 1st experiment (P=0.29), 113% in the 2nd experiment (P=0.29) and noted NSD (P≥0.11) with recovery rates of 116% and 120% for either condition in the 3rd experiment.
- **Take-home**: *E faecium* 669 from Chr. Hansen is stable in CMR or premix after 12 mo of storage and during the preparation of the CMR at either 98.6 F or 122 F.

1740W. Effect of Enterococcus faecium *669 DFM (Chr. Hansen) on calf performance.* H. Biricik et al., Tekirdag Namik Kemal U, Tekirdag, turkey; Bursa Uludag U, Bursa, Turkey; Chris Hansen Horsholm Denmark and Milwaukee, MN.

- 1-d old Holstein bull calves (n=42) received either control (no DFM) or a DFM supplemented daily (2.5 B CFU/d) fed via whole milk. Calves received *ad lib* starer feed and alfalfa hay for the 63-d study period. Health measures (rectal temp, scour score, fecal analysis) were taken daily in early stages of the study.
- DFM supplemented calves were heavier (BW; P=0.04) at d 56 and weaning (P<0.01). with improved ADG and G:F (P<0.01). Rectal temps were lower (P=0.04) for DFM supplemented calves. Diarrhea was observed in the 1st two wks of the trial and tended lesser (P=0.09) when DFM was fed.
- **Take-home**: *E. faecium 669* improved calf performance reduced rectal temp and diarrhea.

1466T. Probiotics in pre-weaned calves? Widmer et al. UC Davis, CA Polytechnic U, San Luis Obispo. Chr. Hansen, Milwaukee, WI.

- Holstein heifers (n=324) enrolled within 48 h of birth were fed whole milk either with or w/o probiotic 1x/d. Probiotic supplemented contained 0.55 B cfu/d of a mixture of *B. subtilis, B. lichenformis, L. animalis, and P. freudenreichii* (Bovamine™, Chr. Hansen)
- Fecal scores taken daily, and fecal samples (n=50/trt) collected on d 7, 14, 21, and 42 to assess fecal pathogen shedding.
- Results: NSD for age at first diarrhea event, length of first diarrhea event, total d with a fecal score 2 (1 to 3, 1 being normal, 3 being loose), or in the risk of having a diarrhea event during the prewean period. NSD in fecal shedding of *E coli* and *E coli* 0157:H7 at all time points and *C. perfringens* at d 7 and 14. Total d with fecal score 3 were greater (3.46 ±0.35 vs. 2.85 ±0.31 d; P<0.05) for calves fed probiotic during the first 4 wks and calves fed probiotic also noted increased fecal shedding of *C. perfringens* at 21 d (4.38 x 10^5 vs. 2.34 x 10^5; P<0.05) and at 42 d (1.29 x 10^6 vs. 6.11 x 10^5; P<0.05)
- **<u>Take home</u>**: Supplementing DFM prewean had no benefit on calf health, resulting in increased duration of severe scours and increased fecal shedding of *C. Perfringens*.

1469T. A continuation of 1466T, did the probiotics affect serum metabolite concentrations? Meissner et al. UC Davis, CA Polytechnic State U, Chr. Hansen, Milwaukee, WI.

- Holstein heifer calves (n=112) were fed whole milk either with or w/o probiotic until weaning and then in grain either with or w/out to d 180. Probiotic supplemented in milk contained 0.55 B cfu/d of a mixture of *B. subtilis, B. lichenformis, L. animalis, and P. freudenreichii* (Bovamine™, Chr. Hansen Labs) and then the same bacteria at 0.825 B cfu/d in grain. Blood was collected d 14, 25, 45, 63, 77, 120, and 180.
- Glucose concentrations were greater (P<0.001) pre-weaning vs. post-weaning (88.0 vs. 81.1 mg/dL) and greater preweaning for the probiotic-treated calves (P<0.01). BHB concentrations increased (P<0.001) throughout the 180-d trial, greater (P<0.001) post-weaning vs. pre-weaning (661 vs. 240 µmol), and greater for the probiotic-treated calves post-weaning (P<0.001). Serum total free amino acids (TFAA) concentrations were greater (P<0.001) pre-weaning vs. post-weaning (3.37 vs. 3.03 mM) and greater for probiotic-treated vs. control (3.22 vs. 3.11 mM; P<0.001).
- **<u>Take-home</u>**: Nutrient metabolism and rumen development were enhanced by feeding Bovamine™ probiotic.

2400. Supplementing yeast-based postbiotic (SmartCare, Diamond V); effect on induced viral-bacterial respiratory disease? TW Maina et. al., Biotechnology R & D, Cargill, Minneapolis. Michigan State U. Iowa State U. Diamond V Mills, Iowa.

- Holstein x Angus cross calves (n=23) received either a) base CMR and calf starter, or b) SmartCare at 1 g/d in CMR and calf starter top-dressed with 5 g/d NutriTek.
- "Calves were infected with ~10^4 (Median Tissue Culture Infectious Dose, $TCID_{50}$) cfu of BRSV (bovine respiratory syncytial virus) on d 21, followed 6 d later by intratracheal

- inoculation with ~10^{10} cfu of PM (*Pasteurella multocida*) strain P1062. Bronchoalveolar lavage was collected antemortem (d 14, before BRSV infection) and postmortem (d 10 post viral infection) …". Lung tissue samples were also collected.
- Bronchoalveolar lavage revealed calves supplemented w/ SmartCare in CMR and NutriTek in grain had "milder transcriptional responses and different transcriptional patterns" (P<0.05) when responding to these induced disease challenges.
- **Take-home**: supplementing these two products "modulates immune function in the lungs" and shows potential as "alternatives to antimicrobials."

1682W. SmartCare in CMR, NutriTek Diamond V in grain. M Sfulcini, et al. Universita Cattolica del Sacro Cuore, Piacenza, Italy. U di Messina, Italy. Cargill Animal Nutrition & Health, Italy. Diamond V Inc., Cedar Rapids, Iowa.

- Holstein heifer calves (n=18) post-colostrum feeding were supplemented CMR and grain either a) CMR and grain not supplemented (+10 g/d of ground starter), or b) same CMR with 1 g/d SmartCare, Diamond V, and same grain + 5 g/d of NutriTek Diamond V and 5 g/d of ground starter from 5 to 70 d as solid feed.
- Calves received CMR until 60 d wean and *ad lib* starter from d 5-70, then grouped and fed 4.4 to 6.6 lb./d concentrate and *ad lib* ryegrass and alfalfa hay mix until 160 d. BW, feed intake recorded, blood samples collected.
- NSD in BW or ADG d 0-70, however supplementing Diamond V products to CMR & starter resulted in increased ADG d 70-100 (1.3 vs. 2.0 ±0.21 lb./d; P<0.01) and increased BW from d 100-160 (~22 lbs. more; no P-value provided).
- Diamond V products tended increased plasma concentration of BHB at d 60 (0.27 vs. 0.32 ±0.03 mmol/L; P=0.06), urea at d 70 (4.33 vs. 4.89 ±0.32 mmol/L; P=0.08), plasma myeloperoxidase at 70 d (275 vs. 305 ±37.3 U/L; P=0.04) and PMN phagocytosis at 60 and 70 d (avg values 67.4% and 76.8%; P=0.03).
- **Take-home**: supplementing SmartCare to CMR in combination with NutriTek in grain to d 70 resulted in improved ADG post-wean (d 70 – 100), increased plasma BHB, and increased immune function (greater phagocytosis and myeloperoxidase concentrations).

2470. In starter grain: phytogenic compound? functional mineral compound? yeast cell wall? SE Schuling et al. NutriQuest, Mason City, IA. Elanco, Greenfield IN.

- Female Holstein (n=60) and Holstein x Jersey (n=390) cross calves blocked by breed and initial BW and fed whole milk reconstituted to 14% solids using a 26:20 CMR fed 2x/d from d 1-51 and 1x/d from d 52-54 were supplemented in *ad-lib* fed starter grain (19.25% CP) either a) no-supplemented control, b) starter with 100 mg phytogenic compound + 3 g functional mineral compound + 2 g yeast cell wall, or, c) starter with 200 mg phytogenic compound + 6 g functional mineral compound + 4 g yeast cell wall. Calves moved to pens (12/pen) d 71-84, fed 18% CP grower pellet w/ 1 lb./calf starter.
- BW measured biweekly and starter intake measured 2x/week from d 1-70. Plasma and fecal samples taken from the first 25 calves in each group on d 1, 28, 52, and 84 (plasma

only). Plasma analyzed for TNFα; fecal samples analyzed for myeloperoxidase. Fecal scores biweekly to 28 d, and medications monitored.

- NSD in BW, ADG, or health events. Starter intake wk 5-8 increased (P<0.01) for calves fed either additive blend (2.25, 2.40, 2.45 ±0.13 lbs./d). Fecal scores were lower (P<0.01) for calves fed either additive blend (0.6, 0.51, and 0.51 ±0.03). Fecal myeloperoxidase (gut inflammation) tended (P=0.07) lower for either additive blend vs. control. TNFα at 84 d was lower (P<0.01) for either additive blend vs. control.
- **Take-home**: Feeding these three supplements in grain at either concentration increased pre-wean grain intake, tended to decrease gut inflammation, decreased fecal scores, decreased TNFα, but did not affect BW or scour events.

2471. *Galacto-oligosaccharides prebiotics isolated from whey added to CMR?* K. Ike. NCSU, Casper's Calf Ranch, Freeport, IL. MSG, Eden Prairie, MN.

- Holstein bull calves (n=88, 2-5 d old) received 22:20 CMR with either a) 0 g/d, b) 2 g/d, c) 4 g/d, or d) 8 g/d galacto-oligosaccharides (GOS). CMR fed at 1.25 lb/d (d 1-14), 1.9 lb/d (d 15-35), then a 7 d wean to d 42 at 0.95 lb/d (1x/d). GOS feeding rate was constant.
- Calves fed any concentration of GOS demonstrated lower growth performance variation vs. control (no stats). Final BW was 181.9, 183.0, 188.1, and 183.2 lb for 0, 2, 4, and 8 g/d, respectively, with 4 g/d greater (P<0.05) than others and 4 g/d also improving ADG (1.51, 1.53, 1.66, and 1.55 lbs./d; P<0.05)
- Calf starter intake greater (P<0.05) at wk 7 (3.81, 4.10, 4.30, 4.03 lb/d) and wk 8 (5.16, 5.51, 5.73, 5.50 lb/d) for 4 g/d (0, 2, 4, and 8 g/d). Feed:Gain was greater (P<0.05) for calves fed 0 and 4 g/d compared with calves fed 2 and 8 g/d (0.552, 0.529, 0.563, 0.545 kg:kg). NSD in body frame. 2 g/d fdg rate noted less scours (P value not reported).
- **Take-home**: GOS fed at 4 g/d in CMR improved final BW, BW gains, and ADG compared with control.

1611W. *Milk-derived bioactive tripeptide (Val-Pro-Pro)?* X. Zong, et. al. Huazhong Ag U, China.

- One month old calves (n=18, breed not disclosed) were administered by oral gavage for 17 consecutive d either a) 50 mL of phosphate buffer saline prior AM fdg, or b) 50 mL of Val-Pro-Pro (VPP) solution (100 mg/kg BW/d).
- BW, daily DM intake, and fecal scores were recorded. At 2 h after AM fdg on d 14, blood samples were collected, and antioxidant and immune indices measured. Fecal samples were collected d 0, 7, and 14 and 16s rDNA sequencing was performed.
- VPP had NSD DMI or BW, but ADG increased on d 7 (P<0.05). VPP decreased (P<0.05) serum TNFα and IL-6 and tended to reduce nitric oxide and IL-1β (P<0.10).
- After 7 d of VPP g_Lachnoclostridium, uncultured_bacterium, and g_Streptococcus in fecal samples increased (P<0.05). VPP also increased (P<0.05) concentrations of fecal short-chain FA n-butyric acid and isovaleric acid.
- **Take-home**: Milk-derived bioactive tripeptide increased ADG and decreased TNFα and IL-6. The peptide also increased fecal pathogens and short chain fatty acids.

1727W. Milk-derived bioactive peptide XPP? J Hou et. al. Huazhong Ag U. Wuhan, China.

- Milk-derived bioactive peptide XPP "is the product of casein in milk degraded by gastrointestinal protease" and "has been reported to inhibit inflammation …"
- Mouse study shows milk-derived bioactive peptide XPP alleviates the symptoms of inflammatory bowel disease, increases short-chain fatty acids in intestinal contents, increases expression of tight junction proteins in colon tissues ($P \leq 0.03$).
- **Take-home**: A specific peptide in casein is shown to reduce gut inflammation.

1734W. Saccharomyces cerevisiae boulardii? S. Jantzi et. al. U of Guelph. Lallemand, France & Milwaukee. U of WI-Madison.

- Holstein bull calves (n=20) received dietary treatment of either a) 1 B cfu/d in 5 g dose *Boulardii* live yeast, or b) placebo for the first 7 d of life. The first two meals were colostrum replacer at 2 and 12 h of life (total: 300 g IgG) and then CMR 2x/d.
- "Transcriptome and microbiota profiles of biopsied colon mucosa were obtained using RNA-sequencing and amplicon-sequencing on d 0 and 5." Gut permeability analyses were conducted on d 2 and 6 dosing and measuring chromium, lactulose, and mannitol. Blood samples taken at -1h (baseline) and +2, 4, 6, 8, 10, and 12 h.
- "Gut permeability did not differ between treatments." NSD in alpha and beta diversity and in differentially expressed genes between *Boulardii* yeast supplemented calves and control at d 5. Genes "related to immune function" were "uniquely expressed on d 5" in *Boulardii* yeast group.
- **Take-home**: *Boulardii* live yeast does not influence gut permeability but "it enhances colon mucosa immune function."

2643. Immunomodulation strategies to control respiratory disease. JL McGill. ISU.

- Review of the topic: BRD is 2nd leading cause of prewean heifer mortality and the leading cause of weaned heifer mortality.
- Maternal immunity is often ineffective against BRD, and it wanes before the calf's adaptive immune function is mature.
- BRD incidence in calves has remained static for several decades despite vaccines and therapeutics. Innate immunity can act quickly and provide broad but specific protection.
- The researcher reviewed strategies ISU has researched that enhance innate immune function in young calves, including phytogenic additives, postbiotics, nutrition approaches and intranasal or systemic immunostimulant treatments that prime innate immunity in calves.
- **Take-home**: innate immunity is responsive in young calves and various adjuncts can help its responsiveness and effectiveness.

<u>CMR milk feeding rates and strategies (5 abstracts)</u>

1191M. Low (20% fat) or high (24% fat) best for dairy beef? Scott et. al., MSG, U of MN Waseca, U of MN, St. Paul.

- Angus x Holstein calves (n=80) fed either a 20:20 (MR20) or 24:24 CMR (MR24) composed of milk, plasma, and wheat (65.7 lbs./calf over 49 d; no info on use rates of plasma and wheat or volume/conc per feeding). Calf starter (22.4% CP, 35% starch) offered ad lib.
- MR24 calves ↑ ADG by 30% (0.70 vs. 0.54 kg/d, P<0.01), ↑ BW (81 vs. 71 kg) and hip height at 56 d (P≤0.03). NSD on DMI, so feed efficiency ↑ for MR24.
- MR24 calves ↓ scours incidences w/lower treatment costs ($2.70 vs. $0.10, P=0.02).
- **<u>Take-home</u>**: Higher plane of nutrition for pre-weaned beef x dairy calves improves growth, feed efficiency, and health in the present study.

1194M. Dried cheese powder replacing whey protein and protein encapsulated fat? Vermeire et. al., Nouriche Calf Research Center, McMurray PA. International Ingredient Corp., MO.

- Holstein bull calves (n=133) were fed 24:18 formulas composed of either a) no dried cheese powder, b) 14%, c) 28%, or d) 42% of formula as dried cheese powder. Dried cheese powder is 31% dairy casein-based protein and 41% milk fat.
- Calves fed 1.8 L 2x/d of 18.9% solids milk replacer to d 28 and then 1x/d to wean on d 35 consuming 47.2 lbs. of CMR. Starter (21% CP w/Bovatec) composed of whole shelled corn, pellets, oats, and liquid molasses was offered *ad lib* from d 1.
- Calves were weighed at arrival and d 28, 42, and 56. Calves were housed individually. with hog panels (0.81 x 1.07 m) until d 42 when grouped in pens of 10 in the grower facility.
- Mortality and morbidity were not different (no details provided).
- NSD in BW on d 1 (88.4, 86.4, 86.4, and 87.5 lbs. for 0%, 14%, 28%, and 42%, respectively; P=0.58), d 28 (99.4, 99.9, 99.2, and 98.3 lbs., P=0.89), d 42 (113.3, 112, 113.1, and 112.2 lbs.; P=0.96), or on d 56 (141.8, 142.2, 144.6, and 147 lbs.; P=0.62).
- **<u>Take home:</u>** "dried cheese MR can effectively replace whey protein and dry fat in calf milk replacer formulas with no loss of performance."

1470T Serum profiles of dairy calves fed CMR or whole milk at either 4.5 or 9.0 L/d. T Chapelain et al. Trouw, Amersfoort, the Netherlands.

- Holstein calves (n=48, 2 ±1 d of age) received CMR at either 4.5 or 9.0 L/d or fresh whole milk at either 4.5 or 9.0 L/d. DM, protein, fat, and lactose content (% of DM) in CMR and whole milk was 16.2 vs. 13.9, 23.7 vs. 25.8, 17.5 vs. 32.7, and 48.8 vs. 32.9, respectively. Starter grain and straw was introduced at wk 6. Gradual wean wk 6 to 10 and studied carried on until wk 13. Blood samples taken weekly.
- Calves fed CMR noted higher (P=0.01) blood glucose levels pre-wean but lower (P=0.02) during weaning. Pre-wean blood concentrations of BHB, NEFA, triglycerides, and cholesterol tended greater (P≤0.06) for calves fed whole milk, however during weaning and post-weaning periods only triglyceride concentrations remained greater (P≤0.04).

- Concentrations of total protein, urea, albumin, and globulin were greater (P<0.01) in the pre-wean period for calves fed whole milk and total protein and albumin remained greater (P≤0.01) during weaning. Calves fed high milk allowance noted greater pre-wean glucose (P=0.02) and lower cholesterol (P<0.01). During wean calves fed higher allowance noted increased (P<0.01) concentrations of glucose, NEFA, total protein and albumin, and greater (P=0.04) triglyceride, whereas BHB (P<0.01) and urea (P=0.06) were lower. Post-wean calves fed high milk allowances had greater (P=0.04) NEFA, total protein and albumin (P<0.01) and lower triglycerides (P<0.01).
- **Take-home**: blood metabolites differ during pre-wean between calves fed whole milk and CMR, however, post-wean differences were minimal. Calves fed high milk allowance noted greater concentrations of many metabolites pre- and post-wean but lower concentrations of BHB during wean.

1474T. Does fecal DM correspond to fecal score? How does nutrition manipulate fecal DM? M. Pister and J. Drackley. U of Illinois.

- Holstein calves were fed CMR at 18% solids with various nutritional additives in 3 experiments. "~ 50 g of feces were collected daily from each calf via rectal palpation."
- Preliminary study (n=8 calves): calves fed either a) low concentration and low DM amount, b) low concentration and high DM, c) high concentration and low DM, or d) high concentration and high DM. Results: fecal DM% tended (P=0.083) greater for the group fed low concentration and low DM amount vs. low concentration and high DM, otherwise, NSD.
- Experiment 1 (n=10): calves fed either a) low solids % CMR, b) high solids % CMR, c) high solids % CMR with sodium chloride, d) high solids % CMR with psyllium, or e) high solids % CMR with casein. Results: tendency (P=0.074) for greater fecal DM% when sodium chloride is added to high solids % CMR.
- Experiment 2 (n=10): calves fed either a) low solids % CMR, b) high solids % CMR, c) high solids % CMR with mineral mix, d) high solids % CMR with psyllium, or e) high solids % CMR with guar gum. Results: "fecal DM events did not differ by treatment …"
- Experiment 3 (n=21): calves fed either a) low solids % CMR, b) high solids % CMR, c) high solids % CMR with casein, d) high solids % CMR with psyllium, or e) high solids % CMR with casein plus psyllium. Results: addition of casein in high solids % CMR increased (P=0.032) fecal DM%.
- As expected, fecal DM% decreased with an increased fecal score (P<0.0001); 1 to 4 fecal score scale with 1 being "normal, firm," and 4 being "watery, sifts through bedding."
- **Take-home**: "In all, sodium chloride and casein have potential to improve fecal DM% when feeding a higher solids diet but further research is needed."

1726W. *Beta-casein A1 or A2 milk? Any differences in visceral adipose tissue in calves?* R. Kappes et. al. Universidade do Estado de Santa Catarina, Brazil. Universitat Munchen, Bavaria, Germany. Justus-Liebig U, Hessen, Germany.

- Homozygous A2 milk is absent of beta-casomorphin casein. Does feeding A2 milk affect calf body composition? Calves (15 d old) from Holstein (n=10), Simmental (n=15), and Holstein x Simmental (n=3) cows (sires not disclosed) were fed either a) A1 milk, or b.) A2 milk. All calves offered 7.5 L/d. Mixture of male and female calves.
- Visceral adipose tissue was assessed d 15 "by open magnetic resonance imaging and dual energy x-ray absorptiometry." Fat, lean mass, and bone mineral content and density were determined.
- NSD in body composition between A1 and A2 milk-fed calves. Calves fed A2 noted lower(P<0.05) total milk intake (100.1 vs. 91.4 total liters) which resulted in improved (P<0.05) ADG (798 vs. 543 g/d) for calves fed A1 milk.
- **Take-home**: No differences in body composition noted between calves fed A1 or A2 milk. In this study, A1 milk was more readily consumed, resulting in increased ADG.

Starter grain & forage feeding (7 abstracts)

1185M. *High protein, milk protein containing starter grain*? *Impact of high or low CMR feeding rate?* U in Cordoba, Argentina. INTA, Cordoba. IFINA A, Cordoba.

- Male Holstein calves (n=18) fed either isoenergetic (2.8 Mcal ME/kg DM) 18% or 26% CP grain. The grain mix was the same except the 26% CP rendition contained milk powder (12.5% in DM).
- The calves were fed 21:12 CMR. 3 treatments to 60 d wean: a) 750 g/d CMR + *ad lib* 26% CP starter (high), b) 500 g/d CMR + *ad lib* 26% CP starter (medium), or c) 500 g/d CMR + *ad lib* 18% CP starter (low).
- NSD in starter or total DMI. ADG decreased (1.7 vs. 1.46 vs. 1.23 lb/d) from high to medium to low, respectively (P=0.04).
- Blood BHB concentration concentrations at d 60 were higher in calves fed low (500 g/d) CMR and high (26%) CP grain (i.e., medium group) vs. the other two (P=0.01). Blood glucose was higher in medium and high vs. low (P=0.01).
- **Take home**: In this study, ADG increased with protein intake. BHB concentration optimum with medium total protein intake.

1186M. *Tropical forage in CMR*? U of Sao Paulo and Methodist U Piracicaba, Brazil.

- Holstein calves (n=48) fed 6 L/d whole milk to 60 d wean + *ad lib* pelleted starter to d 28, and then moved to one of four corn, soybean meal and wheat meal TMR diets: a) 16.9% no-forage NDF, b) 7.5% high quality chopped hay (20.9% NDF), c) 7.5% low quality chopped hay, (21.5% NDF), or d) 10% corn silage, 20.1% NDF.
- Diets had NSD on ADG (1.42 lb/d), efficiency or final 56 d weight (142.9 lbs.). Rumination time during wean (d 52-56) was greater (P<0.03) in calves fed high quality chopped hay and low-quality chopped hay vs. no forage TMR. Corn silage did not negatively impact intake or performance.
- **Take home**: Data suggests fiber is necessary, regardless of quality, for pre-wean diets.

1187M. Chopped grass hay ad lib? Krause et. al., W. Virginia U, Morgantown, WV.

- Holstein calves (n=30) fed CMR (4 L/d stepped up to 6 L/d weaned using 3 L/d day 48 to 56) and offered a lib grain were also either offered a.) no grass hay, or b.) ad lib chopped grass hay.
- NSD in starter intake but offering hay ↑ total DMI week 8 (5.85 vs. 5.3 lbs./d; P=0.005) and week 9 (7.6 vs. 7.2 lbs./d; P=0.05). NSD in ADG or BW.
- Offering hay ↑rumination time (17.4 vs. 11.8 min/2 h-period; P=0.04) and tended ↑time spent chewing (17.4 vs. 11.8 min/2 h-period; P=0.07). Feeding hay ↑rumen pH (6.02 vs. 5.39; P=0.01). BHB did not differ, nor did differences in weight of full or empty digestive tracts as % of BW.
- **Take home:** Offering chopped hay pre-wean can ↑total DMI and time spent ruminating with no effect on BW gain.

1188M. High or low starch starter grain pellet? Klipp et. al., ISU.

- Holstein x Angus cross bull calves (n=79) fed transition milk (6 quarts/d) then CMR (8 qts/d) d 4 – 48, and finally 1x/d 4 qts CMR to 56 d wean and either high starch (26.3%) or low starch (15.4%) starter ad lib.
- High starch grain was 20.4% CP, 2.4% fat, 6.6% fiber, 8.2% ADF, 26.3% starch. Low starch grain was 20.4% CP, 3.2% fat, 11.5% fiber, 14.3% ADF, 15.6% starch.
- Starters were composed of wheat midds (higher in low starch grain), dehulled soymeal, fine ground corn (higher in high starch), cottonseed hulls, sunflower meal in low starch, nominal soy hulls, cane molasses (4% and 6%, high and low, respectively) and premix.
- Weaning (57 d) measures noted NSD in ADG (P=0.24), starter grain intake (P=0.98) or body dimension (heart girth, hip height or width, body length) except wither height that was greater (P=0.04) for high starch.
- In this study, there was minimal effect from starch level in grain.

1472T. Texturized calf starter with oats or oat alternatives? E Dufour et al. U of MN Waseca. Hubbard Feeds, Mankato, MN.

- Holstein heifer calves (n-102) were offered one of four texturized starter grains, either a) high fiber (17.6% aNDFom) and oats, b) high fiber and oat alternative (disclosed as a combination such as beet pulp, cottonseed hulls or barley), c) low fiber (16.2% aNDFom, no added fiber) and oats, or d) low fiber and the same "oat alternative."
- Starter CP was 19.4, 22.5, 23.2, and 22.5% and starch was 34.3, 29.3, 28.6, and 30.8% for high fiber + oats, high fiber + oat alternative, low fiber + oats, and low fiber + oat alternative, respectively. Calves were fed non-med 24:20 CMR at 340 g 2x/d from d 1-42 and 1x/d to d 49 wean.
- D 29-42 oat alternatives out gained feeding oats in high fiber texturized grain (1.72 vs. 1.94 lbs./d ADG; P<0.05). D 50-56 oat alternative w/o added fiber underperformed the other three groups (2.40, 2.45, 2.45, and 1.98 lbs./d; P=0.04). D 1-56, oat alternative and

high fiber tended to outperform the oat alternative with low fiber (1.63 vs. 1.50 lbs. ADG; P=0.07), two oat diets (high and low fiber) intermediary.

- Grain intake was greater d 22-28 in the oat alternative group with high fiber compared to low fiber (1.43 vs. 1.15 lbs./d; P=0.05) with the low and high fiber oat diets intermediary. D 29-35 calves fed the oat alternative starter with high fiber out gained low fiber peers (1.43 vs. 1.15 lbs./d; P=0.01) and its high fiber oat rendition (1.43 vs. 1.08 lbs./d; P=0.01) with the low fiber oat diet intermediary.
- Pre-wean calf starter DMI tended (P=0.07) greater in calves fed the high fiber oat alternative rendition (64.8 lbs.) vs. high fiber oat (55.9 lbs.) or low fiber oat alternative (55 lbs.) with low fiber oat diet intermediary (59.1 lbs.). D 1-56 starter DMI followed the same trend (P=0.07) with 91.2, 101, 95, and 87.7 lbs. for oat high fiber, oat alternative high fiber, oat low fiber and oat alternative low fiber, respectively. Hip height tended (P=0.07) greater for oat alternative vs. oat when matched with high fiber texturized grain (12.1 vs. 10.9 cm gain). NSD in G:F.
- **Take-home**: Adding fiber improved ADG when feeding the oat alternative and the "oat alternative" proved to be a viable replacement for oats in calf starter.

2469. Wheat straw or alfalfa hay for young calves? A Nikkhah et al. National Elites Foundation, Iran. Behroozi Dairy Co, Iran.

- Newborn Holstein calves (n=60) were fed either a) no forage, b) chopped wheat straw, c) chopped alfalfa hay, or d) a 50:50 mixture of chopped wheat straw and alfalfa hay. Forage was included at 10% of DM, presented in a TMR. Liquid diet was not reported.
- Calves fed chopped wheat straw had greater (P<0.05) total DMI (3.41 vs. 2.47 lbs./d), starter DMI (2.92 vs. 1.99 lbs./d), ME (3.47 vs. 2.39 Mcal/d), starch (1.26 vs. 0.91 lbs./d), and NDF (0.51 vs. 0.22 lbs./d) as compared to control calves fed no forage.
- Forage-fed calves had greater ADF intake vs. control calves (P<0.01). Total (220.5, 167.5, 160.1 lbs.) and post-wean DMI (138.9, 94.8, 92.6 lbs.) was greater (P<0.05) for calves fed wheat straw vs. alfalfa and control. ADG (1.6 vs. 1.39 lbs./d) tended (P<0.10) greater for calves fed wheat straw vs. all others. Average final BW (215.4 vs. 188.1 lbs.) and total post-wean weight gain (29.5 vs. 20.9 lbs.) were greater (P<0.05) for calves fed wheat straw vs. alfalfa. Water intake was greater for forage fed calves vs. control at wk 8.
- Rumen pH tended greater for wheat straw and combination than for control and alfalfa (pH 6.28, 6.36, 5.88, and 5.61 respectively, P = 0.09). Fecal pH at weaning tended (P<0.10) lower for calves fed wheat straw (pH 6.3) vs. control, alfalfa, and combination (pH 6.8, 7.2, 6.8, respectively).
- Weaning body depth greater for wheat straw than control and alfalfa (47.2 vs. 43.7 vs. 44.1", respectively, P = 0.01). Blood urea nitrogen at wean tended lower for wheat straw than for alfalfa (10.8 vs. 13.2 mg/dL, P = 0.08). Non-nutritive oral behaviors tended to less for calves fed wheat straw (21 min/d) vs. control (59 min/d).
- **Take-home**: this data supports feeding forages and particularly wheat straw in pre-wean starter grain mixes.

1672W. Does variation in starter intake prewean have long-term consequences? ER Russell. U of BC, British Columbia.

- Meta-analysis of 2 published weaning studies (n=25, n=47, respectively). Calves offered 12 L/d whole pasteurized milk fed via autofeeder until d 30. From d 31 onward gradual weaning treatments "intended to result in different intakes of solid feed before the calves were fully weaned d 70." *Ad lib* grain access via auto feeder.
- Grain intake over wean period (d 31-69) avg 1.52 lbs. ±0.97 lbs./d, ranging between 0.02 to 2.49 lbs./d. ADG averaged 1.48 lbs. ±0.53 lbs./d.
- "For every 1 kg increase in ADG during the weaning period, heifers freshened 42 ±17 d earlier. We found no effect of ADG before weaning on 305-d milk yield in first lactation."
- **Take-home** – Starter intake and ADG were widely variable between calves. "Low intakes relate to low ADG before weaning and … low ADG before weaning delays age at first calving." Pre-wean ADG did not affect the first lactation milk yield in this meta-analysis.

Amino acid nutrition/supplementation (1 abstract)

1193M Branched-chain amino acid supplementation (BCAA) in CMR? (Morrison et al. Miner Institute)

- Holstein heifer calves (n=50) were provided 26:18 CMR with 2.4% and 0.72% total DM Lys and Met, respectively, and no added BCAA (basal CMR diet 2.66%, 1.53%, and 1.48% Leu, Ile, and Val concentration, respectively) or 26.8:18 CMR supplemented with synthetic amino acids to 2.6%, 0.81%, 2.88%, 1.73%, and 1.94% total DM Lys, Met, Leu, Ile, and Val, respectively (also maintaining Lys and Met ratios). BCAA supplemented to mimic transition milk. Weaned d 56 (~195 lbs.). ~ 156 lbs. CMR consumed per calf.
- Starter (22% CP) offered *ad lib*; grass hay fed (≤110 g/d) *ad lib* d 36-63. Weekly body measures to d 70 and blood collected 4 h post CMR fdg at week 2, 6, and 8.
- NSD in ADG (~ 1.93 lbs./d), wither height, hip height, heart girth, hip width, or body length at any measure. NSD in DMI or G:F (app. 0.655). ~71.5 lbs. starter consumed.
- NSD in STP, urea N, albumin, total globulin, or total cholesterol. Serum glucose tended (P=0.09) greater in calves supplemented BCAA. Serum Lys, Met, Ile, and Val were greater in calves supplemented BCAA (P≤0.006). Serum Leu tended greater (P=0.08).
- **Take home**: Under conditions of this study, BCAA supplementation is unnecessary.

Fats and oils nutrition (0 abstracts)

None reported at ADSA 2023

Vitamins and trace minerals (7 abstracts)

1189M. Zinpro ProPath TM's fed via CMR via autofeeder? Porter et. al. NC State. Zinpro.

- Holstein calves (n=40) were fed CMR using either a) Zinpro ProPath (amino acid-complexed), or b) inorganic sulfate TM sources for all added Zn, Mn, Cu, and Fe, and individually housed for either a) 3 d, or b) 10 d in a 2 x 2 factorial prior to grouping. All were fed *ad lib* CMR for 40 d via autofeeder, followed by 16-d wean.
- Both CMRs contained 50, 50, 10, and 100 ppm of Zn, Mn, Cu, and Fe. The TM source in the *ad lib* offered grain was not different. No further details provided.
- NSD of days housed individually on performance. Calves fed ProPath increased CMR intake (6.23 vs. 6.10 L/d, P<0.01.). Calves fed inorganic TM increased starter intake and total DMI (details not reported, P≤0.01).
- NSD in ADG pre-wean (1.48 vs 1.54 lbs./d for inorganic and Zinpro, respectively), post-wean (2.49 vs 2.54 lbs./d), or overall (1.67 vs. 1.78 lbs./d; P≥0.40). Feed to gain improved in calves fed ProPath (2.17 vs. 2.65; P=0.02). Calves fed ProPath increased body length (+5.1 cm; P=0.05). NSD in hip width, serum, or liver mineral (Cu, Fe, Mn, Se, or Zn) concentrations.
- **Take home**: ProPath vs. inorganic TM improved CMR intake, feed efficiency, & stature.

1190M. Supplementing vitamins and Zinpro TMs to whole milk? Geiger et. al., Zinpro.

- Calves (n=364) individually housed on a commercial dairy in CA were fed 4 qt/d of whole milk with either no supplemental VTM or 5 g/d of premix providing calf NASEM levels of Zn, Mn, Cu, Fe (Zinpro ProPath; amino acid complexed); I, D_3, E, B_1, B_3, B_6, B_9 & B_{12}.
- Fortification commenced in whole milk directly after colostrum fdg until d 70 wean. BW measures taken d 0, 30, 60, and 90. Grain was offered *ad lib*. No further details regarding grain or whole milk were provided. No health measures or STP reported.
- NSD ADG d 0-30 (0.97 vs 1.02 lbs./d, VTM & control, P>0.10). ADG d 0-60 (1.17 vs. 0.83 lbs./d, P<0.05) and d 0-90 (2.02 vs. 1.80 lbs./d, P<0.05) increased in VTM vs. control. Calves fed VTM +0.5 lbs./d ADG (P<0.01) during the d 30-60 period.
- Post-wean ADG d 60-90 was 3.93 vs 3.86 lbs./d (P<0.10) for VTM vs. control.
- **Take home:** Supplementing whole milk with VTM improved ADG.

1465T. Supplementing rumen protected B-vitamins via starter grain fed pre-wean to calves on pasture? Balogun and AlZahal. Jefo and AlZahal Innovation and Nutrition, Kitchener, Ontario.

- Jersey female calves (n=128) randomly allocated to 8 pens (16 calves/pen) and 2 treatments – starter with or w/o a rumen protected B-vitamin blend containing folic acid, thiamine, biotin, pyridoxine, and pantothenic acid until 90 d wean.
- Starter contained 21% CP, 33% starch, 21% NDF, and 2.1% fat. Post colostrum calves were fed CMR at 4 L, 2x/d wk 1-5, 4 L, 1x/d wk 6-12, and gradual wean on d 90. At 5 wks calves were transferred to paddock pens and grazed pasture w/ *ad lib* grain until weaning. Calves were weighed at trial onset (8.4 ±4.8 d of age), monthly until weaning.

- Calves fed rumen protected B-vitamins noted +10% improvement in ADG (590 vs. 540 ±10 g/d; P<0.05) and final BW improved +7% (185 vs. 173.1 ±2.4 lbs.; P<0.05).
- **Take-home**: Supplementing rumen protected B-vitamins via grain to calves on pasture resulted in increased ADG and BW gain pre-wean.

1467T. Vitamin and trace mineral (VTM) supplementation of whole milk. Zupan et al. Grober Nutrition, Cambridge, Ontario.

- Whole milk is deficient in certain micronutrients required for calf growth (e.g., iron). Following colostrum feeding Holstein calves (n=62) were fed whole milk ± VTM supplementation (Promiks, Grober Nutrition).
- Whole milk was offered at up to 9 L/d until weaning at wk 7. Calf starter offered *ad lib*. Milk refusals and treatments measured daily, weekly body dimension and weight measures, and blood samples for hemoglobin measure taken at d 0, 14, 28, and 42.
- VTM increased wk 4 ADG (2.18 vs. 1.54 lbs./d; P=0.002) and milk intake wk 1-5 (8.05 vs. 7.9 L/d; P=0.02). VTM increased hemoglobin status at d 14, 28, and 42 compared with control (110 vs. 95, 110 vs. 89, and 116 vs. 94 g/L, respectively; P<0.001). Calves w/ low hemoglobin status (<84 g/L) at d 14 had lower ADG wk 2 (P=0.04), wk 7 (P=0.08), and lower milk intake wk 1-5 (7.5 vs. 8.2 L/d; P=0.06) compared to calves with normal hemoglobin concentrations.
- **Take home**: Supplementing VTM in whole milk improved ADG, milk intake, and hemoglobin status in pre-weaned calves.

1473T. Supplementing CMR with additional choline? E Dufour. U of MN, Waseca. Hubbard Feeds, Mankato, MN.

- NASEM 2021 recommends supplementing choline at 1000 mg/kg DM for pre-wean calves despite limited calf research supporting this recommendation.
- Holstein heifer calves (n=100) were supplemented either 0, 900, 1800, or 2700 mg/d of choline via a non-med 24:20 all-milk CMR fed at 0.64 lbs. 2x/d from d 1-7; 0.75 lbs. 2x/d from d 8-42, and 0.75 lbs. 1x/d until wean d 49. 18% CP starter offered *ad lib*. BW measured d 1, 14, 28, 42, 49, and 56.
- CMR intake linearly decreased with increasing choline supplementation (d 1-49; 63.1, 63.3, 62.7, vs. 62.7 lbs. for 0, 900, 1800, and 2700 mg/d; P=0.05). Hip height d 56 was increased in calves supplemented 1800 mg compared to 0 (94 vs. 91.9 cm; P = 0.05). ADG post-wean (d 50-56) was decreased (P<0.05) in calves supplemented 1800 mg/d (2.36, 2.71, 1.67 vs. 2.31 lbs./d for 0, 900, 1800, and 2700 mg/d).
- G:F was improved during weaning (d 43-49) when calves were supplemented 0 or 1800 mg/d vs. 2700 mg/d (0.23, 0.24, 0.16, vs. 0.21 for 0, 900, 1800, and 2700 mg/d; P<0.05). "Feed efficiency of 1800 mg/d deteriorated in the post-weaning phase (d 50-56) compared to" calves fed 0, 900, and 2700 mg/d (P<0.01). NSD on starter intake or health measures (scour scores or days, medical treatment $)

- **Take-home**: No negative or positive results from supplementing choline similarly (900 mg/d) to NASEM 2021 recommendations, however, increased supplementation noted negative effects on intake and growth.

2473. Zn, Cu, Mn, and Fe balance in calves fed two feeding rates of either whole milk or CMR. T. Chapelain et. al., Trouw, Amersfoort, the Netherlands.

- Holstein calves (n=48; 2 ±1 d of age) received either CMR at 169 g/L (same ME as whole milk, 3.4 MJ/L) or whole milk fed either 4.5 L/d or 9.0 L/d. Trace minerals Zn, Cu, Mn, and Fe in CMR vs. whole milk were 10.14 vs. 4.64, 1.82 vs. 0.07, 4.95 vs. 0.03, and 12.19 vs. 0.25 mg/mL, respectively.
- Starter and straw introduced wk 6 and calves gradually weaned wk 6-10, w/ study completion wk 13. Urine and feces collected continuously wk 2, 4, 5, 7, 9, 11, and 13.
- "Prewean Cu, Mn, and Fe balances were higher (P<0.01) for CMR-fed calves than whole milk-fed calves. Increasing milk allowance increased Cu and Fe balances for calves fed CMR but not for calves fed whole milk (P<0.01)."
- Increasing whole milk increased while increasing CMR decreased Zn balance. During weaning, high milk or CMR allowance lead to lower balances of Zn, Cu, and Mn (P<0.01), and Fe (P=0.08) and "Cu balance was further reduced for whole milk-fed calves (P=0.04), whereas Zn balance was increased by whole milk (P<0.01) compared with feeding CMR."
- Post-weaning, "greater Cu (P<0.01) and Fe (P=0.04) balances were observed for whole milk vs. CMR-fed calves." Despite low TM balance in whole milk, NSD on scours occurrence or therapeutic interventions observed (P>0.10).
- **Take-home**: During pre-wean, increasing TM intake with CMR increased TM balance. At wean, calves consuming 9 L/d noted decreased TM balance. Post-wean, whole milk-fed calves gained ground on Cu and Fe balance. No impact on scours or meds noted.

1679W. Mineral and trace mineral concentrations in colostrum, transition milk, and mature milk. Effect of cow parity. K Klein et. al., U of Guelph, Trouw, Utrecht, the Netherlands.

- On a commercial farm multiparous (n=15) and primiparous (n=6) cows fed the same pre- and postpartum rations had colostrum (12 h post calving), transition milk (milking 2 and 3), whole milk (milking 14) collected for macro mineral and trace mineral analysis (by inductively coupled plasma optical emission spectroscopy and mass spectrometry)
- "The most abundant mineral in colostrum and whole milk was Ca (P<0.001; 10.61 ±0.269 g/kg) and K (P<0.04; 11.4 ±0.52 g/kg) respectively." The most abundant TM was Zn in colostrum (P<0.001; 114.7 ±11.38 ppm) and whole milk (P<0.01; 40.2 ±4.45 ppm).
- Concentration of all macro- (P≤0.02) and TM (P≤0.078) were higher in colostrum compared with whole milk except for Ca, Na, and Cu (P≥0.95)."
- Mg (P=0.06) and Se (P=0.002) were greater in multi- vs. primiparous cows while Cu (P=0.003) and Mo (P=0.07) were lower in multi- vs. primiparous.
- **Take-home** – Macro and TM concentrations decrease gradually from colostrum to whole milk. Parity affects the concentrations of minerals over the first wk of lactation.

Maternal-fetal (38 abstracts)

Genetics (8 abstracts)

2243. Breeding and Genetics platform: Genetic improvement of calf health - Genomics makes it possible. Fessenden et al. Zoetis

- Genetic improvement programs that account for differences in calf disease risk and livability can improve dairy profitability, alongside management practices.
- Genomically-enhanced genetic evaluation found estimated heritability of 0.042, 0.045, and 0.060 for BRD, calf scours, and calf livability, respectively.
- Study measured the ability of "calf wellness standardized transmitting ability (STA)" to predict calf disease and mortality (n=10,751 heifers; 10 herds).
  - Reduced disease incidence between worst and best genetic quartiles: 34% (livability), 52% (scours), 33% (BRD).
  - STA difference between worst and best: 11 STA.
- **Take-home**: Moderate heritability of calf morbidity traits, but calf wellness STA show distinct differences between "best" and "worst" genetic quartiles.

2244. Breeding and Genetics platform: Genetic evaluation for stillbirths and pre-weaning mortality. Axford et al. Agriculture Victora.

- Both stillbirth (died at birth, w/in 24 hrs) and pre-weaning mortality (died after d 1 but before weaning) are lowly heritably and binomial, but genetic variation can be measured.
- Compare performance of linear models to predict stillbirth and pre-weaning mortality traits in Holstein and Jerseys in Australia. (n=2.78 million records; 1990-2021).
  - 7% stillborn and 2% pre-weaning mortality 2000-2021 (n=1.74 mill, 0.89 mill)
  - Heritability of calf traits was 1-2%, depending on breed, trait, and model (stillbirth direct, stillbirth maternal, pre-weaning mortality).
- **Take-home**: Low heritability of calf mortality traits, need improved calf recording practices and more data.

2245. Candidate mutation for calf recumbency in Holsteins. Dechow et al. PSU, USDA-AGIL.

- Calf recumbency (unable/difficulty standing) leads to increased calf mortality. A recessive haplotype with incomplete penetrance was previously link to end of chr.16 (Dechow et al. 2022).
- Region included 110 genes, 13 plausible candidate genes. Sequencing data of affected calf, sire and key ancestor found most promising candidate - a missense mutation in *CACNA1S* (calcium channel gene).
  - Genotype analysis traced to key ancestor (HOUSA1964484 Southwind, 1952).
  - Other species: heterozygote CACNA1S mutation – period paralysis, homozygote mutation – more severely affected (can't stand, degenerated muscles, perinatal death)

- **Take-home**: Calf recumbency likely caused by *CACNA1S* gene in chr.16. Monitor for gene using expected addition to genotyping array.

1348T.Haplotype inheritance and livability of recumbent Holstein calves. Al-Khudhair et alUSDA.

- Calf recumbency (unable/difficulty standing) was recently associated with a recessive haplotype with incomplete penetrance on the end of chr.16 (Dechow et al. 2022; see abstract 2245 above)
- Tracing back to the common sire, 85% non-carriers, 12.4% not sure carriers, 2.3% sure carriers, 0.01% homozygotes tracing back to known sire ancestor.
- Haplotype status matched to heifer livability records (n=558 k). 52% of the 46 homozygotes died before 18 mo (avg. 1.7 mo) but death rate underestimated due to survival sampling bias, while death rate 2.4% for non-carriers.
- Of homozygotes that lived beyond 18 mo, most had normal productive lives.
- **Take-home**: Moving forward, identify carrier's matings and monitor resulting calves.

1351T. Genetic evaluation of colostrum production in Jerseys. Schultz et al. U of Mn

- Jersey colostrum yields (n of 3 L bottles) and daughter records were collected from a 6,000-cow commercial dairy (n = 1,577 records) in spring/summer long-day light.
- Avg yield was 2.7 bottles (~8.1 L), weekly estimates ranged by 1.17 bottles (~3.5 L) w/ highest estimates in June. The parity estimates were 2.5 bottles (~7.5 L) for parity 1 and 2.8 bottles (~8.4 L) at parity 3 and 4.
- Heritability estimated = 0.14, breeding values for bulls were from -0.77 to 0.66 bottles.
- **Take-home**: Colostrum production is moderately heritable, affected by time of year and parity. Future work will look at the transition to short-day lighting.

1733W. Evaluating the utility of genomically enhanced RFI as a selection criterion to improve feed efficiency in growing Holstein heifers. O'Reilly et al. TAMU, STgenetics

- Holstein heifers (n=55. ~770 lb) were categorized as predicted low RFIg (n=29) or high RFIg (n=26) based on genomic "EcoFeed" scores (derived from RFI phenotypes of 6.5k heifers, moderately heritable: 0.24)
- Heifers were monitored for DMI (84 days), BW (weekly), predicted RFI, and gaseous exchange measurements.
- Low RFIg heifers ↓ feed intake 7% ($P < 0.05$) with more favorable predicted RFI (-0.188 kg/d) and gas emissions (methane ↓ 8%, CO_2 ↓ 6% $P < 0.05$)
- **Take-home**: Data supports that selecting for RFI through EcoFeed is effective to select for cattle with ideal feed efficiency.

2654. Long-term transcriptomic and epigenetic effects of in vitro embryo production in dairy calves. Rabaglino, University College Dublin

- Healthy bull calves born from in vitro production (IVP) were compared to healthy in vivo-produced calves (embryo transfer, ET; n = 4/group).

- Tissues samples collected at 3 months of age incl. serum, hypothalamus, pituitary, gonad, and adrenal glands, liver, and muscle for methylation (serum) and RNAseq (tissue).
- Early activation of the HPG axis, altered hepatic and muscular energy regulation in IVP calves (based on integration of methylated and differentially expressed genes).
- Identified biomarkers to predict embryo origin (IVP or ET)
- **Take-home**: IVP induces long-term changes to molecular (and sometimes phenotypic) endocrine and metabolic status.

2656. Nerve growth factor-β supplementation for in vitro fertilization and maturation media improve cleavage rates in bovine embryos. Marques et al., University College Dublin

- Study added 0, 10, 100 , or 1000ng/mL of nerve growth factor β (NGF) to fertilization (IVF) or maturation medium (IVM) to assess blastocyst rate and quality.
- 72 h post fertilization, cleavage rate ↑ in IVG-1000 (88%), IVM-1000 (70%) vs. control (49%). NSD on blastocyst rate on d 7 or hatching rate on d 8 or 9 (P > 0.41).
- **Take-home**: NGF supplementation influences cleavage rate in a dose-dependent manner but does not influence any further stage of development.

Dry cow strategies and their impact on the calf (9 abstracts)

1409T Does DCAD balance or nicotinic acid fed to the dry cow (Jersey) impact colostrum or the calf? TC Stahl, et al, UNH.

- Two concentrations of DCAD (-40 or -80 mEq/kg) ± 23 g/d nicotinic acid (2 x 2 factorial) was fed to multiparous Jersey cows (n=40) 4 wks prepartum. Colostrum was harvested, weighed, and fed by 90 m post-calving. Cows had to produce 2 L of colostrum to be enrolled. IgG, bioactive compounds, and fatty acids were measured.
- Calves were fed max 2.5 L of colostrum at the first feeding with any remaining fed at 6h. Calves were fed 3.8 L whole milk and grain to d 42. Blood samples taken at 24 h (41.1 ±16 g/L) and then weekly, and a xylose challenge was performed d 5 to measure small intestine development.
- Nicotinic acid supplementation increased colostral lactoferrin (P=0.04). "There was an interaction for insulin-like growth factor-1 fed to calves (P=0.02), with the highest amount from -40 DCAD + nicotinic acid and the lowest from -40 with no nicotinic acid."
- Colostral fat C18:0 was less and C18:1 tended less in -80 DCAD (P≤0.09). Nicotinic acid feeding reduced omega-3 and omega-6 (P≤0.04). Colostral fat was less (P=0.04) while protein % tended more (P=0.08) with nicotinic acid supplementation. AEA tended greatest at -80 DCAD with nicotinic acid and tended lowest at -40 DCAD with nicotinic acid (P=0.09). Xylose increased with nicotinic acid supplementation (P=0.02).
- **Take home:** "Nicotinic acid may increase bioactive compounds and enhance calf intestinal development."

2472. Prepartum conjugated linoleic acid effecting colostrum and calf performance? CL Cardoso et. al. U of Pretoria, Stellenbosch U, South Africa; U of Padova, U of Parma, Italy.

- Holstein cows blocked by parity (3 ±1), BW and BCS, received via top-dress from 20 ±7 d pre-calving to 5 DIM as either a) 100 g/cow/d Ca salts + 100 g of molasses, or b) 100 g/cow/d conjugated linoleic acid (CLA) + 10 g of molasses. Calves were individually fed their mother's colostrum and transition milk from d 1-4 of life.
- Colostrum was analyzed for fatty acid profile and IgG quantification. Calf blood samples taken d 0-15 to measure IgG. Body dimensions and BW measured weekly d 7 to 35.
- CLA tended to lower fat percentage and increase lactose in colostrum and transition milk (P≤0.10). CLA increased C15:0 and decreased C18:3, total n6 FA and n6:n3 ratio in colostrum and transition milk. NSD in blood or colostrum IgG levels. CLA fed to dam prepartum tended (P=0.10) increased calf ADG, while to d 35 increased (P<0.05) growth rate in female and tended (P=0.10) to increase in male calves.
- **Take-home**: Colostrum and transition milk from cows supplemented CLA pre-fresh resulted in calves with improved ADG but failed to effect IgG levels.

1410T. Effect of in utero choline exposure on Angus x Holstein carcass characteristics. Brown et al. UW-Madison, Balchem.

- Dry dams fed either control (0 g rumen protected choline [RPC]; CTL), recommended (15 g RPC; RD), high dose (22 g RPC; HD), or RD or HD in choline ion form (RPC1, RPC2) for 21 d pre-calving (n=10-13/trt). Calves born were Angus x Hol; n=17 male, n=30 female
- Calves were managed identically, finishing diets at 311 and 415 kg until harvest.
- RPC2 males had ↑ dressing % compared to RPC1 (60 vs. 58%, P =?) but NSD in females.
- Any RPC supplementation ↓ dressing % relative to CTL, RPC linearly ↑ kidney/pelvic heart fat yield and %, and marbling score (P < 0.03)
- **Take-home**: Supplementing dams with RPC might influence beef x dairy dressing % and marbling, more research on mode of action is needed.

1033M. Impact of feeding branched-chain volatile fatty acids during dry period on colostrum composition and neonatal calf muscle metabolic activity. Gast et. al., Purdue.

- Dry dams were fed either CON TMR (soy hulls) or BCVFA (isobutyrate 30 g DM; isovalerate 15 g DM; 2-methylbutyrate 15 g DM) top-dressed TMR for 42 d pre-calving.
- Calves (n=20/trt) fed dam colostrum at <4 h and 12 h after birth at 10% and 5% BBW with a 24-hr blood collection and semitendinosus muscle biopsy
- BCVFA calves had ↑ muscle metabolic activity (Almar blue assay, P= 0.01) but NSD for calf BBW, immunocrit, or colostrum fat/protein
- **Take-home**: Dam supplementation did not greatly impact calf colostrum factors but may have *in utero* impacts on calf development.

2177. Reducing water use to cool cows using "smart" technologies. Casarotto et al. UF.

- Dry dams exposed to cooling (CL; shade, fans, soakers @ 5 min intervals), smart cooling (SS; shade, fans, Agpro soakers w/set timing [not specified]), or heat stress (HT; shade only) for 45-d pre-calving (n=10/trt).

- Dam: SS ↑ DMI over HT, both SS and CL ↓ resp. rate and rectal temp relative to HT, SS ↓ water than CL.
- NSD between treatments for gestation length, dry period length, or calf BBW.
- **Take-home**: smart soaking improved dam responses with less water used but did not influence calf outcomes herein.

2180. Programming effects of in utero hyperthermia on adrenal gland development. Guadagnin et al. UW-Madison.

- Dry dams cooled (shade, fans, soakers) or heat stressed (shade) for 54-d pre-calving.
- Adrenal glands were harvested from in-utero cooled (IUCL) and heat-stressed (IUHT) calves at d 0 and 63 relative to birth (n=8/trt/time), analyzed for histology and RNA-seq.
- IUHT heifers at d 63 had ↑ adrenal gland weight, total tissue area, thickness of zona glomerulosa, fasciculata, and reticularis (ZG, ZF, ZR; P < 0.01). ZG and ZF had ↑ cell area.
- At d 63, 48 genes were diff. expressed incl. *RPL15* and *PRDM9*. Top enriched pathways were related to immune function, inflammatory response, and calcium transport.
- **Take-home**: *In utero* heat stressed heifers have enlarged adrenal glands, cellular hypertrophy, and altered immunity/inflammation-related gene expression.

2182. Rumen-protected Met supplementation during transition period under heat stress: impact on cow-calf performance. Davidson et al. UW-Madison, Adisseo.

- Dry dams fed either control diet (CN, 2.2% Met of MP) or CN + SmartamineM (MT, 2.6% Met of MP) for 42 d pre-calving. At 28 d, electric heat blankets (EHB) initiated heat stress (HS) model vs. thermoneutral (TN). 3 trt – CNTN, CNHS, MTHS (n=17-19/trt).
- Dam: HS ↑ resp. rate and skin temp. (P < 0.001) and ↓ milk protein % (P = 0.07). NSD for post-calving dam BW, BCS, or milk yield. Met suppl. ↑ milk protein % and SNF. (P < 0.005)
- Calf: HS ↓ calf BBW and AEA (P < 0.02). Met supplementation tended to ↑ withers height (P = 0.09, colostrum mgmt. unknown)
- **Take-home**: Late-gestation heat stress impaired calf growth and immunity. In the face of heat stress, rumen-protected Met did not impact MY or calf BW but might improve components and calf stature.

1624W. Preweaning health of dairy heifers is associated with prepartum metabolism of dams. Van Dorp et. al., U of Guelph.

- Pregnant cows (n=273) followed 45 d pre-calving to parturition, and single heifers born from dams were assessed 0-63 d of age. Cows were retrospectively categorized as dams of heifers with health problems (HP, n=32; digestive, respiratory) or no health problems (NoHP, n = 93).
- NSD for gestation length, birth BW, or quantity/quality of colostrum between calves. NSD for dam prepartum BW, BCS, feed intake, energy balance, NEFA, BHBA, albumin or Ca.
- HP heifers had ↑ FPT (20 vs. 6%, *P* = 0.04).

- Dams of HP heifers ↑ haptoglobin, glucose, ferric reducing antioxidant power, and glutathione peroxidase activity ($P \leq 0.10$); ↑ serum urea and selenium concentrations
- **<u>Take-home</u>**: Prepartum metabolism of dams, particularly inflammatory and antioxidant status, is associated with offspring health status.

1632W. Associations of maternal gestation length with colostrum quality and calves' health and performance. Schwartz et al. Guelph.

- Study 1: dams (n=273) divided into categories by gestation length (GL; mean = 277 d, SD = 5 d): short (< 272 d GL), average (272-282 d GL), or long (> 282 d GL) to assess colostrum.
- Study 2: Retrospective data from heifers (n=3,381; BBW, health, repro, milk prod) collected) from dams divided by GL (short <270 d; average 270-282 d; long > 282 d).
- Study 1 results: Short GL ↑ IgG conc (94.2 vs. 74 g/L; P = 0.04) compared with avg and long GL, NSD for volume or total IgG secretion.
- Study 2 results: BBW ↑ as GL ↑, short GL heifers had ↑ % morbidity digestive, respiratory issues (P < 0.03; i.e., 79 vs. 64-66% general morbidity) compared with avg and long GL. Short GL ↑ mortality rate compared to avg but not long GL (16 vs. 11 vs. 15%, P = 0.03). NSD repro, milk production, mature heath, or culling.
- **<u>Take-home</u>**: Although a short GL improved colostrum IgG %, it confers poorer morbidity and mortality outcomes (likely due to a smaller BBW and impaired IgG absorption).

<u>Colostrum, colostrum replacers, and transition milk (21 abstracts)</u>

1421T. Changes in the plasma metabolome of newborn calves: Insights during the first 12 hours of life. Ghaffari et. al., U of Bonn, Germany.

- Holstein calves (n=44; n=30 female, n=14 male) assigned to two trt: before or after colostrum feeding. First colostrum (3.5-4 L) w/in 2 hrs, second (1.5-2 L) 11.5 hrs later.
- Blood collected 30 min before col feeding or 12 h after birth; targeted metabolomics.
- 228 metabolites detected (hexose, lactic acid, AAs, fatty acids, etc.). 96 metabolites ↑ from before vs. after colostrum feeding, while 14 metabolites ↓. Pathways – amino-acyl tRNA biosynth., Val/Leu/Ile biosynth., sphingolipid/Phe, and Cys/Met metabolism.
- **<u>Take-home</u>**: Newborn calf metabolome is influenced by colostrum intake and age.

2403. Serum natural antibody IgM titers in colostrum-deprived and conventionally raised neonatal dairy calves. Altvater-Hughes et. al., U of Guelph.

- Blood was collected from conventional calves fed colostrum (n=40) vs. colostrum-deprived calves (n=16).
- Serum natural antibody IgM (second Ig after IgG) was measured by binding to a foreign antigen (KLH) and measuring via ELISA to determine titers.
- Conventional calves: IgM $\log_2$ titers avg 6.82 (range <2.8 – 8.9; 1 of 40 below detection limit). Colostrum deprived: 16 of 16 titers below detection limit (<2.8; P < 0.01).
- **<u>Take-home</u>**: Colostral transfer of IgM is critical, is there endogenous production?

1419T. Colostrum quality at calving can predict embryo viability in postpartum multiparous Holstein cows. Souza et. al., Cargill, USP Brazil.

- Multiparous cows (n=50) followed from calving to AI. Colostrum was harvested (high > 22% BRIX, n = 24; low ≤ 22%, n = 26).
- Dam uterine flush at 70 to 80 DIM following superovulation protocol, milk production/components/SCC recorded.
- Cows w/ high BRIX: ↑ viable embryos (60 vs. 40%, $P < 0.05$), ↓ degenerated embryos (31 vs. 59%, $P < 0.05$), ↑ milk production 3-8 wks of lact. but NSD components or SCC.
- **Take-home**: Cows producing higher quality colostrum have more viable embryos and greater milk production – driven by energy status?

1675W. Effect of parity on concentration of insulin, lactoferrin and IGF-1 in colostrum and transition milk. SL Cartwright et. al. U of Guelph. Inst of Agrifood Research & Tech, Caldes de Montbui, Spain.

- "Colostrum and milk samples were collected from 10 multiparous and 10 primiparous Holstein dairy cattle." Colostrum was harvested within 12 h of calving and at milkings 2 through 5 and 12. Concentrations of insulin, lactoferrin and IgF-1 were tested.
- Primiparous cows had greater insulin in colostrum and milking 2 ($P \leq 0.04$) and IGF-1 in milking 12 ($P=0.04$). Multiparous cows tended greater lactoferrin in colostrum and milking 2 ($P \leq 0.10$), and greater in milking 3, 4, 5, and 12 ($P \leq 0.05$).
- **Take-home**: Bioactive molecules in colostrum, transition milk and whole milk varied by parity.

1655W. Case Study: On-farm refractometer assessment of colostrum quality and passive immune transfer in dairy calves. Rovai and Salama SDSU.

- Holstein-Jersey heifer calves (n = 73, BBW = 70 ± 10 lb) were fed 3.8 L colostrum (50 mg/mL IgG) within 30 min after birth and a second feeding (20-50 mg/mL IgG) 5.5 h later. Quality was determined by colostrometer then checked retrospectively using digital refractometer.
- Calf STP measured w/in 3 d to measure TPI.
- Only 55% (colostrum) and 33% (second feeding) of colostrometer-checked colostrum tested >22% BRIX via refractometer. But STP avg = 6.6 ± 0.8 g/dL (% Excellent, Good etc. not given).
- **Take-home**: Authors conclude the BRIX>22% did not related to successful TPI, possibly due to quickness and quantity at feeding. STP seems high in this study.

1736W. How precise is STP in estimating serum IgG concentrations? What about gamma globulin concentrations? K Murayama, et. al. Zen-Raku-Ren. U of Alberta. Hiroshima U, Japan.

- Blood sampled from Holstein calves (n=129) in the first wk after life (no age range), and serum concentrations of STP, γ-globulin, and IgG were measured.
- Calves were fed either maternal colostrum (n=74) or colostrum replacer (n=55) and Spearman's correlation coefficients (r^2) were determined for each.

- Mean, SD, and range was 5.5, 0.64, and 4.1-7.2 g/dL, respectively, for total protein; 0.67, 0.390, and 0.07-1.9 g/L for γ-globulin; and 16.8, 10.69, and 0.3-45.4 g/L for IgG. The r^2 between serum IgG and total protein were 0.92 in maternal colostrum and 0.77 in colostrum replacer calves. The r^2 between serum IgG and γ-globulin was 0.95 in maternal colostrum calves and 0.96 in colostrum replacer calves (P<0.01 all).
- Root mean squared error analysis for estimating serum IgG from STP found a "lack of fit" in a simple linear regression model for maternal colostrum and colostrum replacer (P≤ 0.01); however, there was "no lack of fit" in estimating IgG from γ-globulin (P>0.05).
- **<u>Take-home</u>**: "Serum IgG can be estimated more precisely from γ-globulin than total protein particularly for calves fed colostrum replacer, and that passive transfer of immunity in dairy calves can be assessed effectively by serum γ-globulin conc."

1738W. *Measuring IgG content of the abomasal curd in calves.* E Lopez-Bondarchuk et. al., U of VT, Burlington. Zinpro Corp, Eden Prairie, MN.

- "Curd formation may result in curd leakage into the small intestine, competing with IgG uptake," during the brief window of time when IgG can be absorbed.
- Angus x Holstein bull calves (n=18) were fed a) pooled maternal colostrum or b) a whey-based colostrum replacer (Zinpro). Both groups were fed the same 150 g of IgG within 2 hr of calving. Calves underwent ultrasonography "to observe the presence of curd formation using a transabdominal convex ultrasound probe (eCLi43-7 MHz broadband array). Blood samples were collected at 0, 24, and 48 h and measured for IgG using RID.
- Curd formation was detected in maternal colostrum but not colostrum replacer, no additional results reported.

1408T Does extended colostrum feeding have long-term impact on dairy cows? M. Tortadés, et al., IRTA, Barcelona, Spain; Blanca from the Pyrenees, Catalonia, Spain; ICREA, Barcelona.

- Female Holstein calves (n=34) were fed 2.5 L of colostrum ≥25% Brix for either 2 or 8 feedings (1 or 4 d). The 2-feeding group was fed 2.5 L of CMR (12.5% solids, 24% CP, 18.5% fat) for feedings 3 to 8. Then all calves were fed the same CMR at 3 L 2x/d and at 15% solids and gradually weaned at 3 L 1x/d until 56 d wean.
- All calves were fed the same dry feed and TMR through stages of development, and were weighed at birth, wean, and bi-monthly until first calving. Health was monitored. Plasma samples were taken 21 d post-calving and for non-targeted metabolomics.
- NSD in ADG or health reports between groups. BW tended greater at 14 months in calves fed extended colostrum (P=0.06). No distinct metabolic profile differences were noted. However, 22 plasma metabolites noted differences (P≤0.01) in extended vs. shortened colostrum: downregulation - 3-oxo-tetradecanoic acid, 5 beta-cholestane-3 alpha 7 alpha 27 triol, and lysoSM(d18:0); upregulation - succinyl adenosine.
- **<u>Take-home</u>**: "Results suggest modulatory effects of duration of colostrum feeding on insulin sensitivity (lysoSM(d18:0)) and liver metabolism (5beta-cholestane-3alpha,7alpha27-triol)."

1463T. *What's the effect of enriching maternal colostrum with colostrum powder? And how does feeding transition milk affect these two colostrum strategies?* Silva et al., U of Sao Paulo, Piracicaba, SP Brazil.

- Holstein calves (n=50) were fed in a 2 x 2 factorial, either a) colostrum with 25% Brix, or b) medium quality colostrum (20% Brix) enriched with colostrum powder to 25% Brix, and either a) whole milk, or b) whole milk supplemented with 70 g/L of colostrum powder (totaling 280 g/d) for 3 days. From the 4th day calves received grain and 6 L/d of whole milk until weaning at 56 d.
- All achieved excellent passive transfer (avg = 10.1% Brix) due to high IgG intake (517.5 g). NSD in AEA of IgG with a mean of 30.4%. NSD in ADG (577 g/d) or wean weight (67 kg). NSD in health scores (avg fecal score 0.72, 8.7 d w/ diarrhea, 3.8 d w/ fever).
- **Take-home**: Enriching medium quality colostrum results in equal performance as high-quality colostrum. Supplementing colostrum powder post-gut closure had no effect on growth or health.

1468T. *Supplementing waste milk with either CMR or transition milk during the winter?* IRR Castro et al. Washington State U. Shiraz U, Fars, Iran.

- Cold-stressed Holstein dairy calves (n=51) were fed either a) waste milk (WM), b) WM + CMR, or c) WM + transition milk (quantity not shown for any trt).
- The average maximum, mean, and minimum temperature during the study were 54, 39, and 25°F. Calves were housed individually and had access to *ad lib* grain. Calves were weaned d 61 and kept on study until d 101.
- Total DMI (g/d) was 4.38[a], 4.72[b,x], and 4.47[b,y] lbs./d for WM, WM + CMR, and WM + transition milk, respectively (subscripts diff P<0.05). Body weight (101 d) was 174.6[a], 177.0[b], and 178.1[b] lbs., and ADG was 2.05[a], 2.23[b], and 2.18[b] lbs./d for WM, WM + CMR, and WM + transition milk. NSD in incidence of diarrhea (7.2-7.8 d), but shorter BRD if WM + CMR or transition milk (1.3, 0.4, and 0.5 d; P=0.02).
- **Take-home**: adding either CMR or transition milk to waste milk improves DMI, BW gain, and ADG while also reducing incidence of BRD in cold-stressed calves.

1471T. *Supplementing powdered colostrum for 14 days: effect on metabolism and gut permeability.* H McCarthy. U of Guelph. Saskatoon Colostrum Company.

- Holstein heifers (n=32) were provided colostrum replacer (150 g IgG) at 0 h and then assigned to one of two d 1-14 treatments, either a) 100% CMR, or b) 90% CMR + 10% colostrum replacer. Both groups were fed 3 L 2x/d for 14 d then 4 L 2x/d from d 15-49 before wean d 50-56.
- BW recorded at birth and weekly. Blood samples taken 0, 24, and 48 h relative to birth and weekly until d 56. Postprandial insulin and glucose analysis on d 13 and gut permeability assessed d 14 using lactulose, mannitol and chromium-EDTA as markers.

- NSD on serum IgG, ADG, postprandial glucose or insulin to glucose ratios, or weekly insulin and glucose concentrations. Post-prandial insulin concentrations were greater in the calves extend-fed colostrum replacer (P=0.01). NSD in gut permeability.
- **Take-home**: Extended feeding of colostrum replacer had no effect on ADG or gut permeability, however, increases in post-meal insulin suggest an effect on metabolism.

1476T. Does total solids % of colostrum replacer impact IgG absorption? AJ Lopez et al. U of Guelph. Saskatoon Colostrum Co. (SCCL).

- Male Holstein calves (n=48) were fed 2.1 lbs. (150 g IgG) of colostrum replacer (SCCL, 15.8% IgG, 16.4% fat, 47.1% protein) in one of four fluid volume doses within 1 h of birth, either a) 3.9 lbs. water, 2.6 L, 360 g/L, b) 4.6 lbs. of water, 3 L, 320 g/L, c) 5.7 lbs. of water, 3.4 L, 280 g/L, or d) 6.9 lbs. of water, 4 L, 240 g/L.
- 6 calves/group were catheterized to estimate abomasal emptying rate and to determine gut permeability. Blood samples were drawn at 1-6, 8, 10, 12, 24, 26, 28, 30, 32, 36, and 48 h post colostrum feeding.
- Results reported with ascending dilution rates: the osmolarity was reduced with the addition of water: 835.1, 714.8, 514.0, and 410.3 +23.32 mOsm/kg (P<0.01). Serum IgG concentration at 24 h tended to linearly increase with ascending dilution rates: 15.5, 12.2, 17.3, and 18.4 +1.75 g/L (P=0.10). AEA (%) tended to linearly increase with reduced total solids 43.9, 35.1, 49.5, and 51.2 +4.77% (P=0.09).
- Abomasal emptying rate per hr increased with decreased total solids levels: 0.09, 0.11, 0.13, and 0.13 +0.017 (P=0.03). NSD lactulose, mannitol, and Cr-EDTA concentrations (i.e., gut permeability). NSD abnormal fecal scores or respiratory scores until d 7.
- **Take-home**: Reducing total solids increased IgG absorption and abomasal emptying rate but did not affect gut permeability.

1731W. Effects of time and colostrum composition on immunoglobulin G absorption in neonatal dairy-beef calves. Pereira et al. UK, Zinpro.

- Holstein-Angus calves (BBW = 100 ± 12 lb) fed either maternal colostrum (MC, n=23), colostrum replacer (CR, Premolac Plus, 300 g total IgG n = 23), or casein supplemented CR (CCR, Premolac + 95 g/L casein, n = 24). All trt fed as 3.75 L tubed at 3 h post birth.
- CR calves ↑ AEA and serum IgG concentration at 24 h (P < 0.01; 36 vs. 29-32%). MC ↑ STP at 24 (6.2 vs. 5.0-5.6 g/dL) and 36 h (P < 0.01).
- **Take-home**: CR without casein more positively influenced TPI compared to CR with casein. MC had higher STP (but add'l research has shown this is due to different protein profiles).

1475T. Does colostral fat impact passive transfer? How does AEA compare between adding colostrum powder to low-quality maternal colostrum and feeding high quality maternal colostrum? TS Dennis and AJ Geiger. Cargill Animal Nutrition, Lewisburg, OH. Zinpro, MN.

- Newborn male Holstein calves (n=60) received either a) high-quality maternal colostrum (HQMC; 92 g IgG/L, total 351 g IgG), b) low-quality maternal colostrum (LQMC; 28 g

IgG/L, total 112 g IgG), c) LQMC w/ 850 g of colostrum replacer containing 20% animal fat (CRF+; total 351 g IgG; Genesis, Cargill), or d) LQMC w/ 644 g of added colostrum replacer containing <2% colostral fat (CFF-; total 351 g IgG; Premolac Plus, Zinpro).

- All trts fed at 3.6 L w/in 2 h of birth and IgG intake between all groups except LQMC were identical. Fat intake in the HQMC and CRF+ (representing 60% of total fat) were the same. Calves fed CRF- consumed 50% less fat than those fed the higher fat formulas. Blood samples were taken at birth and 24 hr.
- Serum IgG 28[a], 20[b], 27[a], and 33[c] g/L, (P=0.003) for HQMC, LQMC, CRF+ and CFF-. STP was 6.6[a], 5.5[b], 5.6[b], and 5.7[b], serum Brix % was 9.9[a], 8.6[b], 8.7[b], and 8.9[b], and AEA % was 28[a], 70[b], 29[b], and 35[b], for HQMC, LQMC, CRF+ and CFF- (P<0.01). To which contrasts P-value was applied was not clear in poster or abstract.
- **Take-home** – Whey-based colostrum powder supplementation to low-quality maternal colostrum resulted in greater IgG absorption. Colostral fat did not impact AEA. Serum Brix % is a poor indicator of serum IgG when using these colostrum powders.

1737W. Colostral whey isolate containing IgG vs. typical milk WPC protein absorption at 6, 12, 18, 24, and 30 h fed within 2 h of birth. AJ Geiger et. al. Zinpro, Eden Prairie, MN. U of VT

- Newborn crossbred calves (n=10) were fed either a) colostral whey isolate from maternal bovine colostrum providing 150 g IgG (Premolac Plus, Zinpro) or b) whey protein concentrate (WPC) fed to provide same protein intake but no IgG. Both fed w/in 2 hr of birth at same rate (375 g of powder).
- Blood samples were collected at birth, 6, 12, 18, 24, and 30 hr post treatment feeding and analyzed for serum IgG, Brix, and STP.
- Serum IgG peaked at 12 hr post-feeding (19.2 g/L) for calves fed Premolac colostrum replacer and IgG were greater at all time points vs. WPC (P<0.01; serum IgG was 0.0, 15.5, 19.2, 17.8, 16.4, and 16.0 g/L for 0, 6, 12, 18, 24, and 30 hr, respectively, with Premolac, and ranged from 0.1 to 0.8 for WPC). NSD for STP and Brix% (P≥0.48), which were "below traditionally defined" passive transfer of immunity threshold at every time.
- "Calves absorb protein in a non-specific manner in the 24 h following birth regardless of protein type (IgG vs. whey)" and authors postulate there is potential for other proteins to be absorbed instead of IgG in the first 24 h of life.
- **Take-home**: Typical WPC raises serum total protein and Brix % the same as IgG-containing whey protein isolate based colostrum replacer. Only IgG-containing whey raises calf serum IgG.

1729W. Colostrum powder, pork plasma, or trimethoprime sulfadoxine at onset of diarrhea? Wood et. al. Animix. Mapleview Agri, Palmerston, Ontario. Dept of Pop. Med. U of Guelph

- At onset of diarrhea (fecal score 3 or 2 consecutive d fecal score 2, 0-3 score) male calves (n=160; 140 Holsteins, 20 crossbred; 59.4% eligible) were supplemented either a) colostrum powder (SCCL): 10 fdgs over 5 d, 30 g/L formulated into 1 L of 26:20 CMR, b) pork plasma (APC Nutrapro P), 10 fdgs over 5 d, 30 g/L formulated into 1 L of 26:20

CMR, c) injection of 3 mL trimethoprime sulfadoxine (Borgal/Merck) intramuscularly 1x/d for 5 over d with same 26:20 CMR fdg (all-milk, no functional protein added), or d) control, same 26:20 CMR feedings (all-milk, no functional protein added).

- Mean d from barn arrival (transported, co-mingled calves) to enrollment were 4.2 ±1.7 d. All diets formulated to be isonutritious in protein and fat. Resolution of diarrhea defined as 2 consecutive fecal scores of 0 or 1. Trimethoprime sulfadoxine was administered if fecal scores did not improve. Weights, fecal scores, respiratory scores, and med treatments recorded 2x/d.
- NSD in quantity of antibiotics for diarrhea or BRD for functional protein groups. NSD in mortality or diarrhea resolution. Borgal group increased 56-d ADG vs. control (P≤0.05).
- **Take-home**: No difference in resolution of diarrhea between using colostrum powder, pork plasma powder, and trimethroprim/sulfa-drug injections as an intervention strategy at onset of significant diarrhea. Drug improved 56 d ADG vs. control.

1730W. Colostrum powder, beef plasma, or trimethoprime sulphadoxine at onset of diarrhea? Wood et al. Animix, Mapleview Agri, Palmerston, Ontario, Dept. of Pop. Med. U of Guelph.

- At onset of diarrhea (fecal score 3 or 2 consecutive d fecal score 2, 0-3 score) male calves (n=160; 155 Holsteins, 5 crossbred; 67.5% eligible) were supplemented the same as abstract **1729W** except beef instead of pork plasma: colostrum powder, Borgal, control; beef plasma (APC Nutrapro B), 10 fdgs over 5 days, 30 g/L formulated into 1 L of 26:20 CMR.
- Mean d from barn arrival (transported, co-mingled calves) to enrollment were 5.1 ±1.7 d. All diets were formulated to be isonutritious in protein and fat. Resolution of diarrhea was defined as 2 consecutive fecal scores of 0 or 1. Trimethoprime sulfadoxine was administered if fecal scores did not improve. Weights, fecal scores, respiratory scores and med treatments recorded 2x/d.
- NSD in 28 d or 56 d growth. NSD in number of calves requiring follow-up antibiotics for diarrhea. Supplementing bovine plasma tended to improve resolution of diarrhea vs. control. Relative to other treatments, Borgal antibiotic tended to reduce % treated for BRD (P≤0.10), reduced % secondary treatment for BRD, and increased 42 d BW (P≤0.05). Bovine plasma reduced (P≤0.05) % secondary treatment for diarrhea.
- **Take-home:** Treating diarrheic calves with either colostrum powder, beef plasma, or Borgal trimethoprime sulfadoxine as interventions noted minimal differences in resolution of diarrhea. Bovine plasma tended to have a quicker scours resolution. Borgal antibiotic used at scour intervention had a modest benefit on subsequent BRD and BW.

1142M Effect of transition milk on blood metabolome. Ghaffari et. el., U of Bonn, Germany.

- Holstein calves (30 F, 20 M) fed 6 L/d of either CMR (140 g/L) or transition milk for 5 days after colostrum w/in 2 h of birth (3.5 to 4 L) and again 11.5 h later (1.5 to 2 L).
- Calves fed via autofeeder with max CMR intake 12 L/d, *ad lib* access to grain and hay, and weaned wk 14. Blood metabolites (n=301) were measured in wk 2, 6, and 14.

- At wk 2, phosphatidylcholines 36:6, 36:5, 40:5, and 40:6, & cholesterol esters 20:5, 15:0, and 17:1 were ↑ in calves fed transition milk vs. CMR. NSD in any metabolite wk 6, 14.
- **Take-home:** Transition milk had minimal effect on metabolome of dairy calves.

1407T Effect of transition milk on growth performance and health (further data from 1142M), Boucher et. al., U of Bonn, Germany.

- Holstein calves (30 F, 20 M) fed 6 L/d of either CMR (140 g/L) or transition milk for 5 days after colostrum w/in 2 h of birth (3.5 to 4 L) and again 11.5 h later (1.5 to 2 L).
- Calves fed via autofeeder with max CMR intake 12 L/d, *ad lib* access to grain and hay, and gradually weaned from wk 8 to 14. Weekly BW and health measures.
- NSD in BW (P=0.42) or ADG (0.19), but a trend (P=0.09) for a group x time interaction on ADG (2.25 vs. 2.33 lbs./d ADG for CMR vs. transition milk).
- There were fewer sick calves in the transition milk group (6 vs. 3; P<0.05) wk 1 and a trend wk 2 (3 vs. 0; P<0.10). Trend for fewer total sick calves if fed transition milk (19 vs. 13; P=0.07). Otherwise, NSD in relapse rate or total medications/antibiotics, however, of the diseased calves 58% in the CMR and 30.5% in the transition milk groups relapsed.
- **Take-home:** Transition milk for 5 days instead of CMR "did not improve growth but might have the potential to improving health."

2644. IgG transport kinetics and histological features in the postnatal bovine intestine are maximized during very early life. Hiltz et al. U of Alberta. **see Physiology → Gut and gut microbiome.**

1679. Mineral and trace mineral concentrations in colostrum, transition milk, and mature milk. Klein et al. U of Guelph, Trouw. **see Nutrition → Vitamins and trace minerals.**

Health (28 abstracts)

Respiratory disease (4 abstracts)

1615W. Respiratory "infectome" of dairy calves characterized by RNA sequencing? Brito et. al., Elizabeth Macarthur Ag Inst; Aust. Inst. Microbiology and Infection; DairyUp, NSW, Australia.

- Nasal swabs from 5-54 d old calves (n=60) from two farms in New South Wales, Australia, with calves on both farms with and w/o clinical respiratory disease were sequenced in 10 RNA libraries (Illumina Stranded Total RNA with Ribo-Zero library preparation, sequenced on Illumina Novaseq)
- Most corresponded to bovine transcripts. Of the total transcriptome bacteria RNA ranged from 3 to 0.05% and viruses 0 to 1%." The most prevalent on both farms were *Mycoplasma* sp., mainly *M bovoculi, M. dispar,* and *M. bovirhinis*. "Other bacterial species were less prevalent."
- The "virome" between farms differed. One farm "identified Astroviruses (4 genotypes), Kobuvirus, Torovirus, and Bovine Respiratory Syncytial Virus (BRSV)." The other farm "was predominantly Bovine Rhinitis A (BRAV) but also Influenza D, Bovine Rhinitis B, Bovine Coronavirus, and Influenza." *Babesia* sp. and cryptosporidium were detected.
- **Take-home**: Bacteriome of both farms was similar but the infectome differed. "*Mycoplasma* other than *M. bovis* may play an important role in respiratory disease."

1341T. Barn air particles as a pro-inflammatory predisposing factor for BRD. Nikousefat et al. U of Guelph. **see Management → Environment.**

2409. Effect of group housing of pre-weaning dairy calves on health and fecal shedding of antimicrobial resistance E. coli and Enterococcus spp. Breen *et al. UC Davis*. **see Management → Housing.**

2643. Immunomodulation strategies to control respiratory disease. JL McGill. ISU. **see Nutrition → Additives in CMR, whole milk, and starter grain.**

Enteric disease (15 abstracts)

1310T. Activity behaviors and relative changes in activity patterns were associated with diarrhea status in individually housed calves. Guevara-Mann/Cantor et al. U of Guelph, PSU.

- Diarrheic or healthy control calves were matched (n=13 pairs, based on BW, date, and diagnosis). Calves sourced from auction; health scored daily for 28 d after arrival. Diarrhea diagnosis = 2 consecutive d of loose/watery feces.
- Activity patterns d-3 to d 4 relative to diagnosis (assuming leg logger, not stated)
- Diarrheic calves: ↓ steps (119 vs. 227 steps, P =?), ↓ activity index, ↑ lying time d-3 (trt x time; 20.8 vs. 19.2 hrs/d, P =?), ↑ % change in steps at d-2. NSD lying bouts.

- **Take-home**: Diarrheic calves are more lethargic and show early signs of lethargy 2-3 d prior to diagnosis. Need for activity alerts in calves?

1617W. Virulence factors and antimicrobial resistant genes in RNA sequenced from rectal swabs from scouring calves. Brito et. al., Elizabeth Macarthur Ag Inst; Aust. Inst. Microbiology and Infection; DairyUp, NSW, Australia.

- Fecal microbiome was evaluated in non-diarrheic (n=55), and diarrheic (n=5) calves aged 4-54 d from 2 farms. "Untargeted RNA sequencing approach" was used. The sequences obtained were screened using virulence factor (VF) database and AMRFinder to identify antimicrobial resistance (AMR) genes."
- Two libraries from scouring animals had increased expression of virulence genes, 10 significant (P<0.05). One had increased virulence factor from *E coli* and *Campylobacter jejuni* and had co-prevalence with rotavirus A (2 calves 6-7 d old) with 8 virulence factors differentially expressed (P<0.05). A second had increased *C. jejuni* associated with virulence genes (2 calves 24-25 d old) but no association with viral pathogens with 19 genes differentially expressed (P<0.05). A third noted no increase in virulence factors compared to healthy calves but had virulence factors associated with Torovirus (43 d).
- Antimicrobial resistance genes against tetracycline, aminoglycosides, cephamycin, sulfonamide, macrolide, lincosamides, streptothricin, one beta-lactamase (bla_{ACI-1}), glycopeptides, and nitroimidazole were identified. Tet(Q), followed by sul2, and aph(3")-Ib were highly expressed across all libraries. Only 2, (aph(3")-Ib, aph(6)-Id, sul2), had significantly higher expression (P<0.05) in diarrheic calves."
- **Take-home**: Antimicrobial resistance genes to a multitude of common antibiotics were detected, and in scouring calves, virulence genes to *E coli*, *Campylobacter jejuni*, rotavirus A, *C. jejuni* and Torovirus, were detected in feces from diarrheic calves.

1616W. Untargeted metatranscriptomic methods to characterize the enteric infectome of calves with and without diarrhea. Brito et al. NSW, Australia

- Rectal swabs collected from n=56 healthy calves (fecal score = 0) and n=4 diarrheic calves (fecal score = 2) from 2 farms (F1 and F2).
- Bacterial genus diversity: health calves w/ *Prevotella*, *Bacteroides*. Scouring calves w/altered abundance for *Campylobacter*, *Bacteroides*, *Parabacteroides*, and *E. coli.*
- Older scouring calf (43-d) on F1 had *Bovine torovirus* RNA. Younger calves on F2 with scours had rotavirus A RNA. Identified several picornavirus species.
- **Take-home**: Research guides disease association; development of lab cultures, infection models, and diagnostic assays.

1728W. Assessment of blood and fecal oxidative stress markers in neonatal dairy calves with diarrhea. Fu et al. Chinese Academy of Agricultural Sciences

- Calves monitored from 21 to 28 d of life and classified as continuous diarrhea (DD, n=15), diarrhea at 21 but not 28 d (DH, n = 19), diarrhea at 28 but not 21 d (HD, n = 14), or continuously healthy (HH, n = 16).

- Blood and fecal samples at 21 and 28 d to measure oxidative stress biomarkers.
- Serum/fecal ROS and MDA ↑ from 21 to 28 d in HD, ↓ in DH calves ($P < 0.05$, unsure if main effect is trt or time). Serum H_2O_2 ↓ in HD, ↑ in DH calves from 21 to 28 d ($P < 0.05$)
- **Take-home**: The shift in oxidative stress markers depending on timing of diarrhea suggests oxidative stress occurs when calves undergo diarrhea (not convinced by stats in abstract or by timing of observation).

2404. RNA-Seq reveals induced calves' mucosal immune response to Cryptosporidium parvum infection. Veshkini et al. Research Inst. for Farm Anim. Bio., Germany.

- Calves infected (n=5) or not (n=5) with oral appl. of C. parvum oocysts at 1 d of life.
- Calves confirmed fecal shedders, euthanized at d 8, jejunal mucosa for RNA-Seq.
- Key molecular players in establishing host immune reaction to C. parvum infection: chemokine ligands 3, 4, 24, and 26; SAMHD1, interferon gamma, and lactotransferrin.
- **Take-home**: Model - Host immune system activates inflammatory response via NF-KB pathway and subsequent antimicrobial production.

1614W. Crypto's effect on nutrient absorption in the jejunum. A Veshkini, et. al. Research Inst for Farm Animal Biology, Dummerstorf, Germany. U of Vet Med, Vienna, Austria. U of Applied Sci Neubrandeburg, Germany. Leipzig U, Germany.

- One day old Holstein Friesian calves (n=10) either received a) no crypto infection, or b) oral application of 2×10^7 *C parvum* oocysts (LE-01-Cp-15 strain).
- Calves were slaughter d 8 and jejunum mucosa RNA was extracted for sequencing on Illumina HiSeq 2500. Results searched against bovine reference genome (ARS-UCD 1.2).
- Of the 12,908 genes, "193 and 87 genes were down and upregulated in the infected calves' mucosa, respectively." The differentially expressed genes included ATP-binding cassette and solute carrier transporters: downregulation of *ABCC2*, *ABCD1*, *SLC28A2*, *SLC38A3*, and *SLC5A4*; upregulation of *SLC10A2* and *SLC4A4*.
- Transporters on the brush border impacted by crypto are associated with transport of substrates "including organic/inorganic anions/cations, bicarbonate, monocarboxylates, cholesterol and fatty acids, bile acids, vitamins, and amino acids/oligopeptides…"
- **Take-home**: *C. parvum* effects transporters that "control acid-base balance as well as nutrient absorption."

1621W. Crypto's effect on intestinal short-chain fatty acids produced by microbes. W Liermann. Research Inst for Farm Animal Biology, Dummerstorf, Germany. U of Vet Med, Vienna, Austria. U of Applied Sci Neubrandeburg, Germany. Leipzig U, Germany.

- Male Holstein calves (n=10) were either a) not infected, or b) infected with *C. parvum* on d 1 of life (2×10^7). Calves were slaughtered d 8 and gas chromatography was used to measure intestinal short chain fatty acids (SCFA). Free fatty acid receptors, immune response genes, and FFAR2 protein expression measured by qRT-PCR and Western blot.

- Crypto infection lowered acetate and lactate concentrations in the colon (no P value). Reduced gene expression of: *FFAR1* and *2*, hydroxycarboxylic acid receptor 1 and 2, SOD1, and TNFα gene expression and increased indoleamine 2,3-dioxygenase 1, IFN-γ, IL1β, and nitric oxide synthase 2 expression compared with control calves."
- **Take-home** – Crypto infection results in changes in intestinal short chain fatty acid concentrations and impacts intestinal immune response.

1639W. Survey of Salmonella *population in cattle feed and water across the USA*. MN de Jesus et. al., Arm & Hammer, Waukesha, WI.

- From June 2016 to December 2022, 2,017 feed and water samples from 216 farms were collected and tested for *Salmonella.* "DNA was extracted from each isolate and the CRISPR2 array region was sequenced."
- Of the 2,017 feed and water samples: 128 were *Salmonella* positive (6.3%); 11.3% of TMR samples and 8.9% of water samples were positive for *Salmonella*; 1.4% and 2.9% of corn silage and haylage samples were positive for *Salmonella*.
- "The most prevalent serovars overall: *S.* Cerro (23.4%), *S.* Kentucky (19.6%), *S.* Montevideo (16.8%)." A prior study reported Cerro and Montevideo as the "most prevalent serovars in cow and calf fecal samples."
- The most abundant water serovars were *S.* Montevideo (46.5%), *S.* Cerro (20.9%), and *S.* Bredeney (16.3%).
- **Take-home:** Pertinent to the calf: 8.9% of water samples were *Salmonella* positive and *S.* Montevideo is the most prevalent serovar, with *S.* Cerro and *S.* Bredeney significant contributors.

1633W. Exploring the impact of Salmonella Dublin on cross-bred dairy calves. Pharo et al. Guelph

- Cross-bred male and female calves (n=160) were raised in a veal facility. Housed indiv. for 56 d, fed CMR 2x/d (no add'l info) with ad lib water and grain. Grouped into 5 until departure (age not stated). S. Dublin detected via arrival/departure serum draws and fecal samples at 1, 2, and departure wks.
- S. Dublin cases were 5.6% at arrival, 11.4% at wk 1, and 29% at departure; 46% calves positive at least once during trial.
- Calves positive for S. Dublin: ↑ days with abnormal fecal score, ↑ % treated (74 vs. 55%, P = 0.02) and % treated BRD (P = 0.05), ↑ odds of mortality (4.1x; P < 0.01). NSD growth.
- **Take-home**: Not surprisingly, S. Dublin was highly contagious and greatly impacted calf morbidity and mortality.

1625W. Evaluating the effectiveness of a nonsteroidal anti-inflammatory drug as an early intervention strategy for neonatal calf diarrhea. Welk et al. Guelph

- Calves (n=70) were fed 15 L/d CMR in an AMF from 2 to 35 d of age. Calves with a milk feeding alert (60% change in CMR intake or speed) received a dose of NSAID or saline and monitored for diarrhea (loose feces ≥ 2 d, watery feces ≥ 1 d). Calves were given electrolytes if <4 L/d CMR intake.

- NSD in milk alert/diarrhea diagnosis (9 ± 2 d; HR = 0.61, *P* = 0.07), diarrhea duration (~3 , *P* > 0.10), or ADG (~2.1 lb/d, *P* > 0.10).
- NSAID calves ↓ odds of electrolyte treatment (OR = 0.30, *P* = 0.03)
- **Take-home**: NSAID provision might prevent severe scours, but does not influence scours prevalence, length, or calf performance.

1735W. Does aspirin affect intestinal permeability in Holstein and Jersey calves? E Lopez Cruz, et. al., CA Polytechnic State U, San Luis Obispo, CA.

- Holstein (n=6) and Jersey (n=6) heifers received either a) 0 mg aspirin, or b) 100 mg aspirin/kg BW/12 h for 21 d. Heifer age was 10.4 ±0.7 months and BW was 798 lbs. (Holsteins) or 593 lbs. (Jerseys). Aspirin administered orally in water via a drench gun.
- On d 21 heifers were orally dosed 40 g of Co-EDTA, urine was sampled 0, 1, 3, 6, 8, 12, 18, 18, 18, 24, 30, and 36 h post-dosing to determine gut permeability.
- Jersey's had substantial increase in cobalt excretion in urine vs. in Holsteins (0.63 vs. 0.372 g/d; P<0.001), moderate increase due to aspirin (0.509 vs. 0.493 g/d; P=0.019).
- **Take-home**: "intestinal permeability may be higher for Jerseys vs. Holsteins and may be increased by aspirin administration.

2477. Effects of ororuminal forced feeding in severely dehydrated calves. Skarbek et al. WSU.

- Calves (n= 80) between 5-14 d of age diagnoses as mildly or severely dehydrated due to scours enrolled into 4 groups: health control, IV only (ringers, Vit B_{12}, $NaHCO_3$), IV + 2 L tubed oral electrolyte (Calf Gold Lyte, Bio Vet; sodium acetate/propionate/bicarb), or IV + 2 L CMR (Lawleys, no add'l info). Treatment duration not stated.
- NSD for fecal DM, blood sodium concentration. IV ↑ bicarb vs. CMR group (metabolic acidosis), and CMR ↑ anion gap.
- **Take-home**: Authors conclude CMR treatment worst for calf metabolic status, IV best (data not convincing, need more information on product osmolarity and treatment duration differences, for instance).

1411T. Butyrate metabolite hesperidin alleviates necrotizing enterocolitis by increasing tight junction proteins via inhibiting the PI3K-Akt pathway. Liting et al. Chinese Academy of Ag. Sci.

- Rat model of necrotizing enterocolitis (NEC) to determine efficacy of butyrate in alleviating intestinal inflammation. Summary of 3 experiments (n = unk.)
- NEC rates fed butyrate by gavage, feces collected for metabolomics and transcriptomics.
- *In vivo* studies: butyrate ↑ BW, ↓ cell injury, and improve inflammation (no stats).
- Metabolomics – hesperidin found to be a key metabolite (no mentions of stats)
- Transcriptomics – apply hesperidin *in vitro* ↑ tight junction, ↓ pro-inflammatory, and ↑anti-inflammatory protein expression through blocking PI3K-Akt pathway (cell type?)
- **Take-home**: Supposedly revealed mechanism of butyrate for alleviating NEC, new idea for treating NEC for calves (abstract information does not support this conclusion).

1729W and 1730W. Colostrum powder, pork OR beef plasma, or trimethoprime sulfadoxine at onset of diarrhea? Wood et al. Animix, Mapleview Agri, U of Guelph. **see Maternal-fetal → Colostrum, colostrum replacers, and transition milk.**

Disease prediction (3 abstracts)

1303T. Feeding behavior of group-housed pre-weaned dairy calves to predict disease using machine learning algorithms. Perttu et al. U of Mn

- Dataset of healthy (n=560) and sick (n=484) calves (n=741 calves total, n=1,044 observations). Some calves were both healthy and sick at diff observation. (No notes on what diseases/sicknesses were)
- AMF data (milk intake, drinking speed, visit duration, rewarded/unrewarded visits, visit interval), treatment records, and health scores collected wkly May 2018-May 2019.
- 3 predictive models developed – GLM, random forest, and gradient boosting machine. RF and GBM best at prediction of health status (F1 scores 0.775 and 0.784). No add'l information about which combinations of behaviors were best predictors.
- **Take-home**: machine learning effective in determining feeding behaviors to predict disease. Not enough data presented to draw many conclusions.

1622W. Evaluation of technologies for early detection of dairy calf pneumonia. Poulin et al. Universite Laval

- Commercial calves monitored and paired as healthy (n=72) vs. pneumonia (n=72; given treatment per producer protocol). AMF behaviors (consumption, speeds, visit) and activity (lying bouts, duration of bouts, and lying time) were monitored prior to pneumonia detection.
- AMF consumption speed ↓ 1 d before pneumonia trt (496 vs. 559 mL/d, $P = 0.04$; NSD consumption, visits). Lying bout number ↓ and lying time per bout ↑ 1 d before trt ($P < 0.04$). Lying time per d ↑ 1, 2, and 4 d before trt (~18-19 hr/d vs. 17-18 hr/d, treated vs. healthy; $P < 0.04$)
- **Take-home**: Both AMF and calf activity (accelerometers) can detect pneumonia earlier, activity more so than AMF.

1634W. Inter- and intra-observer reliability for performing welfare and health assessments of prewean calves. J Silva Ramos et al. U de Montréal, Québec. Lactanet, Québec.

- 19 possible indicators of health and welfare were identified after consulting experts and conducting a literature review. Four different observers made assessments via both direct calf observation (3 farms, 40 calves) and via pictures and videos (20 farms).
- "Each observer scored the same calves 3 times in a random order over a 2-d period whereas it was performed in the same day for pictures/videos."
- "A poor reliability was observed for assessing cough, nasal secretion, and ear carriage. Good inter- and intra-reliability was achieved for identification of diarrhea, hygiene,

weight, length, hip height, sunken eyes, skin tent test, swollen navel, hygiene, and humidity."

- **Take home**: Human observation to assess most health and hygiene measures is good, however, tracking cough, nasal secretions and ear carriage are all problematic.

Immunity, inflammation, and general morbidity (4 abstracts)

1610W. Comparison of calf morbidity, mortality, and future performance across categories of passive immunity. Crannell and Abuelo MSU.

- Retrospective cohort study of n = 4,336 calves at commercial farm categorized by TPI (poor - <5.1 g/dL TP, fair – 5.1-5.7 g/dL, good – 5.8-6.1 g/dL, and excellent >6.2 g/dL).
- TPI predicts ↑ diarrhea risk (1.49x poor, 1.32x fair, 1.14x good vs. excellent). Poor calves ↑ BRD and mortality risks (1.39x and 4.29x vs. excellent).
- Poor calves ↓ risk reaching first insemination, successful insemination, first calving. NSD between TPI groups for ADG or first-lact 305ME.
- **Take-home**: Four categories of TPI help distinguish enteric disease risk, but only Poor calves were at greater risk of BRD, mortality, and fertility issues in the present study.

1620W. Arrival risk factors associated with morbidity and mortality in veal calves in Quebec, Canada. Mohamed et al. Universite de Montreal.

- Prospective cohort study of n = 1,729 veal calves from 59 batches arriving at veal facility – blood measured for TPI (FPT considered BRIX < 8.4%)
- 63% of calves (n=1,084) had FPT. Morbidity rate = 25%, mortality rate = 3.9%.
- Calves with FPT had 1.5x risk of morbidity, 1.2x risk of mortality (non-significant); calves in fall season 6.1x risk of mortality compared to winter. NSD between calf suppliers.
- **Take-home**: Veal calf TPI and season of arrival can impact morbidity and mortality risk – did not look at the four new TPI categories.

1623W. Distribution of navel size of newborn calves from 23 source dairies in California. Silva-del-Rio et al. Vet Med, Tulare.

- From 23 source dairies and 11 calf raising facilities, Holstein (n=502), Jersey (n=230), and crossbred (n=173) calves had navel diameter measured at 3-10 d of age as a proxy of navel disease. Navel size: adequate (≤13 mm), uncertain (>13-20 mm), or inadequate (>20 mm)
- The proportion of calves with adequate navel size = 40-52%, inadequate = 8-16%.
- Jerseys and calves < 6 d had smaller navel sizes than Holstein/crosses and calves > 6 d of age (*P*=not stated).
- **Take-home**: Around 10-15% of calves have abnormally large navels herein (potentially indicative of navel infection), factors influencing navel size including. age and breed.

1732W. Relationship between serum γ-globulin concentration and morbidity in pre-weaned dairy calves. Kobayashi et al. ZEN-RAKU-REN, Japan.

- Heifer calves (n=273) from source farms were sampled at 3 to 7 d of age for γ-globulin concentration and divided into categories: Excellent (>1.0 g/dL), Good (0.7-0.9 g/dL), Fair (0.4-0.7 g/dL), and Poor < 0.4 g/d.
- Categories were compared to diarrhea and BRD morbidity up to 56 d of age.
- Category distribution: 19% Excellent, 16% Good, 33% Fair, 32% Poor.
- Diarrhea distribution: 32% of Excellent, 44% of Good, 52% Fair and 53% Poor (no stats)
- BRD: Excellent ↓BRD relative to other categories.
- **Take-home**: Serum γ-globulin predicted health outcomes similarly to serum IgG.

Antimicrobial resistance (2 abstracts)

1638W. Change in incidence of drug-resistance after farm employees are trained in an antimicrobial stewardship program. A Garzon et. al. UC-Davis. Ohio State U.

- Pooled fecal samples from cows a) treated with antimicrobials from the hospital pen, b) fresh pen (1-5 DIM) the c) mid-lactation pen (90-150 DIM) in conventional dairies in CA (n=9) and OH (n=9) were tested for *E. coli* and isolates categorized as either susceptible, intermediate, or resistant to antimicrobials.
- Farms were assigned to either the training intervention group (9 per state) or control group (3 per state).
- "The prevalence of resistant isolates remained unchanged between control and intervention farms after the training was delivered. Isolates from the hospital pens were 5.04 (P=0.032) and 10.54 (P=0.001) times more likely to be resistant to amoxicillin/clavulanic acid and chloramphenicol, respectively than isolates from the mid-lactation pens."
- **Take-home**: In this study antimicrobial training had no effect on incidence of antimicrobial-resistance. Feces from hospital pens were more likely to be antimicrobial-resistant than feces from mid-lactation pens.

1617W. Virulence factors and antimicrobial resistant genes in RNA sequenced from rectal swabs from scouring calves. B Brito et. al., **see Health → Enteric disease.**

Physiology (9 abstracts)

Gut and gut microbiome (7 abstracts)

2645. Early-life microbiome: Modulator of immunity and health. Malmuthuge, Agriculture Agri-Food Canada.

- Role of the neonatal gut microbiota:
  - Primes developing immune system (active and passive)
  - Stimulates long-term memory, requiring interventions pre-weaning if perturbed.
  - Modulate calf health (i.e., prevent enteric infections)
- Diversity and density of gut microbiota impacted by:
  - Calving method, colostrum and milk feeding, antibiotics, water, and housing.
- Microbial interventions:
  - Prebiotics, probiotics, fecal or rumen fluid inoculation → all require additional research.
- **Take-home**: More research is needed to better understand the immuno-modulatory role of the microbiome to improve calf health.

1515T. *Fecal microbiota transfer from a healthy calf to a diarrheic calf*? MY Hu et. al. Huazhong Ag U. Wuhan, China.

- 4-d old Holstein calves (n=15) were either subjected to a) fecal microbiota transplantation from healthy calves of 10^8 cfu/mL or b) fed PBS buffer.
- Fecal microbiota of diarrheic calves changed when subjected to fecal transplantation as measured by Shannon (P=0.049), Ace (P=0.016), and Chao1 (P=0.016) indexes. All measured increases, "indicating species richness was significantly increased."
- Fecal transplantation resulted in a decrease (P=0.015) in *E. coli.* Negative correlation (P=0.002) between *Bifidobacterium pseudocatenulatum* and diarrhea index. "Short chain fatty acids acetate, propionic acid, butyric acid, and valeric acid and the metabolites of microorganisms were significantly increased (P<0.02)."
- **Take-home**: Fecal microbiota transfer from a healthy calf to a diarrheic one improved species richness and reduced *E coli*. Researchers concluded that *Bifidobacterium pseudocatenulatum* "could alleviate calf diarrhea."

2475. Changes in microbial community and host transcriptome in the duodenum of newborn calves. Li et al. USDA DFRC

- Calves (n=8) fed pasteurized colostrum and euthanized at 12 or 48 h. Duodenum collected for RNA seq and microbial abundance.
- Notable genes: ↑regulated @ 48 hrs = cell cycle, cell division, microbial genera related to cow's milk; ↓regulated @ 48 hrs= asparagine proteins, glycoproteins, general related to rumen contents
- **Take-home**: Colostrum feeding targets assembly and establishment of microbiome.

2644. IgG transport kinetics and histological features in the postnatal bovine intestine are maximized during very early life. Hiltz et al. U of Alberta

- Holstein-Angus calves were fed (C) or not fed colostrum (NC; time not stated, guessing prior to 1.5 h), and euthanized at different time points (1.5NC, 6C, 12C, 18C, 24C, and 24 NC) for serum, duodenum, jejunum, and ileum tissue samples.
- Tissues were assessed for histology (vesicle density and size) and serosal appearance of biotinylated IgG (i.e., IgG flux across tissue).
- IgG flux highest at 6C in all GIT tissues except proximal jejunum. Distal jejunum had highest absorption, particularly at 6 h (no stats). Vesicle density highest in 12C calves and in the jejunum (P<0.001).
- **Take-home:** The IgG flux suggests maximal IgG absorption is at 6-12 hrs of life, with highest absorption in the jejunum.

2401. *Development of gamma delta (γδ) T cells in the colon. How does weaning affect them?* LR Cangiano et al. UW-Madison. U of Guelph.

- Blood and colon biopsy samples were collected d 2, 28, and 42 of life on Holstein bull calves (n=36). "Lymphocytes were extracted from blood and colon biopsies and stained with fluorescent antibodies to determine the proportions of various γδ T cells subsets by flow cytometry. Additionally, colon biopsies were used to isolate microbial DNA."
- On d 2 T cells 58.5% of total lymphocytes, gradually decrease until weaning on d 42 to 38.2% (P<0.01)." γδ T cells "effector function" decreased from d 2 to 28 (P<0.01), no change was observed in "regulatory function."
- Proportion of γδTCR$^+$ intra-epithelial lymphocytes in colon increased 50% during on d 42 vs. d 28 (P<0.01)," and the expression of "effector function" on γδTCR$^+$ lymphocytes doubled from d 28 to 42 (P≤0.01).
- Microbial diversity of the epimural microbial community increased from d 2 to 28," as measured by chao 1 (P=0.03) and Shannon (P<0.01) indices and "a reduction in microbial diversity was observed during weaning denoted by the Chao1, Shannon, and Phylogenetic Diversity indices (P<0.01). This diversity reduction was correlated with the increase in all γδ T cell subsets in colon (P≤0.02, Spearman P≤0.40)."
- **Take-home**: "…ontological adaptations during early life coordinate expansion of γδ T cells to provide early systemic protection, as well as to steer immune tolerance at birth. Increase of colonic γδ T cells on d 42 suggests a protective role during weaning."

2402. How does lysophosphatidylcholine administration impact circulating levels and haptoglobin concentrations? BN Tate, et al., Cornell, Johns Hopkins School of Med.

- "Endotoxin exposure decreases circulating lysophosphatidylcholine (LPC) concentrations in dairy cattle. Moreover, subcutaneous administration of LPC impairs growth and induces acute febrile response in calves."
- Healthy Holstein heifer calves (n=43; age 7 ±3 d) fed 27:24 CMR at 1.7% of BW/d until start of wean at 6 wks and 22% CP starter *ad lib* were administered either a) no

supplement, b) mixed LPC (69% LPC-16:0, 25% SPC-18:0, 6% other), c) LPC-18:0, or d) CMR with 3% lysolecithin.

- The lysolecithin CMR was administered for 5 wks. The mixed LPC and LPC-18:0 were administered as a 10 mL injection of PBS containing 20 mg/mL bovine serum albumin providing 10 mg of LPC/kg of BW every 12 h during wk 3 of life. The control and lysolecithin CMR-fed calves received the same bovine serum albumin injections w/o LPC. Blood samples were collected 0, 5, and 10 h, relative to the final injection.
- Plasma total LPC were greater (P<0.05) for calves administered either mixed LPC or the lysolecithin containing CMR, similar for plasma LPC-16:0, -18:0, and -18:1. NSD for plasma LPC-18:3., -20:5, or -22:5 concentrations. Serum haptoglobin elevated with mixed LPC at h 5 and 10 post-final injection (P<0.05) relative to control.
- Mixed LPC and lysolecithin in CMR did not modify serum haptoglobin relative to control.
- **Take-home**: "Mixed-LPC and lysolecithin administration increased plasma LPC concentrations in pre-weaned calves, and the ability of mixed-LPC to induce serum haptoglobin concentrations aligns with our prior evidence for immune activation."

2411. Social housing: impacts on health scores and gut microbiome of dairy calves. Goncalves da Costa et al. U of Mn. **see Management → Housing.**

Rumen development (1 abstract)

2474. Is there an interaction between rumen development and calf health? A. Wolfe et. al. U of Alberta, Edmonton.

- Holstein calves (n=32) fed CMR (26:18) up to 2 lbs./d and grain (18% CP) were ruminally cannulated at 10 ±3 d of life. One wk post-cannulation calves were assigned into a 2 x 2 factorial: a) low pH, low SCFA, b) low pH, high SCFA, c) high pH, low SCFA, or d) high pH, high SCFA.
- Wk 3, 5, and 7, calves underwent 4-h washed reticulorumen procedure w/ a buffer containing one of the four trts. The buffers were added to the rumen at the beginning of the 4-h period and ruminal pH was measured hourly. Daily intakes of CMR and starter were taken. BW, health, blood hematology, and fecal scores measured weekly.
- Low rumen pH increased respiration by 4.7 bpm (P=0.02). NSD in body core temp. From wk 5 to 7 white blood cell counts decreased in the low pH, low SCFA group (P=0.04) but increased in the high pH, low SCFA group (P=0.04).
- NSD in calf red blood cell counts, platelet counts, cortisol levels and BHBA by treatment or age. Hemoglobin (P=0.05) and hematocrit % (P<0.01) increased in the high pH, low SCFA groups during wk 5 and 7.
- **Take-home**: "The rumen environment does not impact clinical health but does impact hematological markers."

Mammary development (1 abstract)

1542T. Longitudinal histological and ultrasound analysis of bovine mammary gland development.
Vang et al. UW-Madison.

- Heifers were enrolled in high (27:20 LOL) and low (22:15) CMR diets pre-weaning (n = 18/trt, volume and solids % not described).
- Mammary ultrasounds, mammary biopsies, and blood samples were collected from heifers (n=36) at 10, 26, 39, and 52 wks.
- Time effects: Ultrasound max. echogenic value ↑ from 10 to 52 wks (related to ↑ histological adipose tissue). ↑ PAR echogenicity at 10 wks correlated w/ ↓ histological adipose tissue at 56 wks (r = 0.46, P = 0.006).
- ADG at 10 and 26 wks negatively correlated to max. echogenicity at 56 wks (r = -0.53, -0.68, P < 0.01). Not sure how echogenicity translates to mammary growth?
- **Take-home**: No information on differences in development between high and low diets, but interesting time effects indicate ultrasounds could be used to track mammary development and that ADG influences development.

Management (24 abstracts)

Housing (7 abstracts)

2151. ABW Symposium-Hot Topics in Calf Mgmt. Calf housing and social impact. Miller-Cushon. UF.

- Described the social impacts of calf housing from a direct, long-term, and individual variability perspectives.
- Direct:
  - Development of social behavior
    - Lindner et al. 2022: Pair vs. indiv over 8 wks. In 4 wk preference test, pair calves ↑ time near any calf but ↑% time near more familiar calf.
    - Lindner et al. 2021: Pair vs. indiv 2 wks, then group housing 2-4 wks. Paired calves ↑ social lying, ↑ novel object contact, ↑ "boldness."
  - Social contact affects abnormal behavior:
    - Doyle and Miller-Cushon 2023: pair ↑ cross-suck but ↓ pen-directed and ↓ overall oral non-nutritive suckling
  - Social contact improves welfare: calves work for companion access, reduces weaning stress (Bolt 2017, De Paula Veira 2010)
- Long-term (*see abstract 1302T, 1304T below*)
  - Preliminary study looking at pair vs. indiv. up to 8 wks, longitudinal to lactation. Heifers currently 18 wks (pastured) w/ minor trt impacts (↑ social standing); TBD on lactation performance.
  - Success in competitive fdg - paired ↑ meal freq pre- and post-wean.
- Individual variability
  - How housing impacts social outcomes depends on calf biological state, pain/disease, and personality traits.
  - Gingerich et al. 2020: calves use shelter to hide 1-2 d post-disbudding (pain)

1302T. Effects of pre-weaning social housing on dairy heifer social networks and behavior on pasture. Clein et al. UF.

- Heifers raised in indiv. pens (n=17) or paired (n=20; 10 pens) for 8 wks then grouped (n=10/grp) on pasture at 9 wks.
- At 18 wks, live observation of activity (lying, standing, feeding) and social proximity (w/in <3 body lengths of neighbor) conducted for 5 d, 6 h/d in morning and afternoon.
- Paired: ↑ standing in the AM (30% vs. 24%, P = 0.04), NSD for lying and feeding time.
- Paired: ↑ neighbor centrality (tendency, P=0.07) while standing but not lying or feeding
- **Take-home**: early-life pairing might influence social interaction in pastured post-weaned heifers.

1304T. Effects of pre-weaning social housing on growth, estrus behavior, and age of onset to estrus. Lindner et al. UF.

- Heifers raised in indiv. pens (n=30), paired (n=30; 1 focal/pair), or grouped (n=30, 5 focal/10 calves in group, 6 groups) for 9 wks then grouped on pasture at 10 wks.
- At 6 mos., heifer BW, hip height, and anogenital distance (AGD) recorded wkly for 24 wks, heat-detected using Estrotect and ultrasound for corpus luteum (CL).
- Paired: ↑ hip height (trt x time, trt effect at 12 months, P = 0.04)
- NSD between trt for BW, AGD, age at estrus behavior or CL detection.
- **Take-home**: early-life pairing might influence long-term growth but no repro success.

1306T. Effect of pre-weaning social housing on development of cognition in weaned heifers. Bonney et al. UF.

- Heifers raised in indiv. pens (n=22), paired (n=22; 1 focal/pair), or grouped (n=22, 5 focal/10 calves in group) for 8 wks then grouped on pasture at 10 wks.
- At 2 and 5 mos., calf cognition tested in T-maze - calves seek reward (ability to exit) on one side, "pass" when they go directly to correct side 3x, then reward is reversed.
- 2 mos.: NSD for pass rate for initial or reversal learning, NSD for # of sessions to pass for initial but tended to differ for reversal (paired lowest at 7.0 sessions, P = 0.07).
- 5 mos.: Same results as above, all NSD except sessions to pass reversal (but indiv. lowest at 6.6 sessions, P =0.02 – paired 8.4 and grouped 12.4 sessions).
- **Take-home**: Pre-weaning housing may persistently impact behavioral flexibility.

2409. Effect of group housing of pre-weaning dairy calves on health and fecal shedding of antimicrobial resistance E. coli and Enterococcus spp. Breen et al. UC Davis.

- Calves assigned to individual or group housing using wooden hutches either in single or removing panels for 3 calves (n = 21/trt). Dimensions not provided.
- Calves monitored 0 to 56 d, health scored daily, fecal sampled 3x/wk. Assessed BRD, scours, and acquisition of anti-microbial resistance (AMR) from drug exposure.
- Group calves: ↑ 1.94x BRD trt hazard, but NSD in BRD or scours disease (98% calves had diarrhea).
- Grouped calved not exposed to pen mate drugs had lower AMR in E. coli isolates (ceftiofur) compared with exposed grouped calves, NSD between group and indiv.
- **Take-home**: Group housing in wooden hutch systems ↑ BRD hazard and can ↑ AMR.

2411. Social housing: impacts on health scores and gut microbiome of dairy calves. Goncalves da Costa et al. U of Mn.

- Calves from 3 diff breeds (2 cross, Holstein) were assigned different housing types: individual (n=87), paired (n=86), grouped (n=84, 6 calves/pen), and dam-reared (n=69, 6 dam-calf pairs/paddock).
- Calves weaned at 63 d (no info on diets). Health scores wkly, fecal samples before and after weaning (n=11-19/trt; no paired calves).

- Dam-reared (6.7%) and grouped (7.2%) ↑ fecal scores vs. paired (3.1%) and indiv. (2.9%). NSD in microbiome diversity between trt pre-wean. After weaning, indiv. calves had ↓ microbiome richness, while dam and grouped had enrichment of lactobacilli and bifidobacteria.
- **Take-home**: Dam or grouped housing might facilitate abundance of beneficial gut bacteria, but at the host of greater scours.

2497. Milking parlor behavior, body measurements, and body condition scores of first-lactation cows raised in individual, pair or group housing compared to dam-reared housing. Sharpe and Heins U of Mn.

- Holstein and cross bred heifers were assigned different housing types: individual, paired, grouped, and dam-reared (n=79 total, assuming trt similar to Abstract 2411)
- Heifers raised to first lactation, monitored for behavior, size @ first 8 milkings.
- Dam-reared 2.3x odds of being restless/hostile, stomping, or kicking compared to other housing types. Dam-reared had reduced rear udder width but NSD for other growth measures (i.e., hip height, body length, BCS).
- **Take-home**: Dam-reared heifers might exhibit behavioral disadvantages as milk cows.

Environment (6 abstracts)

2153. ABW Symposium – Hot Topics in Calf Mgmt. Thermal stress impact on calves. Van Os et al. UW-Madison

- Paired housing/social contact impacts on thermal stress:
  - Cold stress – paired calves prefer to spend most of their time together across weeks of life. Ambient temp ↑ when 2 calves in hutch vs. 1. (Reuscher et al. in preparation)
  - Heat stress – paired calves still prefer spending time together. Ambient temp. not influenced by number of calves in hutch. (Reuscher et al. in preparation)
- Ventilation in calf hutches can improve hutch microclimate, while ventilation in group-housing improves microclimate and calf thermoregulatory responses (Dado-Senn et al. 2023, Dado-Senn et al. 2020)
- **Take-home**: Calves will seek out pairing even at the cost of thermoregulation, but solutions are being developed to moderate microclimates.

1628W. Provision of active ventilation to outdoor hutches during summer improves immune function of dairy calves. Tabor et al. UW-Madison

- Outdoor hutch-housed heifer calves were provided passive (PASS, 0.05 m/s air speed, n=16) or active (ACT, 1.1 m/s, n=16) ventilation from 0 to 28 d of age, and serum immune parameters were measured via hematology, flow cytometry, and qPCR from 1 to 56 d.
- ACT calves tended to have ↓ WBC, neutrophil, and lymphocyte counts ($P < 0.08$), ↑ % neutrophils in phagocytosis ($P < 0.01$), ↓ gene expression of *IL1-B*, *HSP90*, and ↑ gene expression of *TGF-B1* and *CD28* in PBMCs.

- **Take-home**: Active ventilation altered immune cell populations, phagocytosis, and gene expression, likely through a combination of improved heat stress response and air quality in the calf microclimate.

2410. Seasonality of colostrum Brix values and total serum protein of newborn dairy female calves in a temperate climate. Goncalves da Costa et al. U of Mn.

- Calves from 3 diff breeds (2 cross, Holstein) were born in either the fall (n=189) or spring (n=74) between fall 2020-fall 2022. Calves fed 4 L colostrum within 12 hrs.
- Fall-born calves had ↑ STP (5.8 g/dL vs. 5.4 g/dL spring), breed and Brix did not impact STP. NSD in Brix between seasons.
- **Take-home**: Seasonality might impact IgG absorption but not colostrum quality (similar to previous heat stress research).

2179. Description of local immune responses within the pulmonary tract of dairy calves exposed to wildfire smoke. A. Pace et al. U of Idaho.

- Heifers (n=17) monitored summer 2022 in Idaho, birth to early post-wean (wk unknown)
- Meteorological data collected hourly, thermoregulation and health scores 3x/wk and lung ultrasounds 1x/wk. Transtracheal washes for pulmonary leukocytes before and during a wildfire event (max $PM_{2.5}$ = 113 µg/m^3). Data measured w/ lags up to 7 d.
- On lag d0, ↑ $PM_{2.5}$ and THI led to ↓ resp rate but ↑ rectal temp and heart rate ($P<0.04$). $PM_{2.5}$ x THI ↓ eye score but ↑ cough score ($P < 0.05$)
- ↑ $PM_{2.5}$ and THI increased lung ultrasound scores across lag d (data not shown, $P < 0.05$), and wildfire exposure ↑ macrophage proportions (23 vs. 6% baseline, $P < 0.001$).
- **Take-home:** ↑ $PM_{2.5}$ (and perhaps THI) prompt leukocyte alterations and lung consolidation, predisposing calves to a compromised pulmonary system and ↑ BRD risk.

1341T. Barn air particles as a pro-inflammatory predisposing factor for BRD. Z. Nikousefat et al. U of Guelph.

- Concentrations of air particulates (particle matter [PM] 5, 2.5, 1, and 0.3; ammonia, CO_2, and relative humidity) measured weekly for 5 mo. in veal barn (size, stocking density, and ventilation status unknown).
- Air samples collected, applied in vitro to stimulate interleukin-1β in bovine macrophages at diff PM size and exposure times.
- $PM_{1-5?}$ and $PM_{0.5?-1}$ both induced IL-1β secretion at 6, 12, and 24 h of exposure.
- **Take-home**: Fine particulates in barn air can stimulate macrophage inflammatory responses, which could impact predisposition to bacterial pneumonia. More info is needed on calves and housing design.

1468T. Supplementing waste milk with either CMR or transition milk during the winter? IRR Castro et al. WSU. **see Maternal-fetal → Colostrum, colostrum replacers, and transition milk.**

Management surveys (6 abstracts)

2406. Exploring pre-weaning dairy calf mortality risk factors in Ontario. Umana Sedo et al. U of Guelph.

- n=100 Ontario dairy farms; collected retrospective data on previous yr. calf pre-weaning mortality (survived vs. culled vs. died), administered survey on mgmt.
- Herd level mortality: 0-3.0 deaths/60 calf-days, avg = 0.5 ± 0.7 deaths/60 calf-days.
- Factors ↑ mortality rate: calves grouped 6+, mixing indoor/outdoor housing, feeding ↓ 6 L milk/d after 3 wk of age, low farm education/lack of vet inquiry into calves.
- **Take-home**: A variety of housing, nutrition, and personnel factors influence calf mortality for this demographic of dairies.

2407. The effect of benchmarking reports on the health of surplus calves. Habing et al. OSU

- From 2 calf ranches, source farms were allocated to receive benchmarking reports (n=6; n = 282 calves) or not (n=7; n = 371 calves), balanced for herd size and previous FPT.
- The report was provided 6 mo. post-enrollment, including relative passive transfer, hydration, navel health in first 48 hrs. Data were assessed as before vs. after.
- NSD between trt on probability of navel infection or FPT either before or after reports.
- Farms provided reports had dehydration probability of 70% before report and 47% after; probability tended to be less likely in report farms after report (P = 0.07)
- **Take-home**: Providing source farms reports on calf health might improve dehydration status upon arrival.

2450. How benchmarking motivates improved calf care: a realistic evaluation. Renaud et al. U of Guelph

- Differing STP reports from 2 diff vet clinics were presented to dairy producers (n = 21) by veterinarians (n = 7). Report 1 = visual Lombard et al. 2020 style report. Report 2 = mean STP by calf category. Following report presentation, producers were interviewed; answers analyzed qualitatively.
- Contexts identified that influenced outcomes of benchmark meetings: farm resources, mgmt. strategies, producer perception of calf performance, producer values.
- "Will they make a change?"
    - Yes: Data was influential. Limitations – time, facilities, beef x dairy limitations.
    - Maybe: Data unmotivating. Limitations – family labor, time
    - No: Things are already working well.
- **Take-home**: Producers liked illustrative data (Report 1) and saw room for improvement; many had mgmt. and time constraints, and some were motivated to change.

1613W. Barriers to recording calf data on Ontario dairy farms. Edwards and Renaud et al. U of Guelph

- Survey of 88 Ontario dairy farms w/ questions regarding demographics, factors impacting recording compliance, and current recording practices.

- Only 19% of farms recorded all health events. Barriers included – lack of calf health data analysis, records in paper booklets, not keeping records near calves. i.e., farms that recorded calf treatments on paper reported that treatments were not recorded because calf records weren't analyzed.
- Computer software ↑ odds of recording all antibiotics treatments by 3.45x
- **Take-home**: Authors suggest developing mobile app to improve recording – records kept near calves, allows for data analysis.

1637W. Hygiene management practices and ATP luminometry of feeding equipment in pre-weaned calves on dairy farms in Quebec, Canada. Van Driescche et al. U of Montreal

- Compared contamination of feeding equipment (buckets, nipples, bottles, esophageal tube feeders, AMF tube, water and CMR samples) using different measurements (ATP luminometry (Hygiena UltraSnap), visual assessment, bacteriological analysis (1:1,000 dilution 3M petrifilm) on n=50 dairy farms.
- Table of outcomes provided in abstract book. Top 3 highest scoring: bucket (median = 621 RLU, range 171-1,598 RLU), AMF tubing (301 RLU, range 137-1,323), and water (190 RLU, range 71-358).
- Higher correlation between bacteriological analysis and ATP vs. bacteriological and visual (no stats given).
- **Take-home**: Study provided some averages for ATP scores across Canadian dairies, but more work is needed to determine thresholds at which ATP scores are a concern for calf health, thus warranting hygienic interventions.

2506. Survey of stakeholder attitudes towards surplus dairy calves in Australia. Bolton et al. U of BC, U of Melbourne **see Beef x dairy/veal → Beef x dairy.**

Weaning (5 abstracts)

2191*. What happens to the colon mucosa during weaning?* U of Guelph, U of Alberta, Edmonton.

- Biopsied colon mucosa from male Holstein calves (n=6) were obtained at wk 5, wk 7, and wk 12. Calves were weaned in wk 6. Blood inflammatory markers were measured from wk 4 to wk 12.
- No correlation between colon mucosa thickness and fecal starch, fecal DM, or blood inflammatory markers.
- The number of differently expressed genes in the colon tissues between wk 5 and wk7, wk 7 and wk12, and wk 5 and wk 12 was 439, 430, and 757, respectively. 17 immune regulated genes were up-regulated post-wean.
- Researchers speculate colon inflammation at weaning was not severe enough to induce systemic inflammation.
- **Take-home**: Weaning induced colon inflammation.

1052M. Effect of weaning on behavior. McNeil et. al. U of Guelph, UW-Madison

- Male Holstein calves (n=23) weaned from 9 L/d on d 34 to 0.4 L/d on d 42.
- Weaning resulted in 4.3 fewer lying bouts/d, 11.7 minutes longer lying bouts ($P \leq 0.01$), 8.9 seconds shorter play duration per assessment and 1.1 fewer play counts per assessment ($P \leq 0.01$). Play assessed d 33, 37, and 41, for 3 min after adding straw bedding for 30 sec.
- No change in lying time (18.4 hrs/d), maximum eye temperature (98.6 °F), saliva cortisol (0.13 µg/dL; P=0.8), blood serotonin (3986 microgram/mL, P=0.6).
- **Take-home:** Weaning changed behavior.

1672W. Does variation in starter intake prewean have long-term consequences? Russell et al. U of BC. **see Nutrition → Starter grain and forage feeding.**

2401. Development of gamma delta T cells in the colon. How does weaning affect them? LR Cangiano et al. UW-Madison. U of Guelph. **see Physiology → Gut & gut microbiome.**

1052M. Tyndrallized Lactobacillus helveticus (found in Swiss cheese, kefir, fermented foods) at weaning? Effects of weaning in general? BK McNeil et al. U of Guelph; UW-Madison. **See Nutrition → Additives in CMR, whole milk or starter grain.**

Behavior and welfare (16 abstracts)

Transport (6 abstracts)

2152. *ABW Symposium – Hot Topics in Calf Mgmt. Transportation impact on pre-weaned calves.* Cramer. CSU.

- Important welfare concern is transportation of pre-weaned "surplus" calves in the first week of life from source farms to calf-raising facility, esp. with rise in beef x dairy.
  - Avg transport age = 3 d, many < 24 hrs.
- Transportation stressors include limited/no access to food and water, co-mingling (under-developed immune system), thermal stress (poor thermoregulation), and handling (immature physiological stress response).
- Areas to address:
  - Age at transportation
  - Fitness for transportation → some dairies transporting dehydrated, diarrheic, navel infected calves.
  - Calf arrival → lethargic, dehydrated, hypoglycemic. Compromised before or during transit?
- Solutions:
  - Target decision-making
  - Producer-focused education for source farm, transporters, and calf-raisers.

2405. *Effects of transport age on hematological parameters and growth performance in dairy calves.* Chibisa et al. U of Idaho.

- Bull calves (n=20) transported 410 mi at 2, 4, 8 or 14 d old.
- BW and blood samples collected before transport, on arrival, 7 d post for hematology. CMR intake recorded 7 d post.
- At arrival, 2 d old calves had ↓ lymphocyte count and % ($P = 0.02$), ↑ neutrophil % ($P < 0.01$), and ↓ tendency platelet count and volume ($P < 0.10$). 8 d old calves tended to have ↑ monocyte count and % ($P < 0.10$).
- NSD of transport age on CMR intake, BW change, or ADG post-transport.
- **Take-home**: Early transport at 2 d of age influences immune function relative to 4+ d of age but did not impact growth herein.

2408. *Does providing a rest period mitigate the impact of long-distance transportation on markers of energy status in surplus dairy calves.* Goetz and Renaud. U of Guelph

- Surplus dairy calves ≥ 7 d were transported for either 16 hrs continuously (n=32) or 8 hrs transport, 8 hrs rest, 8 hrs transport (n=32). Rest calves were unloaded and fed 2 L CMR.
- Blood samples collected before loading, at arrival, and 1-3 d after.
- At arrival: NEFA and BHBA ↓, glucose ↑ in rest calves relative to continuous ($P < 0.001$). No information on d 1-3, assuming NSD?

- **Take-home**: Providing a rest stop for transported calves influences energy mobilization and improves energy status of calves upon arrival.

1636W. The effect of a rest period on health and growth of surplus dairy calves following long-distance transportation. Goetz and Renaud, Guelph

- Calves > 7 d old either transported for 16 h straight (n=55) or 8 h transport, 8 h rest, 8 h transport (n = 55) in the fall. Calves fed 2 L CMR at rest.
- Health and growth outcomes measured 2x/d (health) or 1x/wk (growth) from arrival to 11 wks. Information on feeding protocol over 11 wks not provided.
- Rested calves ↑ ADG (+0.2 lb/d, P = 0.02); NSD for number of days or % treated for diarrhea or BRD (P>0.44).
- **Take-home**: Providing calves rest during transport did not influence calf health but improved calf growth over 11 weeks.

2500. Effect of post-transport oral electrolyte supplementation on behavior, health, and hydration of neonatal calves. Pempek et al. USDA-ARS, OSU.

- Transported bull calves between 3-7 d of age (n = 30/trt) enrolled in 4 trts upon arrival to a calf raising facility: 1-d oral electrolyte solution (OES), 2-d OES, 3-d OES, or no OES. (transport time not provided in abstract)
- Demographics: 90% calves on arrival w/ mild to moderate dehydration. FPT = 27%, hypoglycemia = 77%.
- Frequency of moderate dehydration ↓ w/2-d OES compared to control. NSD of OES on blood biochemistry or lying time.
- **Take-home**: More research is needed to guide dehydration mitigation for transported calves both before and after transport.

1631W. Evaluating the use of electrolytes or milk replacer to improve surplus dairy calf health and growth outcomes. Bajus et al. Guelph

- Surplus dairy calves were transported for 12 h, rested for 8 h, then transported 6 h to a calf facility. During rest, calves were fed CMR (n=43; no add'l info), high sodium electrolyte for diarrhea (n=43, ORS-D), or high potassium electrolyte for transportation (n=42, ORS-T), all 2 L, 2x.
- Health and growth outcomes measured 2x/wk to 2 wks, once at 8 wks.
- Calves fed ORS-T tendency ↑ proportion w/diarrhea or w/ BRD (+16%, +23%, P ≤ 0.08) compared to CMR. NSD for short (4 wk) or long-term (8 wk) ADG (P > 0.13).
- **Take-home**: Authors suggest feeding CMR during transport rest to encourage calf health.

Pain management (3 abstracts)

1307T. Effects of willow bark on post-disbudding behaviors in organic dairy calves. M. Bacon et al. U of Mn.

- Calves either hot-iron disbudded w/lidocaine (5 mL/bud, n=8), w/ white willow bark oral bolus (*Salix*, 200 mg/kg; n=10), or "sham" disbudded (n=7) at 5 to 7 wks of age.
- Behaviors recorded in 10 min intervals -1 to 4 hrs relative to disbudding.
- NSD between trt for ear flicks, head scratches, tail flicks, or lying-to-standing transitions. Disbudding ↓ self-grooming relative to sham (trt x time, P < 0.05, hrs 2-4). Head shakes ↑ in lidocaine vs. sham, NSD in willow bark (graphs/stats hard to interpret here).
- **Take-home**: Neither lidocaine nor willow bark sufficient for disbudding pain relief.

1308T. Effects of pain following disbudding on cognitive performance of dairy calves. Yoo et al. UBC Vancouver.

- Calves either hot-iron disbudded w/ or w/out ongoing analgesic, or sham (n=30, trt specifics not mentioned) at 14 d of age. All provided sedation, cornual block, and NSAID.
- Assess learning and memory with modified hole-board via square arena w/15 CMR bottle holders. On d 1 after disbudding, calves brought in daily to find location of 4 bottles. Location switched at d 13.
- NSD between trt for working memory, general working memory, reference memory, or number of visits to the bottle (time effects → memory ↑ and visits ↓ over time)
- **Take-home**: Pain from these disbudding procedures and/or test methods were insufficient to impair learning.

2502. Effect of repeated ACTH challenge on hair cortisol, growth, and behavior of pre-weaned dairy calves. Kern et al. Purdue.

- Can hair cortisol be used as a non-invasive measure of chronic stress in calves?
- Calves (n = 27) assigned to control, moderate ACTH exposure (2 ug/kg Cosyntropin and saline alternated weekly), or frequent ACTH exposure ("" weekly) starting at 7 d of age.
- NSD for BW, ADG, hair cortisol concentration, lying time (P > 0.97). Cortisol concentrations ↓ w/ time/age .
- **Take-home**: HPA axis stimulation through Cosyntropin did not influence hair cortisol, growth, or behavior. Perhaps need to find a different model for measuring calf stress.

Cow-calf (5 abstracts)

2150. ABW Symposium – Hot Topics in Calf Mgmt. Cow-calf separation: public acceptance and scientific evidence. Von Keyserlingk and Weary. UBC Vancouver.

- Reviewed public acceptability of cow-calf separation → does not resonate with societal values.
- Systematic review (Meagher et al. 2019) assessed acute responses of cow/calf to separation and long-term cow productivity/calf behavior and growth.

- Early separation ↓acute stress response to separation (n=4 studies).
- Later separation ↑ calf normal social behavior, ↓ abnormal behavior, and can ↓response to stressors, (n= 24 studies)
- Later separation ↑ calf growth due to suckling milk intake (n=23 studies)
- Later separation had short-term ↓ in milk production but generally NSD over the entire lactation. (n=22 studies). (esp. relevant if farm feeds whole milk to calves)

- Systematic review (Beaver et al. 2019) assessed cow/calf health w/out separation incl. mastitis, scours, crypto, Johne's, BRD, immunity, and mortality in calves.
  - Mixed results for crypto, BRD, immunity and mortality (n=7-12 studies) → concerns with dam-reared calf unmonitored/unaided colostrum intake.
  - Cow-calf contact ↓ risk for calf scours (8 of 16 studies) and dam mastitis (n=18 studies)
  - Cow-calf contact not significant risk factor for Johne's in this review but difficult to establish temporal relationship (n=14 studies)
- **Take-home**: von Keyserlingk concludes there is little evidence that early separation improves cattle health or whole-lactation milk yield.

2446. Quarter-level milk yield variation pre- and post-separation among cow-calf contact cows. Ferneborg et al. Norwegian University of Life Sci.

- Cows allowed cow-calf contact for ~128 d (n=17) or cows separated w/in 12 hours (n=18), milked by AMS with quarter-level records for whole lactation.
- Milk yield ↑ per quarter and milking in control cows pre- separation ($P < 0.001$) but not post . ↑ quarter-milk yield variation in contact cows both pre- and post-separation. (CV 69 and 50% contact, 40 and 42% control, pre and post respectively). Similar for w/in cow variation.
- **Take-home**: High cow-contact variation could influence milk ejection and milking patterns.

2503. Cow-calf contact rearing systems in a pasture-based dairy system. McPherson et al. Teagasc, Ireland.

- Compared 3 dairy rearing systems at one farm: full-time cow-calf contact (n=14 cows; FT), part-time cow-calf contact (n=18, PT), or no contact (n=18; CON). FT and CON milked 2x/d, PT milked 1x with calf contact after grazing.
- Assessed for growth, injuries, clinical health until 12 wks (weaned between 8-9 wks).
- PT cows heavier at 4 and 8 wks ($P < 0.01$)., but not 12 wks. NSD for locomotion, ocular/nasal discharge, hock/knee injuries.
- **Take-home**: Cow-calf contact systems did not influence injury or general growth/health parameters, but other factors not measured in this study (MY, fertility, calf health) are important considerations too.

2411. Social housing: impacts on health scores and gut microbiome of dairy calves. Goncalves da Costa et al. U of Mn. **see Management → Housing.**

2497. Milking parlor behavior, body measurements, and body condition scores of first-lactation cows raised in individual, pair or group housing compared to dam-reared housing. Sharpe and Heins U of Mn. **see Management → Housing.**

Feeding behavior (2 abstracts)

1305T. Associations between feeding behavior and social network centrality in group-housed dairy calves. K. Gingerich et al. UF.

- Calves (n=90, 62 heifer and 28 bull) housed in AMF groups (n=9 grps, 10 calves/grp) for 8 wks. Calves allowed 8 L/d CMR.
- AMF feeding behaviors recorded daily, health scores 2x/wk, calf position continuous using ultrawide band positioning system. Centrality determined via "strength" (i.e., connectedness) and "eigenvector" (i.e., network influence).
- Calves w/greater strength centrality tended to ↑ CMR intake (P = 0.08), ↑ unrewarded visits (P=0.02). NSD with eigenvectors centrality or health status on CMR intake/behavior.
- **Take-home**: Having a stronger connection to a social network might influence milk feeding behaviors in AMF groups.

1303T. Feeding behavior of group-housed pre-weaned dairy calves to predict disease using machine learning algorithms. R. Perttu et al. U of Mn. **see Health → Disease Prediction**

Beef x dairy/veal (10 abstracts)

Beef x dairy (10 abstracts)

2227. *The end product of beef x dairy.* DR Woerner et al. PSU.

- Dairy origin cattle comprise 15-20% of the 25 M cattle harvested annually in the US. Beef x dairy has largely replaced Holsteins in feedlots that focus on dairy calves.
- Beef x dairy produces high quality beef in a high-yielding manner.
- **Take-home:** Areas of improvement in system: select beef sires that add muscularity and red meat yield while maintaining marbling potential and focus on solutions to reduce the liver abscess problem that persists in this population.

2228. *Beef x dairy genetic selection considerations.* CD Dechow et al. PSU.

- Beef semen sales on dairies are driven by semen fertility, incidence of dystocia & stillbirths, ability to ID beef on dairy females from replacements based on coat color in Jerseys and producing a calf of high market value. Indexes are established to prevent overlarge frame size and proper muscle development.
- Steer performance (n=124) was compared between Angus, SimAngus, Charolais, and Wagyu sires crossed with Holstein cow as were calving records from 9,508 dairy cows mated to either Holstein or beef bulls.
- Gestation length 2 d longer for BxD vs. pure Holstein (P<0.001). NSD in calving ease or stillbirth rate. Differences among BxD breed groups for ADG, days on feed, hot carcass weight," with Angus calves having higher and Wagyu the lowest performance (P<0.05). ~84% of Angus BxD calves graded Choice vs. 31% of SimAngus (P=0.03).
- **Take home:** The authors advise targeting sexed dairy semen on high genetic merit cows and particularly in nulliparous dams to leverage superior epigenetic programming of younger stock and using beef semen from high quality beef genetics on low Genomic testing females. Use of high-quality beef semen can accelerate genetic improvement of dairy heifers while maintaining a robust market for BXD calves.

2229. *Should we raise beef on dairy calves differently?* VS Machado and MA Ballou. TX Tech U.

- Most beef on dairy (BxD) cross calves are not reared on the source dairy. Recent research reports calves transported 16 h are more likely to scour than calves transported 12 or 6 h. Also, research shows calves transported at less than one week of age are more likely to experience BRD than calves transported when older than 7 d.
- TX Tech research suggests mass medication does not reduce BRD incidence in transported calves, but it may reduce mortality. Recent research also shows arrival BW and certain blood parameters may identify specific calves with higher risk of disease.
- BxD cross calves are largely managed the same as rearing heifers, however, "anecdotal data suggests their feeding behavior and resilience to common health events such as BRD is different …also, high prevalence of liver abscesses at slaughter poses a major health challenge for BxD."
- **Take-home**: More research needs to examine whether management and diet differences have short- and long-term impact on beef x dairy cross calves.

2506. Survey of stakeholder attitudes towards surplus dairy calves in Australia. U of BC, Vancouver, BC. U of Melbourne, Victoria, Australia.

- When beef prices are low more calves are euthanized at birth or slaughtered at 5 to 30 d of age in Australia. "It is now recognized that early life killing of surplus calves is out of step with public values and threatens the industry's social license to operate."
- "Representatives from 7 companies (beef and dairy processors, feedlots, genetics companies, and supermarkets were interviewed as individuals or in groups from a single company." Views on current practices, alternatives to early life killing were discussed.
- Responses were organized into three themes: 1.) ethics of surplus calf management: public perception, impact on stakeholders, animal welfare concerns, 2.) Economics. Effect on beef and dairy industries. Logistic and practical challenges, and the opportunity to develop beef on dairy. 3.) Change toward solutions, environmental outcomes, how to make change happen.
- **Take-home**: Technical solutions like sexed semen and beef on dairy breeding are important, and collaboration by all stakeholders along the value chain is necessary.

1626W. Are abomasal ulcer scoring systems reliable in special milk fed veal calves? L. Van Driessche et. al. U de Montréal, St-Hyacinthe, Quebec. Ecole national Vétérinarie d Toulouse, France.

- "Abomasal lesions are common in veal calves and usually assessed by visual inspection at slaughter." Abomasa (n=76) of veal calves from seven slaughter days in were scored by four independent raters "after a short training session."
- Lesion localization separated into pyloric area (leading to abomasal exit), fundic area (abomasal opening) and torus pyloricus (abomasal exit)." Three types of lesions were identified: erosions, ulcers, and scars. Inter-rater reliability was measured.
- Poor to very good inter-rater agreement for presence of pyloric/torus pyloric lesions of the abomasum, but a higher agreement was observed when combining lesions in the pyloric area.
- For the fundic area, a poor to very good agreement was observed. A poor to moderate agreement was found for inter-rater agreement for the number of lesions.
- **Take-home**: "These results show that scoring abomasal lesions is challenging and suggest implementation of a new reliable scoring system."

2476. Impact of milk replacer feeding program on growth and efficiency of Angus x Holstein calves. A. Seitz et al. UW-Madison.

- Beef x dairy calves (n=96) fed 2 CMR plans: 28:14 (1.72 lb/d DM) w/35-d wean or 22:20 (1.26 lb/d DM) w/42-d wean (n=24/trt; 12 male/female). NRV CMR w/soy protein, 2x/d.
- NSD in treatment or sex for starter intake (avg 101 lb total), ADG (1.36 vs. 1.38 lb/d, $P > 0.59$) either birth to wean or birth to 7 wks, or feed efficiency (avg 0.54 G:F, $P > 0.49$).
- **Take-home**: In this study, CMR volume, composition, weaning, and sex did not impact outcomes (authors suspect too low plane of nutrition – esp. fat – for a winter study).

1191M. Low (20% fat) or high (24% fat) best for dairy beef? Scott et al. U of Mn. **see Nutrition → CMR and milk feeding rates and strategies.**

1188M. High or low starch starter grain pellet for dairy beef? Klipp et al. ISU. **see Nutrition → Starter grain and forage feeding.**

1410T. Effect of in utero choline exposure on Angus x Holstein carcass characteristics? Brown et al. UW-Madison, Balchem. **see Maternal-fetal → Dry cow strategies and their impact on the calf.**

1731W. Effects of time and colostrum composition on immunoglobulin G absorption in neonatal dairy-beef calves. Pereira et al. UK, Zinpro **see Maternal-fetal → Colostrum, colostrum replacers, and transition milk.**