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Dairy calf pertinent abstracts

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Abbreviations:

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

Assumptions:

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

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Nutrition (48 abstracts):

Additives in CMR, whole milk, or starter grain (21 abstracts):

1584. Effect of probiotic supplementation on fecal microbiota in preweaning Holstein dairy calves. Lee et al. UC-Davis.

- Calves (n=30) received in their milk from birth to wean either a.) no probiotic, or b.) *Bacillus subtilis, B. licheniformis, Lactobacillus animalis,* and *Propionibacterium freudenreichii,* each species supplemented at 1.1×10^{10}.
- Fecal samples collected d 7, 14, 21, and 42 and fecal scores daily on a 3-point scale. Both groups were subgrouped into diarrheic vs. non-diarrheic calves to compare bacterial diversity and abundance between and w/in groups.
- NSD for diarrhea prevalence and bacterial diversity.
- Probiotic supplemented calves had ↓ *Clostridium perfringens* (0.009x, P<0.01) and ↓ *Fusobacterium varium* (0.045, P<0.01) at d 7. *F. varium* ↑ abundance in diarrheic vs. non-diarrheic calves (108.4x, P<0.01). NSD in pathogenic bacteria post 7 d.
- (a side note: *F. varium* found more abundant in rumens of cattle suffering from liver abscesses. Tylan kills it. https://doi.org/10.1093/jas/skad130).
- **Take-home** – probiotic administered early in life may mitigate fecal pathogen shedding, "thereby reducing disease spread."

2491. The effect of quorum-sensing science-based products on the health of preweaned calves. Moreira et al. Texas Tech University, Lubbock.

- Newborn Holstein bull (n=60) and beef x dairy calves (n=60) were fed a CMR w/ either a.) no quorum-sensing products (control), or b.) 70 g/d and 40 g/d of "quorum-sensing products" w/in the first 14 d and between d 15 and 28 of life, respectively (treatment).
- Quorum-sensing products (cell-to-cell communication leading to environmental disadvantages) are defined in the abstract as "containing propyl-propane thiosulfonate and propyl-propane-thiosulfinate." derived from *Allium cepa* (onion).
- Calves bottle fed 6 L/d 24:20 CMR, ad lib access to texturized starter. Enteric and respiratory disease was monitored, and calves were weighed d 0, 28, 56, and 70.
- NSD of trt on BRD incidence (P=0.16), diarrhea (P=0.40), or mortality (P=0.38). Trt vs. control hazard ratio (95% CI) of BRD, diarrhea, and mortality was 0.55 (0.22 – 1.37), 0.71 (0.23 – 2.21), and 1.51 (0.48 – 4.80).
- Trt ↑ ADG from 1 to 28 d (0.92 vs. 0.84 lbs/d, P=0.04) and tended ↑ ADG from 1 to 56 d (1.28 vs. 1.21 lbs/d, P=0.09) and 1 to 70 d (1.50 vs. 1.42 lbs/d, P=0.06).
- **Take-home** – supplementing quorum-sensing product to CMR improved ADG but had no impact on calf health.

1244. Effects of yeast cell wall supplementation and/or vaccination on intestinal health, immunological status, and performance of calves. Silva et. al. UNICENTRO Guarapuava, Paraná, Brazil; ICC São Paulo, Brazil.

- Female dairy calves (n=40) were treated with either a.) no vaccine and no yeast, b.) no vaccine and yeast, c.) vaccine and no yeast, or d.) vaccine and yeast.

- The vaccine was Inforce3® administered intranasal on d 18 and the yeast product was Immunowall® sugar cane yeast cell wall fed at 10 g/calf/d in the AM milk fdg. Blood was collected on d 4, 22, 25, and 39.
- Yeast cell wall improved fecal score (P=0.02), IgA (P=0.05) and ADG (P<0.001) w/ NSD on IgG. Vaccine improved IgA (P=0.003) and IgG (0.04) but NSD fecal score or ADG.
- "There was neither interaction effect between trt nor trt x d of evaluation" (>0.05).
- **Take-home** – "…whether calves are vaccinated or not, yeast cell wall supplementation enhances gut health and modulates immune response…"

1162. Effect of early-life supply of milk secretory immunoglobulin A on the performance of dairy calves. de Oliveira, et al. U of Florida, Gainesville.

- Female Holstein calves (n=82) were fed either a.) CMR alone, b.) CMR + 7.2 mg of milk secretory immunoglobulin A, or c.) CMR + 7.2 mg of milk secretory immunoglobulin A + fresh rumen fluid from adult dairy cows (quantity not shown) from 2 to 28 d of age. Feeding program not provided.
- Grain intake was measured daily d 2 – 28, BW and BCS weekly to d 56, rumen fluid pH recorded on d 4, 14, 28, and 56.
- Grain intake ↓ for IgA calves (36.1 g/d) and IgA + rumen fluid calves vs. control (36.1 vs. 39.7 vs. 45.4 g/d, P<0.01). NSD in ADG, BCS, or rumen pH (P>0.17).
- **Take-home** – "Our preliminary results indicate that early-life supply of milk immunoglobulin A may improve calf feed efficiency."

2067. Survival of various probiotics in whole milk prepared at different temperatures. Copani et al. Novonesis, Denmark & Novonesis, Milwaukee.

- Survival of a bacteria-based probiotic containing *Bacillus licheniformis* 809, *B. subtilis* 810, *Ligilactobacillus animalis* 506, and *Propionibacterium freudenreichii* 507 (Bovamine®) when added to whole milk at different temperatures was examined.
- Bovamine® was added to whole milk at 1.0 x 10^6 concentration and exposed to 113 °F, 131 °F, 149 °F, or 167 °F for 90 min. Samples were analyzed at 0, 30, 60, and 90 min. Samples were enumerated using MRS and TSA plates.
- NSD in total CFU recovered after 0 to 90 min in experimental conditions when exposed to 113 °F (P=0.38) or 131 °F (P=0.69). However, an ↑ of 0.5% CFU observed when exposed to 149 °F at 90 min (P=0.03) and ↑ of 1% CFU when exposed to 167 °F for 90 min (P=0.03). Trend (P=0.07) for ↑ at 167 °F for 30 min.
- **Take-home** – Bovamine Dairy Plus® remains stable in whole milk for up to 90 min post-mixing in temperatures ranging from 113° to 167° F.

1246. Response of Holstein neonatal bull-calves to a DFM program. Adelusi et al., NC State Greensboro. Casper's Calf Ranch, Freeport, Ill.

- Calves (n=86, 2-5 d old) were assigned to 1 of 4 trt in a 2 x 2 factorial design: CMR either w/ or w/o a mix of *Bifidobacterium animalis* and *Lactobacillus animalis* and starter grain w/ or w/o *Lactobacillus plantarum*. Concentrations of DFM not disclosed.
- Calves fed CMR at 1.25 lbs/d via bucket for 14 d, ↑ to 1.9 lbs/d until d 35 and then 1x/d at 0.93 lbs/d after d 42 of the 56-d experiment. Free choice pelleted grain.

- Calves fed starter with *Bifidobacterium animalis* tended (P<0.07) ↑ feed intake (108.1 vs. 97.4 lbs.) and numerically (P=0.12) higher BW (187.8 vs. 181.7 lbs.).
- ADG tended ↑ for calves fed CMR + starter DFM and starter DFM only (1.61 and 1.59 lbs./d) vs. no DFM in CMR + starter or CMR DFM only (1.52 and 1.43 lbs./d, P<0.07).
- No health data reported.
- **Take-home** – *L. plantarum* in starter feed may improve feed intake and weight gain.

2199. *Immunoglobulin G and Immunoglobulin G specificity in milk replacers.* Saltman et al., RLS Mngt Solutions, NY, and Arkion Life Sciences, DE.

- Five CMR w/ milk protein and whey as protein sources were reconstituted at label directions and analyzed for IgG concentration and IgG specificity for rotavirus, coronavirus, *Crypto*, *E coli* K99, and *C. perfringens* Types C & D.
- Total IgG titers were measured using a bovine IgG ELISA. Specificity was determined using A450 values, a measure of the amount of antibody bound to the pathogen. Superscripts indicate P<0.05 difference.
- Total IgG (g/kg CMR) was 11.1^{d}, 2.0^{a}, 3.8^{b}, 5.7^{c}, and 12.2^{d} for the 5 CMR brands.
- A450 values for the 5 CMR brands:
  - Rotavirus: 0.136^{c}, 0.009^{a}, 0.031^{b}, 0.128^{c}, and 0.301^{d}.
  - Coronavirus: 0.075^{c}, 0.004^{a}, 0.024^{b}, 0.117^{d}, 0.277^{e}.
  - Crypto: 0.084^{c}, 0.006^{a}, 0.022^{b}, 0.116^{d}, 0.305^{e}.
  - E. coli: 0.131^{c}, 0.012^{a}, 0.044^{b}, 0.203^{e}, 0.494^{e}.
  - Clostridium 0.345^{c}, 0.026^{a}, 0.054^{b}, 0.355^{c}, 0.703^{d}.
- **Take-home**: The 5 CMR's varied in IgG concentration and specificity of the IgG. Total amount of IgG did not always correspond to levels of specific pathogen IgG.

2495. *Improving antibody titers in milk replacers with IgY.* Saltman et al. RLS Mngt Solutions, Cazenovia, NY; Arkion Life Sciences, New Castle, DE.

- 5 CMRs void of spray dried plasma plus one produced to mimic a CMR with 5% bovine plasma tested w/out or w/ IgY egg product (EggTek®-C, Arkion) analyzed for IgG specificity profile using same specificity panel as above (abstract 2199)
- Adding IgY egg product ↑ antibody titres (P≤0.05) for all pathogens:
  - Rotavirus: 0.136, 0.009, 0.031, 0.128, 0.301, 0.678 (5 CMRs, 5% bovine plasma) → adding 2 g of egg antibody ↑ to 0.321, 0.171, 0.265, 0.261, 0.376, and 0.922.
  - Crypto: 0.084, 0.006, 0.022, 0.116, 0.305, 0.714 (5 CMRs, 5% bovine plasma) → adding 2 g of egg antibody ↑0 .354, 0.155, 0.271, 0.275, 0.402, and 1.059.
  - And so on for other pathogens.
- **Take-home** – Common calf pathogen antibody specificity in CMR was highly variable between 5 commercial brands. IgG isolated from equivalent of 5% bovine plasma in CMR increased pathogen binding and IgY from 2 g dose of EggTek-C significantly increased pathogen binding even further.

1179. *Bacillus, bioactive clay, and yeast cell wall in CMR and grain.* Plunkett et al. ISU, Ames, Iowa. Vita Plus, Madison, WI. Phileo-Lesaffre, Milwaukee, WI.

- Holstein x Angus cross calves (n=63, 2-3 d old, ~107 lbs., STP avg 5.61 mg/dL) were assigned to either a.) milk additive, b.) milk additive and starter additive, or c.) control.

- Milk additive was 25 mg/d DFM and 3 g/d bioactive clay added during CMR mixing. Starter additive was texturized starter w/ whole corn and pellet w/ 25 mg/d of DFM, 3 g/d of bioactive clay, and 5.5 g/d of Safmannan®.
- All calves were fed a 22:22 CMR containing 5.5 g/d Phileo Safmannan® MOS (control) at 13% solids and fed at 5.0 L/d (d 1-10), 7.0 L/d (d 11-42), and 3.5 L/d (d 43-49). Calves were monitored through d 70.
- NSD for d 70 starter intake (5.8-6.0 ±0.26 lbs, P=0.49), ADG (1.83-1.93 ±0.86 lb/d, P=0.39), BW (226-238 ±4.4 lbs, P=0.83), or hip height gain (5.6-6.1± 0.2 inches, P=0.23).
- **Take-home** – no differences noted from addition of combo bacillus, bioactive clay and yeast cell wall. The +12 lbs. 70 d BW gain (no sig diff) from addition of additives in both CMR and grain vs. control may warrant further studies.

2494. Effects of calf gut-originated probiotics and weaning pace on health measures, hematology, and productivity in Holstein dairy calves. Rasmussen et al. U of Idaho, Moscow; U of Alberta, Edmonton.

- Holstein bull calves (n=38) were weaned and received either a.) abrupt wean (d 54 – 57, 3 step-downs of 1.13 L), b.) abrupt wean w/ probiotic, c.) gradual wean (d 49 – 63 in 7 step-downs of 0.49 L) or d.) same gradual wean w/ probiotic.
- The probiotic supplement was calf-gut originated *Lactobacillus agili, L. delbrueckii, L. mucosae*, and *L. rueteri* (1 x 10^9 cfu/d), fed 1x/d for 7 d starting 4 d prior to wean. Feed intake, growth (weekly), vitals (weekly), and hematology (d 3 & 7, onset of trt & d post wean) were measured.
- Calves received 6.8 L/d of 22:22 CMR, ad lib starter (18% CP) and chopped alfalfa hay.
- NSD in red blood cells, white blood cells, or platelets across trt. NSD in feed intake or vitals. During probiotic trt, ADG ↑ in abrupt vs. gradual weaned calves (2.8 vs. 1.8 lbs./d; P=0.009).
- **Take-home** – "…abrupt pace (of wean) influenced ADG, but hematological and vital parameters were not affected by pace, supplementation, or their interactions."

2556. Effect of probiotic fed in milk and starter feed on growth and prevention of diarrhea in preweaned Holstein x beef cross calves. Brasil et al. UC-Davis; Cal Poly, San Luis Obispo.

- Holstein x Angus calves (n=208) received in milk either a.) no probiotic, or b.) 50 mg/d of Lactobacillus probiotic (1 x 10^9 cfu) added to individual milk bottles in AM fdg and same dose top dressed in starter grain 1x/d until 60 d wean.
- Calves housed individually in wooden hutches. Starter provided from 14 d and 4 L/d of CMR fed daily. Fecal scores taken daily and fecal samples were collected from ~30 calves/trt d 7, 14, 21, and 42 to assess salmonella.
- NSD on growth (+ 57 lbs.), diarrhea, or mortality (1 calf/group). Fecal shedding of Salmonella was not detected. Fecal score 2 and 3 affected ADG (no statistics).
- **Take-home** – probiotic did not affect growth or incidence or severity of diarrhea.

2558. *The effect of probiotic supplementation on serum tumor necrosis factor alpha, lipopolysaccharide binding protein, and immunoglobulin concentrations in young Holstein heifers.* Vagnoni et al., CA Polytech State U, San Luis Obispo; UC-Davis; Chris Hansen Labs.

- Holstein heifer calves (n=112) received either a.) control, or b.) B. subtilis 810, B. licheniformis 809, L animalis PTA-6750, and P freudenreichi PTA6752 probiotic (Bovamine Dairy Plus, Chris Hansen).
- Control received 0.5 g/d lactose in milk and 0.75 g/d lactose in grain post-wean, trt calves received 0.5 g/d Bovamine in milk (1.1 x 1010 cfu/g) until wean and 0.75 g (1.65 x 1010 cfu/g) in grain thereafter.
- Calves weaned at 60 d and blood collected at 45, 63, and 180 d. Probiotic ↓ TNF-alpha (P<0.001) but ↑ lipopolysaccharide binding protein (P<0.02). NSD trt effect on IgG (P=0.80), but a trt x day interaction where IgG ↑ for probiotic d 180 (P=0.005).
- **Take-home** – Bovamine may reduce inflammation (lowered TNF-alpha, but raised LBP, both are proinflammatory markers in blood) and improve IgG (immunity).

2162. *Effect of probiotic fed in milk and starter feed to preweaning Holstein Angus calves on health*. Cardin et al. UC-Davis; Cal Poly SLO, San Luis Obispo, CA.

- Holstein x Angus cross calf-ranch calves were randomly enrolled in a 2 x 2 factorial: STP < or ≥ 5.2 g/dL and w/ or w/out (n=56-110/trt).
- Calves weighed upon entry to the wooden hutch and at weaning. Starter offered d 14 ad lib. Daily fecal score, respiratory score and general appearance score collected.
- NSD between trt in total gain, ADG, cause of death, d of fecal score 3 (worst diarrhea), or in most severe respiratory score or appearance score.
- Initial BW ↑ total gain ↑ and general appearance score ↓ STP (no stats provided). 7 of 8 calves necropsied reported primary cause of death as BRD.
- **Take-home** – Probiotic treatment did not affect calf health, but STP "positively affected overall gain and ADG for control calves indicating probiotic may have helped low (serum) total protein calves maintain growth."

2555. *Multicarbohydrase enzyme complex in texturized calf starter feed affects calf growth and health*. Fensterseifer et al. United Animal Health, Inc., Sheridan, IN.

- Holstein x Angus cross calves (n=128; 2 to 10 d old; 94.1 ±8.7 lbs.) received starter grain (17% CP, 3% fat) during two 71-d trials (pooled data) with a.) no enzyme additive, b.) Enspira®+ enzyme additive (United Feeds) at 125 ppm, or c.) Enspira®+ at 500 ppm.
- All calves fed the same 24:20 CMR, housed individually. CMR intake, fecal scores, and calf health monitored daily. BW and starter intake were measured weekly.
- Calves receiving Enspira®+ at either concentration ↑ postwean BW gain (55.7 vs. 52.5 ±1.3 lbs.; P<0.05) and ADG (2.6 vs. 2.5 ±0.07 lbs.; P<0.05) and tended (P<0.09) ↑ prewean BW gain (77.8 vs. 72.9 ±2.4 lbs.) and total 71-d BW gain (132.3 vs. 125.4 lbs.; P<0.07) vs. control.
- Control calves received 3x more (P=0.01) anti-inflammatory therapies than either Enspira®+ supplemented groups (15 vs. 4 and 5 doses).
- Calves fed lower feeding rate of Enspira®+ ↓ post wean (P=0.001; -50%) and ↓ 71-d scours (P=0.02; -26%) vs. control and high feeding rate calves.

- **Take-home** – 125 ppm Enspira®+ in grain is adequate concentration to improve performance and health in dairy calves.

1241. *Effects of protected and unprotected butyrate supplementation on growth performance and fermentation profile in dairy calves.* Martinez Mayorga, et al. U of Alberta, Edmonton.

- Dairy calves (n=31) fed texturized starter grain composed of either a.) 1% palm fat (control), 2.) 1% protected butyrate (2.5% grain formula), or 3.) 1% unprotected butyrate (1.5% grain formula).
- Reported both butyrate sources had equal odor and no apparent differences in voluntary intake. Ad lib grain introduced d 21 to not affect the microbiome (presentation, not abstract).
- Calves fed 2 lbs/d CMR with a 2-stage stepdown from d 49 – 63. Feed intake was measured daily, blood and BW weekly, feces and rumen fluid sampled d 28, 42, 56, and 70. Calves were slaughtered d 70, digesta collected.
- Calves fed unprotected butyrate ↑ d 28 ruminal pH (P=0.05) and d 42 ruminal propionate and butyrate (P=0.01) vs. calves in control or protected butyrate groups.
- Calves fed protected and unprotected butyrate ↑ d 56 and d 70 ruminal propionate (P<0.07) vs. control. The author reports acetate is the energy source for peripheral tissues while propionate is energy source for liver.
- Duodenal pH tended ↓ in protected butyrate vs. control (P=0.07), whereas duodenum propionate ↓ in unprotected vs. control (P=0.05). Starter intake and BW ↓ for unprotected butyrate fed calves vs. either control or protected butyrate (P=0.02). NSD in plasma BHBA.
- **Take-home** – Both forms (protected and unprotected) of butyrate similarly impact fermentation profile, but unprotected butyrate compromised growth during weaning. The author hypothesized that unprotected butyrate may be causing parakeratosis.

1242. *Effect of calf starter, weaning, and butyrate supplementation on hindgut development in Holstein calves.* Sayles et el., U of Alberta, Edmonton. U of Idaho. Adisseo.

- Holstein bull calves (n=36; 11 d ± 4 d age) were fed 2.64 lbs/d 28:18 CMR and assigned to either a.) pre-wean group fed CMR-only, b.) pre-wean group fed CMR, hay, and & grain, c.) post-wean group fed CMR, hay & grain, or d.) post-wean group fed CMR, hay, and grain supplemented with 1% butyrate during wean transition.
- The two pre-wean groups (a & b) harvested d 48. The two post-wean groups (c & d) were weaned over 14 d (↓ to 75% d 49, ↓to 50% on d 56, and ↓to 0% d 63) and harvested d 70. Blood samples collected week 3, 5, & 7; cecum, proximal colon, and distal colon tissue sampled upon harvest for RT-qPCR.
- Independent of tissue type, the expression of immune markers *IL17A* (P<0.10), *TLR4* (P<0.01), *TLR10* (P<0.05) and *PCNA* (P<0.10) were upregulated in calves fed CMR alone (group a). Other immune marker results were reported but the abstract did not align which trt group those results were aligned with.
- **Take-home**: Calf starter decreases local inflammation pre-wean and "decreases inflammatory gene expression in the calf hindgut," "but neither the weaning transition nor supplemental butyrate impact hindgut enterocyte proliferation, barrier integrity, or inflammation." Authors advise increasing starter intake weeks 7, 8, and 9, and get to 3 kg/d grain intake prior complete wean.

2160. Health and growth of weaned Holstein and crossbred calves fed bovine plasma proteins in grower grain. Pister et al., U of Ill; APC, Ankeny, IA.

- Data from two experiments examining bovine plasma in grower grain were pooled. Experiment 1: male Holstein calves (n=21) housed in groups of 3 from 10-14 wks of age. Experiment 2: male and female HolsteinxAngus calves (n=40) housed in groups of 6-7 from 9 -13 wks of age. Calves weaned on d 1 of both experiments over 1 (Exp 1) or 2 wks (Exp 2).
- Treatments in both studies were: a.) 20% CP, 2.4% fat, 32% starch grower, b.) same diet with plasma (% inclusion rate ?). Both contained 2.5% chopped wheat straw.
- Feed intake and health scores (fecal, ocular, nasal, ear, and respiratory) recorded daily. BW recorded weekly, skeletal growth recorded d 0 or d – 1 and d 28.
- Calves fed bovine plasma tended ↑ hip height (P=0.07) and ↑ hip height ADG (P=0.09). NSD in frame growth, body weight, ADG, or health scores.
- **Take-home** – adding plasma to grower grain improved skeletal growth but not ADG, nor did it benefit health or feed intake.

2424. Effect of oral administration of Megasphaera elsdenii *for young calves.* Barboza et al., U of Pao Paulo Piracicaba, Brazil. Nutricorp Araras, São Paulo, Brazil. Axiota Animal Health, Fort Collins, CO.

- Newborn colostrum-fed heifers (n=50) were supplemented either a.) placebo, or b.) *Megasphaera elsdenii* NCIMB 41125 (a.k.a. Lactipro NXT, MS Biotec, Wamego, KS) at 10 mL ($5x10^9$ cfu/calf) in one single dose administered d 14 ±1 d of age.
- Calves were fed 6 L/d whole milk to d 20, 8 L/d CMR from d 21 to 56, then gradually weaned until d 63. Calves fed ad lib starter from d 1 and hay at wk 9, post-wean. Starter intake d 14 averaged 25 ±51.1 g/d.
- NSD on ADG (P=0.77), starter intake (P=0.81), liquid diet intake (P=0.64) hay intake post-wean (P=0.74) or gain:feed (P=0.84).
- **Take-home** – *Megasphaera elsdenii* supplementation at 14 d age in calves fed 8 L/d liquid diet had no effect on performance.

2559. Supplementation of naturally sourced caffeine from green tea extract, on early-life weight gain of Holstein heifer calves. Lutz, et al. U of Guelph.

- Holstein heifer calves (n=120) received a single dose at birth of – a.) 15 mL dose of green tea extract (327.6 mg caffeine; Calf Perk, TechMix, LLC), b.) 30 mL (2x) dose of the same (655.2 mg caffeine), or c.) control (15 mL placebo).
- At birth, calves were dystocia scored (yes/no), weighed and given oral trt before colostrum (w/in 2 h of life, 4 L CR, 300 g IgG). BW weekly for 4 weeks. STP measured at 24 h using a refractometer.
- NSD for BBW (avg. 89.9 ±1.5 lbs, P=0.40). STP averaged 5.79 ±0.77 g/dL. Dystocia incidence was 18%, affected ADG (P=0.01) but no dystocia by trt interaction.
- NSD in wk 1 or wk 3 ADG (1.1-1.2 ±0.11 lbs/d), but single dose tended ↑ wk 2 ADG (1.0 vs. 0.7 ±0.11 lbs./d, P=0.09) and wk 4 ADG (2.2 vs.1.9 ±0.11 lbs./d, P=0.06) vs. control. NSD 2x dose vs. control.
- NSD for BW at wks 1, 2, or 3, but calves fed single dose ↑ BW week 4 vs. control (129.8 vs. 126.3 ±1 lbs.; P=0.03). 2x dose was intermediary and NSD (126.3 ±1 lbs.; P=0.94).

- **Take-home** – supplementing natural tea-sourced caffeine at birth might impact weight gain during the first 4 weeks of life. No difference reported in serum total protein from its administration pre-colostrum feeding.

1583. *Effect of bovine-derived* Bifidobacterium longum *ssp.* Longum *and resistant potato starch on the gut bacterial colonization in colostrum-restricted calves.* Wu, et al. U of BC, Vancouver, BC; U of Saskatoon, Saskatchewan; Ag and Agri-Food Canada, Lethbridge, Alberta. U of Alberta, Edmonton.

- Newborn Holstein calves (n=45) received either a.) 100 g/L of IgG CR + placebo, or b.) 25 g of IgG/L of CR w/in 2 hrs. Calves receiving the 25 g of IgG/L of CR also received either a.) placebo (negative control), b.) probiotic (10_e9 cfu/d bovine-derived *Bifidobacterium longum* spp. *longum*), c.) prebiotic (80 g/d resistant potato starch), or d.) symbiotic (both probiotic and prebiotic) from 2 to 14 d of age.
- Fecal samples collected d 2, 7, 14, 21, 28, and 35 to estimate density of total bacteria, and abundance of *Bifidobacterium*, *Lactobacillus*, *E coli,* and *C. perfringens*.
- Density of total bacteria tended (P<0.10) ↑ across time in the low CR calves w/ placebo (the negative control) vs. prebiotic and prebiotic + probiotic.
- *Bifidobacterium* ↑ 6.4x and *Lactobacillus* 8.8x in resistant starch supplemented calves vs. negative control (P<0.05) at d 7. *E. coli* had 5.1x colonization in probiotic supplemented calves vs. negative control (P<0.05). NSD in *C perfringens*.
- **Take-home** – "…supplementing calves with resistant starch alone or in combination with *Bifidobacterium* may promote the colonization of beneficial bacteria in the gut…"

2426. *Performance and health of post-weaned Holstein heifers offered a low moisture block self-fed nutritional supplement with or without menthol.* Stypinski et al. U of MN, St. Paul; Hubbard Feeds, Mankato, MN; U of MN, Waseca; Ridley Block Operation, Mankato.

- 20 pens of 7 post-weaned calves (n=140, 60 ±2.6 d old, 183 ±0.9 lbs.), received either 1.) no lick block, 2.) access to a low-moisture salt lick block w/o menthol, or 3.) access to same block w/ menthol (target menthol intake 2.5 oz./head/d).
- Treatments administered for 84 d and intake of menthol monitored weekly. Feed intake measured daily, and body weight measured d 1, 28, 56, and 84 of the study.
- NSD in BW (P=0.11) or ADG (P=0.27) at all time points. NSD on feed intake, but tendency (P=0.07) for ↓ intake in w/ menthol 1 to 28 d. NSD feed efficiency (P=0.30).
- NSD in disease incidence (P=0.45) despite 50% numerical reduction w/ menthol.
- **Take-home** – "Results suggest menthol supplementation of post-weaned calves was not successful in increasing energy partitioning toward growth …"

Milk feeding rates and strategies (6 abstracts)

2158. *Effect of water quality and milk replacer composition on performance and health of dairy calves.* Carvalho et al., Luiz de Queiroz College of Ag, University of São Paulo.

- Holstein calves (n=45) fed either a.) CMR w/ mostly vegetable protein (20% CP, 18% fat) in tap water, b.) CMR w/ mostly milk protein (22% CP, 18% fat) in tap water, or c.) CMR w/ mostly milk protein (22% CP, 18% fat) in purified water. All fed at6 L/d (14% solids) until gradually weaned d 49 – 53. All calves received colostrum at birth.

- Calves individually housed, continuously offered pelleted starter, offered chopped hay ad lib d 49-70. Dry matter and water intake monitored daily and BW weekly.
- NSD in DMI or water intake among trt (P>0.05). Using purified water tended ↑ prewean ADG (0.84 vs. 0.70 ±0.07 lbs/d. P=0.07) and feed efficiency (0.39 vs. 0.31 ±0.035; P=0.08), but NSD in final BW. Purified water also tended ↓ fecal score (1.44 vs. 1.57 ±0.06; P=0.07)
- Postwean, feeding milk protein CMR mixed in purified water ↑ hay consumption (0.30 vs. 0.22 vs. 0.23 lbs./d; P<0.014). Purified water also ↑ hay consumption (P<0.004).
- **Take-home** – Water quality was important regardless of CMR composition.

2427. Health & performance of Holstein calves fed titrated levels of a cheese ingredient in CMR. Suazo et al., U of MN Waseca & St. Paul, MSG, Eden Prairie, MN.

- Holstein heifer calves (n=100) 2-5 d of age randomly assigned to one of four 24:20 CMR treatments: 1.) no dried cheese, 2.) CMR w/ 7% dried cheese, 3.) CMR w/ 14% dried cheese, or, 4.) CMR w/ 21% dried cheese. Protein and fat from dried cheese was accounted for replacing whey protein and protein encapsulated fat. Basal CMR w/ whey-based proteins and fat composed of tallow, lard, and coconut oil.
- CMR fed at 1.5 lbs/d to d 42 with ½ rate wean to d 49. Starter grain (18% CP) ad lib. BW measures d 1, 14, 28, 42, 49, and 56; hip height d 1, 49, and 56; fecal scores daily.
- NSD prewean (1.28 lbs/d; P=0.88), post-wean (1.3 lbs/d; P=0.83) and total (1.4 lbs/d; P=0.90) ADG, starter intake (2.4 lbs./d; P=0.87), hip height gain (11.6 cm; P=0.81), gain:feed (0.56:1; P=0.73) or average fecal score (1.32; P=0.33).
- **Take-home** – MSG dried cheese can replace whey proteins w/o negative effects on health or growth

1239. Short- and long-term effects of pasteurized waste milk on calf growth, health, and subsequent performance and longevity. Li et al. China Ag U Beijing, China.

- Newborn Holstein female calves (n=240) were fed during the pre-wean period either a.) pasteurized waste milk or b.) CMR, energy concentration adjusted (based on the calculated energy content) to be consistent with pasteurized waste milk.
- All calves received 4 L of colostrum w/in 1 h of birth. Day 1 – 7 fed 3x/d and housed in individual hutches, d 8 – 67 transitioned to AMF and stepdown wean d 40 to 67.
- Data on feed intake, fecal and respiratory scores, physiological parameters and milk production through 5th parity were monitored.
- Pasteurized waste milk-reared calves ↑ pre-wean ADG (1.75 vs. 1.40 lbs/d), ↓ starter intake (0.55 bs. 0.79 lbs./d) and ↓ diarrhea frequency (0.05 vs. 0.14 d?) vs. calves fed CMR (no stats provided).
- CMR group ↑ blood C3 (0.25 vs. 0.37) and ↑ cortisol (5.8 vs. 12.6) vs. waste-milk fed calves week 1 post-wean. Units and P-values not reported.
- Pasteurized waste-milk fed calves grew to have ↓ colostrum Brix (24.5 vs. 27.5) and ↑ 305 d milk yield in only the 2nd parity (4,929 ± 2,394 vs. 3,949 ±2,424 kg), no stats provided. NSD in repro, health, or culling rate up to the 5th parity.
- **Take-home** – Pasteurized waste milk-fed calves improved pre-wean performance but minimal long-term outcomes through the 5th parity in poorly performing cows.

2668. Meta-analysis of the effect of milk feeding method on ADG, concentrate intake, and weight at weaning in dairy calves. Alcantara et al. Universidade Estadual Paulista

- A meta-analysis of 13 studies compared milk feeding method (bottle vs. nipple) on calf performance.
- Hypothesized nipple feeding would improve performance due to prompting the natural suckling reflex.
- Calves fed by nipple tended to ↑ ADG (+0.01 kg/d, *P*=0.09), NSD starter intake or weaning BW (*P*>0.22)
- **Take-home**: Offering milk via open bucket or nipple does not greatly influence calf performance, not accounting for calf emotional state

2659. Effect of preweaning plane of nutrition and age on blood DNA methylation of dairy calves. Laflamme-Michaud et al. Université Laval.

- Holstein heifer calves were fed either 8.3 L/d CMR (n=6, ReCan) or *ad libitum* (n=6, AdLib) from 0 to 76 d of age (matched by date, birthweight, and STP), and blood was collected at 0 and 76 d for whole-genome DNA methylation.
- Avg CMR intake was 7.0 vs. 9.7 L/d (P<0.001) for ReCan vs. AdLib (other productive parameters not reported herein).
- DNA from weaned calves significantly hypermethylated compared to birth (P<0.001).
- Between trt, 1,619 differentially methylated regions (q-value <0.05, methylation difference >10%) were identified, associated with 1,056 unique genes.
- 640 genes hypermethylated and 416 hypomethylated in AdLib vs. ReCan calves, some pathways related to energy metabolism, cell diff, and neural development.
- **Take-home**: Feeding calves at different planes of nutrition may impact the epigenetic profile of pre-weaned developmental traits.

2676. CalfSim Tool: A free and user-friendly tool for tailoring calf nutritional strategies and growth. Da Silva and Costa, U of Vt **see Management → Growth**

Starter grain & forage feeding (6 abstracts)

2429. High-protein corn product to replace soybean meal in starter. Skinner, et al., K-State.

- Fractionation and yeast protein from stillage used to create grain product w/ ↑ CP and remove fiber (~50% CP, <8% fiber, <7.5% fat, <3.5% ash; Protomax, ICM, Inc.). Product replaced either 0, 50, or 100% of soybean meal. Rumen protected Lys and Met used to meet calf rqmts. Diets: wheat midds (24.5%), respective protein & bypass AA, corn (24.4%), ground oats (11.1%), molasses (10.5%), blood meal (7%) and minerals (5.7%). Diets formulated to 23% CP, 17-19% aNDFom, 28% starch, 4% fat.
- Calves (n=42, half each sex) assigned respective grain from 14-84 d of age. Whole milk fed until stepdown wean at 6 wks age.
- Data collected 8-12 wks only when grain was the sole feed. Daily DMI, biweekly measures of BW and body dimensions, and blood (unknown time) were taken.
- Including high protein product linearly ↑ DMI (P=0.08), BW (P=0.05) and ADG (P=0.05). 50% and 100% use rate tended ↑ BW (P=0.06) and ADG (P=0.08) vs. 0%. Males on 100%

replacement had greater FE (P=0.04) vs. females. NSD in blood glucose, BUN, or BHB. NSD in body dimensions. Calves gained ~1 kg/d.

- **Take-home** – High protein processed corn distillers grain balanced for AA can replace soybean meal in starter and increased use rates enhanced performance.

2159. Performance and health of calves fed corn and pellet starters with the inclusion of oats or a fiber pellet. Dufour et al. Hubbard Feeds, Mankato, MN; U of MN, St. Paul.

- Holstein heifer calves (n=105) offered corn and pellet calf starters from d 1-56 w/ in a 2 x 2 factorial: cost-effective fiber pellet (22% CP, 16% NDF) or oats (23% CP, 12% NDF) and yeast-based gut health technology (23% CP, 11% NDF) or none
- Calves fed 1.25 lbs/d 20:20 CMR from d 1-35 and 0.63 lbs/d from d 36-42. BW was measured d 0, 14, 28, 42, 49, 56, and 84, fecal scores weekly, feed intake daily.
- NSD of trt on MR intake, starter intake, or scouring frequency throughout the study.
- During post-wean (d 43-49) there was fiber source x yeast effect on feed efficiency (P=0.02) and BW gain (P=0.09); fiber pellet w/yeast ↑ 20% G:F over fiber pellet alone.
- **Take-home** – replacing oats w/ a fiber pellet in a corn and pellet type calf starter may be a viable and more economical option, with improved performance and efficiencies post-wean when yeast-based gut health technology is also included.

2671. Association between water consumption and solid feed intake in dairy calves. Van Dorp et al., U of Guelph; Mapleview Agri, Palmerston, Ontario; U of Vermont.

- Holstein and cross calves (n=346; 6 groups) fed CMR (up to 8 L/d, 13% solids) from arrival (5-14 d) to 63 d wean. Solid feed w/ 4% straw and pellet (19.8% CP, 1.64 Mcal/kg) offered ad lib arrival to 84 d. Water available ad lib via nipple or bowl and continually monitored by an individual calf water meter, read and recorded weekly.
- Over 84 d, calves consumed on avg 150.8 ±32.5 kg starter and 363.8 ±103.8 L water.
- For every 1 L of water consumed over 84 d, starter consumption ↑ by 240 g (P<0.001). Every 1 kg ↑ in arrival BW was associated with an 870 g ↑ in starter intake over 84 d.
- Evaluating each wk of growth independently, for every L of water consumed, starter intake ↑ during the 12 wk after arrival.
- **Take-home** – Increasing water consumption increases calf starter intake

2709. Effect of forage sources in total mixed rations on rumen fermentation and development of the gastrointestinal tract of dairy calves. Toledo et al. U of São Paulo Piracicaba, Brazil.

- Holstein calves (n=48) 28 d old fed either a.) a no-forage coarsely ground starter (control), b.) TMR w/ 7.5% DM Tifton hay of medium quality c.) TMR w/ 7.5% DM Tifton hay of low quality, or d.) TMR w/ 10% DM corn silage.
- Calves fed 6 L/d whole milk, pelleted starter ad lib and no forage to 28 d of age. After, grain was converted to trt. Calves gradually weaned d 52-56 and n=5/trt harvested at d 70. Rumen fluid samples taken at wk 6, 8, and 10 via oro-esophageal tube.
- Control diet ↑ total VFA conc (89.9, 68.5, 65.7, and 71.5 ±3.3 mM, P<0.01) and ↓ rumen pH (5.7, 6.0, 6.1, and 5.9 ±0.1, P<0.01) vs. all forage (control, 7.5% medium hay in TMR, 7.5% poor hay in TMR, and 10% corn silage in TMR, respectively).
- NSD (P>0.05) in butyrate proportion in the rumen (8.5, 8.0, 8.4, 8.8 ±0.4mM/100mM)

- Forage tended to ↑ gut fill (19.6, 22.3, 23.8, and 20.9 ±1.8 lbs, P=0.07) but, NSD on true empty BW by forage provision (170.2, 169.8, 172.8, and 165.8 ±12.7 lbs, P>0.05)
- **Take-home** – authors conclude – "Including fiber sources in the TMR, with high energy content, resulted in small fermentation profile variation, with the benefit of lower rumen pH, but w/o negative effects on the performance of young dairy calves."

2428. *High-quality forage as solid feed for unweaned dairy calves on accelerated rearing.* Amero, et al. Universidad de la República Liberated, San José, Uruguay; Independent Practice, Montevideo, Uruguay; Universidad de la República EEMAC, Paysandú, Uruguay.

- Calves (n=20, 88.1 lbs. ±7.5 lbs.) w/ "adequate" TPI and housed individually received 2.2 lbs/d CMR and offered either a.) ad lib chopped alfalfa hay or b.) ad lib concentrate as solid feed. All were weaned wk 8.
- Feed organic matter, crude protein, NDF and ADF intake were measured daily. BW and ADG, hip height and hip height growth were recorded weekly.
- Calves fed concentrate had ↑ solid feed intake (1.34 vs. 0.99 lbs/d; P<0.01), ↑ total DMI (2.83 vs. 2.45 lbs./d; P<0.01), ↑ CP intake (0.56 vs. 0.48 lbs./d; P<0.01) and ↑ 5th wk OM dig % (94.6 vs. 93.2%; P=0.05).
- Calves fed chopped hay ↑ ADF intake (0.19 vs. 0.28 g/d; P<0.01). NSD in NDF intake, 10th wk OM dig (74 vs. 66%; P>0.24), ADG (1.45 ±0.1 lbs/d) or hip height (0.18 cm/d).
- **Take-home** – "...supplying only alfalfa hay as a solid feed before weaning reduced feed and nutrient intake and diet digestibility without differences in performance."

2261. *Effects of different protein sources on protein intake and antioxidant capacity of Holstein heifers.* Yao et al., Lab of An Nutr, Inst of An Sci, Chin. Ac of Ag Sc, Beijing. Beijing U.

- 8 Holstein heifers (558 ± 12 lbs) assigned to 8 trt in a 6 x 8 Youden square design with 6 periods of 13 d each. Trt groups: 1.) basal diet (17.6% CP, soybean meal 24.1%, corn silage 31.5%, and alfalfa hay 22.7%), 2.) diet w/more soybean meal (18.8% CP), 3.) diet w/cottonseed meal (18.6% CP), 4.) diet w/rapeseed meal (18.7% CP), 5.) diet w/expanded soybean (18.5% CP), 6.) diet w/alfalfa hay (17% CP), 7.) corn silage (16% CP), and 8.) oat hay (16.5% CP; 12.1% of the total CP in basal diet).
- Daily feed intakes (TMR, residues and feed materials) were collected on d 11-13 and plasma samples on d 12 or 13.
- Compared to basal diet, alfalfa hay ↑ (19 vs. 17 lbs./d, P<0.05) DMI. CP intake ↑ w/ all groups except corn silage. Compared to basal diet, catalase activity and superoxide dismutase activity were ↓ w/ cottonseed meal or corn silage (P<0.01). Plasma malondialdehyde from corn silage diet ↑ (P<0.05) vs. basal diet, indicative of ↑ oxidative stress.
- **Take-home**: Increasing corn silage in diet may affect protein intake in developing heifers, and addition of cottonseed meal or added corn silage may have adverse effect on the antioxidant capacity of heifers.

Protein and amino acid nutrition/supplementation (3 abstracts)

2711. *Health and performance of beef x dairy calves fed CMR of different fat levels and timing of varying protein sources.* Stypinski et al., U of MN, St. Paul; U of MN, Waseca; MSG, Eden Prairie, MN.

- Angus x Holstein calves (n=58) were assigned trt in a 2x2 factorial design: 18% or 24% fat CMR and milk, plasma and wheat as CMR protein source for d 1-63 (i.e., entire pre-weaning) or only d 1-21 (followed by only milk and wheat protein d 22-63).
- CMR was fed at 1.5 lbs/d with 1 wk wean at 0.75 lbs/d. Ad lib access to starter. Feed intake recorded daily, and BW recorded d 1, 21, 35, 49, 56, and 63.
- Feeding milk, plasma, and wheat protein from d 1-63 tended to ↑ ADG from d 1-49 (1.29 vs. 1.16 lbs/d; P=0.08), ↑ starter intake d 1-63 (1.38 vs. 1.16 lbs./d; P=0.05), and tended to ↑ total feed intake (2.72 vs. 2.52 lbs/d; P=0.07). NSD on FE and fecal score.
- CMR intake d 1-63 ↑ if fat % ↑ (1.36 vs. 1.33 lbs./d; P<0.001) but NSD on growth.
- **Take-home** – "…feeding only milk and wheat protein from d 22-63 reduces feed intake and growth of beef x dairy calves compared with inclusion of plasma protein during the entire preweaning period, whereas increasing fat concentration increased CMR intake but did not affect growth."

2034. *Impact of protein source and provision day of the different milk replacer on growth, health, and feeding behavior of Holstein Calves.* Nooroozi et al. WSU; Shiraz U, Iran.

- Female Holstein calves (n=58) housed individually were fed in a 2x2 factorial design: animal or plant protein fed from d 4 or d 24 onward. Calves on CMR d 24 were fed whole milk from d 4-24. All calves gradually weaned d 56-61, monitored to d 91.
- Nutrient intake, BW and diarrhea incidence were measured/monitored.
- Calves fed animal protein CMR ↑ BW gain vs. plant protein on d 10, 30, 40, and 50 (P<0.001). Calves started on d 24 ↑ BW gain on d 20 and 30 vs. starting d 4 (P<0.001), but those started on CMR d 4 had ↑ d 80 ADG (P<0.001).
- Calves fed animal protein CMR ↑ starter intake d 50, 60, and 70 vs. plant protein (P<0.01), and calves started on d 24 ↑ starter intake d 50 and 60 vs. starting d 4.
- Calves fed animal protein CMR ↑ ADG per metabolizable protein intake d 10, 30, and 40 vs. those plant protein (no P value). By d 90, NSD of trt on body measurements.
- NSD in the incidence of diarrhea, but calves fed plant protein CMR ↑ duration of diarrhea (1.93, 1.80, 3.67, and 4.43 d for animal protein d 4 and d 24, and plant protein d 4 and d 24, respectively; P=0001).
- **Take-home** – feeding animal protein sourced CMR improves growth, health, and performance when compared to feeding plant protein sourced CMR.

1240. *Effects of branched-chain amino acids (BCAA) supplementation on plasma amino acids and growth of preweaning calves.* Madureira Ferreira, et al. Cornell U. and WSU.

- Female Holstein calves (n=12, 2 d of age) received either a.) milk w/ no added BCAA or b.) supplemented with 15 g of L-Leu, 6 g of L-Ile, and 9 g of L-Val 1x/d from 2-56 d. Whole milk was 13.6% solids, 24% CP and 33.6% fat.
- Calves fed 2.8 L of whole milk 3x/d from d 2-43, then 2x/d until d 50, then 1x/d until a 56-d wean. Blood samples taken and BW measured weekly.

- BCAA-supplemented calves ↑ plasma concentrations of all three BCAA (P<0.001). Plasma conc of Lys and Met ↑ (P=0.0001) in the control group.
- BCAA-supplemented calves ↑ ADG (1.61 vs. 1.28 lbs/d for BCAA vs. control,; P=0.008), especially 6, 7, and 8. NSD in milk or grain intake.
- **<u>Take-home</u>** – Supplementation of BCAA in whole milk increased plasma BCAA concentrations and increased ADG (small study, n=12).

<u>Fats and oils nutrition (8 abstracts)</u>

2669. Effect of milk replacer fat levels on feeding intake and performance of male dairy calves. Lovatti, et al., U of Vt; U of Guelph; Mapleview Agri, Palmerston, Ontario.

- Holstein male calves (n=126) housed individually fed 26% CP CMR (13% solids) w/ a palm and coconut oil blend lipid source and either a.) low fat (17%), b.) moderate fat (24%), or high fat (31%) concentrations.
- Calves fed at 4 L/d, ↑ to 8 L/d, and gradually weaned d 42-63. Texturized starter (19.5% CP, 4% straw) and pelleted grower (16.8%) were fed ad lib. Calves weighed weekly, grain, CMR, and water intake were measured, and health records recorded.
- Pre-wean ADG ↑ for calves fed low fat CMR vs. moderate or high fat (2.0, 1.7, 1.6 lbs./d, P<0.001). NSD for post-wean ADG (2.8, 2.6, 2.6 lbs/d). Low fat calves ↑ 91-d BW vs. moderate or high fat CMR (354, 324, 328 lbs, P<0.01)
- Average daily grain intake ↑ for calves fed low fat vs. moderate or high fat pre-weaning (d 0-41; P=0.002), weaning (d 42-63; P=0.004) and post-weaning (d 64-91; 10.1, 8.6, 8.7 lbs/d and P<0.001), leading to ↑ metabolizable energy and crude protein intake for low-fat CMR calves (P<0.01). NSD of trt on overall FE (P=0.13)."
- **<u>Take-home</u>** – Low (17%) fat CMR increased pre- and post-wean ADG, 91 d BW, pre- and post-wean grain intake, and post-wean ME intake, w/o affecting feed conversion.

2057. Effects of fat content of high protein CMR on DMI and growth in dairy calves. Murayama, et al. U of Alb. Edmonton, U of Hiroshima, Japan.

- Holstein heifer calves (n=42) born Nov-Dec 2022 (ambient temp=41°F, range 26-60°F) fed CMR w/ 29% CP and either a.) low fat (20% fat, 41% lactose, and 4.7 Mcal/kg ME), b.) moderate fat (26% fat, 36% lactose, and 5.0 Mcal/kg ME), or, c.) high fat (32% fat, 31% lactose, and 5.3 Mcal/kg ME).
- All CMR fed at 16.7% solids (488, 428, and 383 mOsm/kg, low, moderate, and high) as step-up and step-down: 0.6 kg/d d 7-13 and 49-55, 0.8 kg/d d 14-20 and 42-48, and 1.2 kg/d d 21-41 w/ d 56 wean. Calves fed starter and chopped hay ad lib from d 7.
- Under thermoneutrality and max CMR, energy/protein allowable ADG were 0.81/0.97, 0.90/0.97, and 0.99/0.97 kg/d for low, moderate, and high fat CMR.
- CMR intake ↑ (P<0.05) as fat content of CMR ↑ from d 21-41 (2.50, 2.52, and 2.52 lbs/d) and d 42-55 (1.47, 1.47, and 1.48 lbs/d). NSD for starter intake (0.55, 0.60, 0.46 lbs/d), hay intake (54, 41, and 43 g/d), pre-wean ADG (1.43, 1.50, 1.45 lbs/d), and post-wean ADG (2.65, 2.51, 2.54 lbs/d)

- D 7-20 wither height gain (0.11, 0.12, 0.17 cm/d) and hip width gain (0.01, 0.03, 0.04 cm/d) ↑ linearly (P<0.05) for low, moderate, and high fat.
- **Take-home** – increasing fat content of CMR (20%, 26%, and 32% fat) in calves fed at high-volume and high-protein during winter resulted in no differences in ADG or starter intake but greater skeletal development early in life (d 7 – 20).

2156. *Effects of fat content of high protein CMR on insulin sensitivity in dairy calves.* Fukami, et al., U of Alberta Edmonton; Zen-Raku-Ren, Hiroshima University, Japan.

- Same experimental design as above (abstract 2057).
- Insulin resistance and sensitivity calculated from plasma insulin, glucose, and NEFA concentrations of calves fed each CMR-fat trt group at each step of feeding curve.
- Plasma total cholesterol, fatty acids, and triglyceride concentrations ↑ linearly as CMR fat ↑ (P<0.05). Plasma urea nitrogen ↓ linearly (P<0.05) as fat content of CMR ↑, continuing post-weaning (P<0.05).
- As CMR fat content ↑, insulin resistance homeostatic model ↑ linearly (P<0.05) in 22-56 d of age and insulin sensitivity quantitative index ↓ linearly (P<0.05) in 45-56 d of age. Both trends indicate ↓ insulin sensitivity as CMR fat content ↑.
- **Take-home** – higher fat concentrations in high-protein CMR's fed at high-volume in a step-up, step-down fashion resulted in increased nitrogen efficiency and decreased insulin sensitivity.

1238. *Lipid metabolism in calves fed milk replacer differing in fat composition*. Berzoini Costa Leite, et al. WSU; Trouw Nutrition; U Federal de Vicosa Vicosa, Minas Gerais, Brazil.

- Holstein male calves (n=45) fed different CMR fat sources either a.) 60% rapeseed (canola oil) and 40% coconut oil, b.) 35% coconut oil and 65% palm oil, or c.) 65% lard and 35% milk cream. Diets were isoenergetic, formulated to mimic milk fatty acid profile. Rapeseed oil has ↑ HDL-cholesterol, ↑ LDL-cholesterol, and ↓ C16:0 (5-10% vs. 20-30%) vs. other trts.
- Calves fed 6 L/d from d 1-5, 7 L/d from d 6-9, 8 L/d from d 10-35 (13.5% solids). Straw, milk, and water intake recorded daily; BW measured weekly. ? grain feeding.
- NSD in straw, milk, and water intakes or BW. Total cholesterol, HDL- cholesterol, and LDL-cholesterol of calves fed rapeseed/coconut oil blend ↑ (P=0.01) vs. other trts.
- **Take-home** – "Inclusion of vegetable fats in CMR, especially rapeseed, did not affect growth but increased plasma cholesterol in calves."

2715. *The effect of milk oligosaccharides on calf fecal microbiome composition and functional potential*. Van de Vosse et al. Denkavit

- Bull calves (n=100/trt) fed four CMR diets w/ diff milk oligosaccharides (2-fucosyllactose [2'FL], 3'-sialyllactose [3'SL], and 6'-sialyllactose [6'SL]). Diets were control (CMR), "B" (0.005% 2'FL), "C" (0.025% 3'SL + 0.015% 6'SL) and "D" (B + C).
- Calves fed CMR diets at 3 L, 2x/d (150 g/L) until ? d w/ 4-wk step-down weaning. Fecal samples (n=6/trt) collected at 29 and 57 d for fecal metagenomics, microbial diversity, abundance, and metabolic activity.
- NSD between trt for microbial diversity but microbial abundance varied → B diet ↑ carbohydrate-polymer degrading bacteria vs. C + D, while C + D diet ↑ SCFA and health-promoting bacteria.

- Metagenomics at 29 d: B + C diets promote biotin and isoprenoid synthesis, D diet enhanced lactate production. At 57 d, B+C diet promote AA synthesis, C+D diet promote SCFA production.
- **Take-home**: Feeding calves CMR with different milk oligosaccharides modulates fecal microbial abundance and functional potential.

1243. Effect of milk oligosaccharides on calf performance, gut development, and health. Van de Vosse, et al., Denkavit Nederland; inbiose NV, Gent, Belgium.

- Same experimental design as above (abstract 2715).
- BW taken at arrival and wk 2, 6, 10, and 12, also daily CMR intake, solid feed intake, disease incidence and medical treatments. Fecal scores taken the first 10 d.
- Calves (n=4/trt) slaughtered at d 71, and a jejunal segment excised for villi trophy, mucus measures, and sequencing.
- Milk oligosaccharide-supplemented calves ↑ BW at wk 6 (P<0.001) and post-weaning (P<0.10) vs. control.
- NSD between trt for feed intake, fecal consistency, villi height, crypt depth, and mucus thickness, but villi height:crypt depth (P=0.06) and feed conversion ratio (P=0.06) of CMR Diet D tended ↑ vs. control.
- Cumulative disease incidence, specifically BRD, was ↓ in B ad D diets (no P-value).
- **Take-home**: CMR "enriched with 2'FL, 3'SL and 6'SL, and especially their combination, can positively influence growth, FCR, gut development, immune response, and disease incidences in calves."

2260.Addition of butyric and caproic acid in CMR improves gastrointestinal physiology and apparent fat digestibility in calves fed 2x/d. Wilms et al. Trouw Nutrition; U of Guelph.

- Holstein calves (n=45, 2.1 ±0.6 d of age) fed CMR w/ either a.) dairy cream, b.) vegetable fat blend or c) vegetable fat blend + 3.3% tributyrin (1% butyric acid) and 3.3% tricaproin (1% capraic acid), added prior to spray drying to reduce smell.
- All CMRs w/ 36% lactose, 27% fat, and 24% protein, fed at 13.5% solids. Calves housed individually wks 1-6 and fed 6 L/d from d 1-5, 7 L/d from d 6-9, and 8 L/d from d 10-35 w/ no starter grain offered.
- Fecal scores taken daily for 21 d and BW weekly. Feces collected over 48-hrs at d 28 to determine apparent total-tract digestibility. Calves euthanized d 35 for histomorphometry measurements in the rumen (ventral sac) and ileum.
- NSD in CMR intake or growth. Calves fed vegetable fat + tributyrin and tricaproin tended ↓ % d w/ scours in wk 3 (P=0.07).
- Apparent total-tract digestibility of crude fat and Ca ↑ in milk fat calves vs. only vegetable fat blend (P<0.05). Calves fed vegetable fat + tributyrin and tricaproin tended ↑ fat and Ca digestibility vs. only vegetable fat (P<0.10).
- Polyp width (P=0.06) and papillae length (P=0.07) in the rumen and villi in the ileum (P<0.01) were ↑ in calves fed vegetable fat + tributyrin and tricaproin vs. other trts.
- **Take-home** – Incorporating tributyrin and tricaproin enhanced GIT development and apparent fat digestibility but did not affect ADG.

2711. Health and performance of beef x dairy calves fed CMR of different fat levels and timing of varying protein sources. Stypinski et al., U of MN. **see Nutrition → Protein/AA nutrition**

Vitamins and trace minerals (4 abstracts)

2431. *Feeding rumen protected B-vitamins around weaning may result in better odds of reaching 1st lactation and improving milk production*, Roszkos et al., ADEXGO, Hungary, Jefo Nutrition, PQ Canada, AlZahal Inn. & Nut, Ontario Canada.

- Holstein heifers (n=80 heifers) fed w/ or w/out 3 g/hd/d of rumen-protected B1, B5, B6, and B9 blend, offered in mash-grain d 31-67 (weaning) and in TMR d 68-75.
- Transition milk fed d 1-4, then 6 L/d CMR from d 5-67 w/ grain fed ad lib d 10-30 until grain/TMR trts. Previous study found ↑ ADG (P<0.001) w/ B-vitamin blend. Heifers raised under same management, monitored for survival and milk yield up to 97 DIM.
- Calves w/ B-vitamin blend during weaning were more likely to reach 1st lactation (90% vs. 75%; P=0.08) and numerically ↑ milk yield (36.9 vs. 35.1 kg, P=0.12).
- **Take-home** – Calves supplemented rumen-protected B1, B5, B6, and B9 during weaning transition had increased likelihood of reaching 1st lactation.

2256. *B-vitamin inclusion rates in CMR. Effect on health and growth.* Brost et al. U of ILL, Zen-Raku-Ren, Japan.

- Holstein x Angus calves (n=42) fed basal diet plus a.) no added B-vitamins, b.) low added B-vitamins (1.9 ppm B1, 1.68 ppm B3, 0.32 ppm B6, 43 ug/kg B12, or c.) high added B-vitamins (>NASEM; 18.9 ppm B1, 8.5 ppm B3, 11.4 ppm B6, 0.3 ppm B12).
- Calves housed in individual hutches and fed 28:15 CMR: 0.6 kg/d at d 0-14 and d 57-63, 0.8 kg/d at d 15-21 and d 50-56, and 1.13 kg/d at d 22-49. Ad lib starter grain starting d 50. CMR intake and health scores recorded 2x/d; starer intake, fecal intake, attitude, and fecal color score daily; skin scores, BW and skeletal measures weekly.
- Low added B-vitamin ↓ d w/ ocular discharge (4.3 vs. 0.8 d, P=0.02) but ↑ total d w/ respiratory event vs. control (3.4 vs. 5.9 d, P=0.07). NSD for fecal, nasal, or ear scores.
- Grain intake wk 8 and 9 ↑ for low B-vitamin vs. control (P<0.001), and hip width tended ↑ for high B-vitamin vs. control. NSD for other growth (ADG=1.82-1.85 lb/d)
- Fecal intake tended ↑ for high B-vitamin vs. control (P=0.07) which "suggests improved rumen development in the absence of solid feed." Feces in low B-vitamin group were green vs. control at wk 4-7. NSD in CMR intake, attitude or skin scores.
- **Take-home** – Some health benefits documented but results inconsistent between treatments. "Increased starter intake (for low-added B-vits) may suggest improved animal wellbeing but contributed minimally to ADG or growth performance."

2153. *Phytogenic antioxidant supplementation improved efficiency, growth, and health outcomes in dairy calves under 8 weeks of age regardless of vitamin E status.* Dennis, et al. Cargill Animal Nutrition, Lewisburg, OH.

- Holstein heifer calves (n=50; 93 ± 10 lbs.) fed either a.) pos. control, 3.8 IU/kg BW Vit E (160 IU), b.) neg. control, 2.0 IU/kg BW Vit E (84 IU), c.) a. + phytogenic antioxidant (+ 76 IU Vit E), or d.) b.+ phytogenic antioxidant (same dose as c).

- Calves fed 24:17 CMR up to 2 lbs/d and weaned on d 49. Respective trts were added to CMR via 20 g/d supplement or into pelleted starters.
- Starter intake measured daily, BW and BCS weekly, and hip height and width at d 0 and 56. Antioxidant status assessed via serum malondialdehyde and Vit E at d 28 and 56, and metabolic profile via serum BUN, BHB, and NEFA d 42, 50, and 56.
- Avg vitamin E intake = 383 and 234 IU/d for pos. and neg. control. NSD DMI and ADG. Gain:feed tended ↑ for diet d. vs. diet c. (0.479 vs. 0.449, P=0.07). Serum BUN and BHB ↑ at d 50 for calves fed phytogenic antioxidant (P<0.07).
- Calves fed phytogenic antioxidant tended ↑ hip height (P=0.08) but NSD on hip width. Total med d ↓ 67% when fed phytogenic antioxidant regardless of vit E (1.5 vs. 3.8 d; P=0.05). NSD for serum vit E status similar, but d 28 serum malondialdehyde ↑ for diet d. vs. diet a. (P=0.03).
- **Take-home** – phytogenic antioxidant replaced synthetic vitamin E in pre-wean calf feeds while also improving calf health and reducing meds.

2423. *BASF glycine chelated TM's in CMR fed via autofeeder.* Burrell et al., NC State.

- 40 Holstein calves fed a 28:20 CMR supplemented with 50, 50, 10, and 100 ppm of Mn, Zn, Cu, and Fe from either BASF glycine-chelated or inorganic sources.
- Calves housed in hutches and fed via nipple bottles for 7 d and then transferred to trt pens and fed via AMF as "40FIT": step-up 6-12 L/d for 7 d, 12 L/d for 30 d, then step-down 12-0 L/d over a 19 d wean (72 d on AMF). Grain fed ad lib.
- Intake monitored daily. Growth measured every 14 d pre- and 7 d post-wean; blood drawn every 14 d for trace mineral concentration. No health measures reported.
- For calves fed chelated trace minerals, daily DMI ↑ (4.0 vs. 3.1 lbs./d, P<0.001), post-wean ADG ↓ (2.6 vs. 2.2 lbs./d, P=0.02), and feed:gain ↓(2.00 vs. 2.36, P=0.02). NSD blood mineral and overall growth (~1.45 lbs./d).
- **Take-home** – No differences in growth but in this study inorganic TM fortification resulted in improved feed conversion because of improved grain intake post-wean.

Maternal-fetal (49 abstracts)

Genetics (5 abstracts)

1137. Genetic parameters for residual metabolizable energy intake in Holstein calves including maternal effects. Jahnel et al. U Guelph

- Residual metabolizable energy intake (RMEI) from n=471 Holstein calves were measured at 1 and 2 mo of age to estimate genetic parameters of feed efficiency and determine significance of maternal genetic effects.
- Heritability: RMEI at 1 mo = 0.19 ± 0.11 and at 2 mo 0.32 ± 0.12
- Estimated genetic correlation = 0.77 ± 0.36, suggests 2 periods as different traits.
- Maternal effects improved model fitting (P=0.04) but with a high negative genetic correlation (-0.88 ± 0.02) w/ direct effects.
- **Take-home**: Further analysis w/ more animals and other traits is needed; moderate heritability herein demonstrates ability to select feed-efficient pre-weaned calves.

2645. Genetic relationship among colostrum traits, feed efficiency, and growth traits in Canadian Holstein calves. Jahnel et al. U Guelph

- Phenotypic and pedigree records from calves (n=471) 0 to 65 d of age were collected by Ontario Dairy Research Centre from 2015 to 2021 and used to estimate genetic relationship between colostrum intake and quality, feed efficiency, and growth traits.
- Avg col intake = 3.1 L, IgG = 74 g (perhaps g/L?), 1-mo ADG = 0.89 kg/d, 2-mo ADG = 0.91 kg/d, 1-mo RMEI = 0.08 Mcal, 2-mo RMEI = -0.69 Mcal.
- No information on genetic correlations found in the abstract.
- **Take-home**: Not enough data in abstract to make any conclusion on genetic relationship between colostrum and feed/growth traits.

1193. Development and genetic evaluation of novel resilience traits in Holstein cattle utilizing precision calf-feeding technologies. Graham et al. Purdue

- Genomic and pedigree data integrated from 10,076 genotyped Holstein calves and longitudinal calf feeding (AMF) and health status data collected to develop models to derive novel traits and estimate genetic parameters related to resilience (i.e., calves' response to environmental perturbation).
- Significant heritability estimates found for several resilience indicators (i.e., amplitude of deviation, perturbation time, recovery time, velocity parameters, and disease-related traits), ranging from 0.16 to 0.52.
- **Take-home**: Results inform breeding strategies for more resilient, efficient dairy cattle.

2085. Investigating the genetic architecture of dairy calf disease traits and their relationships with economically important traits. Lynch et al. U Guelph.

- Calf disease data and phenotypes (n=69,695 records, n=62,361 calves, n=1,1617 herds) were collected from Lactanet Canada from 2006 to 2021 to estimate genetic correlations among calf disease traits (i.e., diarrhea and BRD) and economic traits.
- A GWAS for calf disease traits was also run from 71,428 genotyped animals.
- Genetic correlations between calf disease traits and production traits were low (0.03 to 0.08), stronger for fertility and health traits (-0.66 to 0.35).

- GWAS identified 17 SNPs, 34 genes, and 6 traits (i.e., ADG, stillbirth, milk fat yield , bovine tuberculosis susceptibility, kappa-casein and glycosylated kappa casein %), associated with diarrhea and 20 SNPs, 47 gene, and 6 traits (i.e., milk K, calf size, milk yield, non-return rate, lactation persistency, and bovine tuberculosis susceptibility) associated with BRD.
- **<u>Take-home</u>**: Results help understand correlation of calfhood disease with productive traits and identify potential genetic pathways for managing disease.

2659. Effect of preweaning plane of nutrition and age on blood DNA methylation of dairy calves. Laflamme-Michaud et al. Université Laval. **see Nutrition → Milk feeding rates**

<u>Dry cow strategies and their impact on the calf (16 abstracts)</u>

2713. *Effect of maternal nutrition on calf morphometry at birth*. Oliveira et al. U Federal de *Viçosa,*

- Holstein x Gyr calves (n=16) were produced via ET, originating from Holstein x Gyr heifers under diff gestational diets to target 0.39 kg/d ADG (MOD) or 0.72 kg/d (HIG).
- Calves fed MC (15% BW, 25% BRIX) w/in 2 hrs, then 12 L/d whole milk to 90 d. Calving difficulty recorded. BW and morphometry measured at 1, 31, 61, and 91 d.
- HIG calves tended ↑ BBW (39 vs. 33 kg, P=0.10) and ↑ body length at birth (61 vs. 56 cm, P=0.01), likely causing ↑ calving difficulty (P=0.02).
- NSD between trts for BW or morphometric measures from 31 to 91 d.
- **<u>Take-home</u>**: Dam ADG during gestation impacts birth weight but does not extend to pre-weaning growth outcomes.

2035. *The impact of maternal nutrition on calf performance during the weaning phase.* Oliveira et al., Universidade Federal de Viçosa, Minas Gerais, Brazil.

- Same experimental design as above (abstract 2713).
- Starter offered d 3 and hay d 40. Blood taken d 1, 31, 61, and 91 for IGF-1 and glucose.
- HIG dams gave birth to heavier calves, but NSD of dam trt on calf ADG or DMI by weaning. NSD for albumin, globulin, total protein and urea.
- **<u>Take-home</u>** – body weight of dam during pregnancy did not affect ADG or DMI of offspring. Nor did it impact blood metabolites.

2557. *Effects of symbiotic supplementation to late gestation cows on offspring growth and health.* Daley et al. Purina Animal Nutrition, Gray Summit, MO.

- Multiparous dams (n=62) received either a.) 454 g/d DM conc. w/ no DFM or b.) 440 g/d DM conc. + 14 g/d of *Bacillus subtilis* and yeast products (Amulet, Purina) for 28 d before expected calving. Female offspring (n=24) were assessed.
- Heifers housed in individual hutches, fed 27:20 CMR peaking at 2.5 lbs./d w/ weaning d 48-61. Calves fed ad lib starter as a.) 28.5% CP (d 2-21) + 25% CP (d 29-87) or b.) 25% CP (d 2-87). CMR and starter intake measured daily, and stature weekly.
- NSD in performance between starter diets (P>0.60). NSD between trt for BBW (86 vs. 90 lbs), hip height, heart girth, or scours incidence. Calves born to DFM-fed dams tended ↑ starter intake (P=0.07)

- Calves from DFM-fed dams ↑ final BW (271.2 vs. 253.5 lbs. P=0.04) resulting in +0.16 lb/d ADG (P=0.09) vs. control calves. These heavier heifers were also longer (+5.9 cm; P<0.05) w/ ↑ body length gain (+4.6 cm; P<0.05) vs. peers from dams w/no DFM.
- **Take-home** – supplementing bacillus and yeast based DFM final 4 weeks of gestation resulted in heifer calves with improved growth.

2019. *Effects of maternal supplementation of* Saccharomyces cerevisiae *var.* Boulardii *CNMCM l-1079 during late gestation on neonatal Holstein calf immune status.* Boerefyn et al. U of Guelph; Elanco, Granger, IA; Saskatoon Colostrum; U of WI – Madison; Lallemand, Bagnac, France.

- Holstein cows (n=80) were supplemented w/ or w/o *Boulardii* yeast during "late gestation" (no details of quantity fed, or period *Boulardii* provided in diet).
- Calves (n=40 male/40 female) fed CR at 15% BW in two fdgs (300 g IgG). Blood taken at 0, 12, and 24 hrs and d 4 and 7 of life for immune markers and target antibodies.
- NSD in IgG concentrations, oxidative burst, or phagocytic capacity. The T cell WC 1.1 % (35% vs. 23%) and WC 1.2 % (36% vs. 21%) ↑ in control vs. *boulardii* groups (P<0.05; adaptive immunity markers).
- Female calves ↑ proportions of CD21 (7 vs. 4%, P<0.05) and CD32 (8 vs. 5%) vs. male calves. NSD for B cell functions or growth.
- **Take-home** – *Boulardii* "supplementation during late gestation of dairy cows does not affect offspring phagocytic capacity but may reduce T cell populations."

2258. *Influences of energy in late-lactation Holstein cow diets on female offspring growth efficiency pre-wean and later prepubertal greenhouse gas emissions.* Wu et al. UW Madison, DFRC USDA-ARS

- At 170 DIM, Holstein cows fed either a high energy or low energy diet (1.82 vs. 1.57 Mcal/kg DM) to achieve a 4.0 or 2.75 BCS at the end of lactation. Resulting BCS was 3.68 (high diet) vs. 3.26 (low diet, P<0.01).
- Female calves (n=38) from respective dam trts measured weekly for BW, stature, and DMI up to wk 8 then at prepuberty (6 mo) measured DMI, BW, stature, ultrasound backfat depth, and daily enteric greenhouse gas (GreenFeed).
- Colostrum BRIX similar (P=0.18) but 24 hr STP ↑ in calves from low energy dams (P=0.02). NSD between trt for 8-wk milk or starter DMI nor in 6-mo DMI. NSD between trt for BBW (86 ±4 lbs.), weaning BW (185 ±2 lbs.) or 6-mo BW (421 ±18 lbs.) or in any body dimension or backfat depth measures. NSD in CH_4 or CO_2 emissions at 6-mo.
- **Take-home**- Body condition score differences resulting from increased energy density of dry cow feed had no effect on female offspring growth or greenhouse gas emissions. Lower energy diets in dry period resulted in improved colostrum status.

2196. *Prepartum acetylsalicylic acid effects on colostrum and passive immune transfer in neonatal Holstein calves.* Sorto et al. PSU; ISU.

- Prepartum Holstein cows (n=102) were treated w/ either a.) 4 aspirin boluses (125 g/d aspirin), or b.) 4 placebo tablets 14 d prior to expected calving.
- Colostrum collected (0-8 hrs) and assessed for Brix and IgG. Single female calves born to dams were enrolled (n=93), blood collected w/in 3 d for IgG concentration.
- NSD between trt for colostrum quantity (30.6 vs. 29.8 lbs.; P=0.84), Brix (26.1 vs. 26.4 ±0.5%; P=0.73) or IgG concentration (130.3 vs. 133.2 ±6.0 g/L; P=0.72).

- Calves from cows treated w/ aspirin tended ↑ serum IgG (37.0 vs. 31.8 ±2.3 g/L; P=0.08) and ↑ Brix (6.7 vs. 6.2 ±0.1 g/dL; P=0.002).
- **Take-home**- Feeding aspirin 14 d pre-partum did not affect colostrum quantity or quality but might impact immune transfer through in-utero mechanisms.

2197. Prepartum acetylsalicylic acid effects on metabolic status and systemic inflammation in preweaned Holstein calves. Sorto et al. PSU. ISU.

- Same experimental design as above (abstract 2196)
- Blood samples were collected w/in 3 d of birth and weekly for the first 4 wks to assess NEFA, BHB, haptoglobin and STP.
- Calves from cows treated w/ aspirin ↑ NEFA w/in 3 d (384.7 vs. 306.6 ±17 mEq/L; P=0.02), ↑ STP 0-4 wks (6.1 vs. 5.8 ±0.1; P=0.01) and tended ↓ haptoglobin (42.1 vs. 72.2 ±12.8 ug/mL, P=0.09). NSD in BHB concentrations.
- **Take-home** – Authors hypothesize, although aspirin- "treated calves may experience higher metabolic stress the first week after birth, this process may be associated with an improved passive immunity early in life."

2198. Prepartum acetylsalicylic acid effects on growth and health during the prewean period in Holstein calves. Sorto et al. PSU. ISU.

- Same experimental design as above (abstract 2196)
- BW collected at birth and weekly for 8 wks, and disease monitored using on-farm computer records and weekly observations.
- Calves from cows treated w/ aspirin ↑ BBW (124.2 vs. 119 ±1.9 lbs.; P=0.05) and ↑ incidence of disease (63.4 vs. 41.8 ±7.5%; P=0.04), due to scours incidence (46.8 vs. 26.1 ±6.9%, P=0.04; not lameness or BRD).
- **Take-home** – Authors hypothesize, aspirin "may affect late fetal development in multiparous cows and calf intestinal health in the first weeks of life."

2554. Intake of colostrum from cows with high or low somatic cell count at dry-off: Effects on the development of calves during the preweaning period. Tomaluski et al. U Sao Paulo.

- Calves (n=22) born to dams w/ low (<200,000 cfu/mL) or high (≥300,000 cfu/mL) SCC at dry-off. Calves fed MC (≥30%) at 10% BW w/in 2 hrs and 8 hrs (5% BW).
- After feeding, calves managed identically with 6 L/d CMR, ad lib starter to 56 d. Blood collected 24, 48, and 72 hrs, then weekly. Fecal scores daily. BW at birth and weaning.
- NSD for TPI, both groups "Excellent" (STP = 7.9 g /dL, P>0.84). NSD for blood glucose, protein, or lactate (P>0.27).
- High SCC calves tended ↑ fecal score and hematocrit (31 vs. 29%, P=0.07).
- High SCC tended ↓ ADG (0.44 vs. 0.36 kg/d, P=0.06), but NSD wean BW (P>0.16).
- **Take-home**: Feeding colostrum from dams with high SCC at dry-off impacts calf scours and hydration with minimal impacts on metabolism.

2157. Colostrum from cows with high or low somatic cell count at dry-off: effects on the development of dairy calves during the neonatal period. Tomaluski et al., Luiz de Queriroz College of Ag, University of São Paulo Piracicaba, SP, Brazil.

- Same experimental design as above (abstract 2554).

- BW gain on d 7, then 11 h after last feeding, calves slaughtered for digestive tract and internal organ evaluation.
- NSD in CMR intake, slaughter BW, metabolic profile and organ weight (P>0.05).
- Low SCC calves ↑ intestinal weight as % of BW (7.18 vs. 6.12%; P=0.03) and tended ↑ BW gain (0.91 vs. 0.39 lbs./d; P=0.06).
- **Take-home** – Colostrum from cows with low somatic cell count at dry-off noted increased intestinal weight of calves and improved short-term weight gain, indicating potential improved long-term performance.

2647. In utero heat stress affects genome-wide DNA methylation in blood cells at birth in Holstein heifers. Boucher et al. Université Laval.

- Holstein heifers born to in utero heat stress (n=3, IU-HS; shade) or cooling (n=5, IU-CL; shade, fans, soakers) had blood collected at birth (before colostrum) for total DNA extraction to identify DNA methylation status.
- Between trts, 1,716 differentially methylated regions (q-value<0.01, methylation difference>15%, same direction) identified in the promoter region, involving 1,061 genes.
- 548 genes hypermethylated (roles in inflammation and immune response) and 513 hypomethylated (roles in cell signaling and development) in IU-HS vs. IU-CL calves
- **Take-home**: IU-HS led to a unique methylation profile that may alter epigenetic profile and contribute to suboptimal productivity traits.

1393. Fetal exposure to heat stress affects the mammary gland epigenome at birth. Guenther et al. UW-Madison

- The mammary glands of heifers born to in utero heat stress (IU-HS; shade) or cooling (IU-CL; shade, fans, soakers, n=8/trt) were harvested at birth for differential methylation analysis of mammary parenchyma.
- 1,449 differentialy methylated cytosines were identified (DMC, methylation difference ≥20%, q-value ≤0.10) involving 557 genes.
- Hypermethylated genes under IUHS play roles in mammary development, cell turnover, cell adhesion, and immune response, whereas hypomethylated genes play roles in cell division and differentiation.
- Enriched pathways of interest include smooth muscle contraction, oxytocin signaling, cell-cell junction, steroidogenesis, and growth hormone signaling.
- **Take-home**: These epigenetic changes help explain the impact of in utero heat stress on impaired mammary growth and development.

1394. Carryover effects of maternal heat stress on growth, mammogenic hormones, and mammary microstructure through the daughter's first pregnancy. Davidson et al. UW-Madison

- Heifers born to in utero heat stress (IU-HT; shade) or cooling (IU-CL; shade, fans, soakers, n=17-18/group) were managed identically after birth and followed from birth to 9 mo gestation.
- Once pregnant, growth measures (BW, hip height, chest girth, body length) taken monthly and mammary measures (teat length, teat distance, mammary gland width) taken at 2, 4, 6, and 9 mo. Plasma progesterone monthly and estradiol at 8 and 9 mo.
- MG biopsies performed at 9 mo gestation for histological analysis.

- NSD of IU-HT on growth, mammary measures, or hormones except mammary width (trt x time interaction: 9 mo IUCL heifers had wider glands vs. IUHT, P=0.03).
- IU-HT tended to ↓ epithelial cells/alveoli, alveolar area (P≤0.09)
- **Take-home**: In utero heat stress minimally impact pregnant heifer gross phenotype but alters the gestating mammary gland microstructure.

1608. Supplementation of rumen-protected methionine to late-gestation heat-stressed cows: Impact on calf amino acid metabolism and liver gene expression. Larsen et al. UW-Madison

- Heifers (n=17/trt) born to dams: late-gestation heat stress w/ rumen-protected Met (IU-MHS), heat stress w/ no Met (IU-CHS), thermoneutral w/ no Met (IU-CTN)
- Heifers exposed 4-wks prenatal, then managed the same. Growth measures collected weekly, DMI daily, plasma AA at d 1 and 49, liver biopsy at d 1.
- Contrast 1 = IU-CHS+IU-MHS vs. IU-CTN (i.e., HS vs. TN); contrast 2 = IU-CHS vs. IU-MHS (i.e., CON vs. Met under HS conditions)
- Contrast 1: HS ↓ d1 essential AA (Met, Lys, and His, P<0.03) vs. IU-CTN but NSD non-essential AA or branched chain AA (P>0.14). NSD in contrast 2 (P>0.23).
- Contrast 1: HS lead to 286 DEG (q-value <0.2, fold change ≥ 2); contrast 2: Met lead to 1 DEG → *SYT6* upregulated under IU-MHS
- **Take-home**: Outside of Met suppl, in utero heat stress reduced circulating limited AA and altered liver gene expression, whereas dam Met did not greatly impact either.

2138. Blood glucose concentrations of unfed newborn dairy calves exposed to different periods of intrauterine heat stress. Del Rio-Aviles et al. Instituto Tecnológico de Sonora,

- Blood glucose measured from unfed calves exposed to different durations of in utero heat stress (IUHS) in the last 60 d of gestation: G1 (<20 d IUHS, n=30), G2 (21-40 d IUHS, n=20), or G3 (41-60 d IUHS, n=16).
- G1 calves w/ ↓ blood gluc vs. G2 and G3 (99 vs. 165 and 140 mmol/dL, P<0.01). NSD G2 vs. G3.
- **Take-home**: In utero heat stress for as little as 20 d can influence newborn calf metabolism.

1331. Effects of prenatal wildfire-PM2.5 exposure on inflammatory markers and health of the postnatal dairy calf. Pace et al. U of ID

- Heifer calves born dams exposed (WFS, n=17) or not exposed (CON, n=26) to wildfire smoke in mid-gestation but otherwise managed the same.
- Heart rate, rectal temp, health scores, and blood samples for hematology parameters were collected every 2 wks to 8 mo. Thoracic ultrasounds conducted monthly.
- WFS calves ↓ ultrasound and eye scores but ↑ heart rate, navel score, and fecal scores vs. CON (P≤0.05)
- WFS calves ↓ lymphocytes, monocytes, red blood cells, and serum amyloid A (P≤0.03) but ↑ serum albumin (P < 0.01).
- **Take-home**: Calves exposed to wildfire smoke in utero have altered inflammatory markers and changes in health scores, suggesting a repressed immune system.

<u>Colostrum, colostrum replacers, and transition milk (28 abstracts)</u>

1504. *Joint AAVI & ADSA AH and LB Symposium: The regulation of colostrogensis*. Baumrucker, PSU

- Colostrogenesis occurs during "regenerative involution" period
    - Transcytosis of IgG is only current valid marker, facilitated by FcRn
    - Start and end unknown
    - Transfers 2 g of IgG/hr → extremely fast, accelerates towards end.
- Problem: high variability of colostrum quality (IgG mass and concentration)
    - Why? Mammary epithelial cell number (shown to be unrelated), dry period length, rate of transcytosis, FcRn expression (balancing pH/lactoferrin)
- **<u>Take-home</u>**: Read "Colostrogenesis role and mechanism of the bovine Fc Receptor of the neonate (FcRn)" Baumrucker et al. 2022.

1505. *Joint AAVI & ADSA AH and LB Symposium: Optimizing passive immunity with dam vaccination: When is too soon or too late? What is too much?* Woolums, Mississippi State.

- Vaccinate dry cows to increase antibodies in colostrum
    - Cow exposure → antibodies in blood or mammary gland → colostrum → calf
    - Give vaccine and booster w/booster between 3-8 weeks pre-calving.
- Calves fed colostrum from vaccinated cows will have higher blood antibodies in first 1-3 months of life (won't last forever).
- Impact on actual calf disease after viral exposure varies; some studies show improved resistance to infection, others show no outcome on disease pressure.
- **<u>Take-home</u>**: Vaccinate cows 2x in late-lactation/dry period, antibody titers ↑ in calves, but harder to see benefit in calf outcomes.

1506. *Joint AAVI & ADSA AH and LB Symposium: The impact of prepartum nutrition on colostrum production and newborn calves*. Hare et al. U of Saskatchewan.

- Can we identify sources of colostrum yield and composition variation?
    - Parity, photoperiod, genetics, prior 305-d milk yield, dry period length, season, calf sex, body condition score, and nutrient intake.
- Aiming at prepartum nutrition to improve colostrum quality
    - ↑ dietary fat or changing source (fatty acids): ↑ IgG conc but ↓ fat %
    - ↑ dietary protein, limited effects: ↑ insulin but ↓ fat %, more influential on colostrum bioactive fractions.
    - ↑ dietary starch: linear ↑ colostrum yield + lactose, ↓ fat and protein (beef)
- Recommendation: feed 16-18% starch, don't worry about crude protein.
- **<u>Take-home</u>**: Focusing on dam dry period nutrition (i.e. dietary fat, protein, and starch) has differing implications on colostrum quality and content.

1507. *Joint AAVI & ADSA AH and LB Symposium: Colostrum—More than immunoglobulin G (IgG): Colostrum components and effects on the calf.* Mann et al. Cornell.

- Beyond IgG, colostrum also rich in:
    - Low-abundant proteins: growth factors, cytokines, hormones, complement proteins, antimicrobial peptides, and enzymes

        - Complement proteins ok under freezing but ↓ under heat treatment → we don't know if and how complement proteins are used by the calf
    - Maternal immune cells
        - ↑ concentration in colostrum but ↓ cell type proportions
        - Heat-treating and freezing removes lymphocytes
        - Heat-treating ↓ IgA by 6.5%
    - MicroRNA
        - ↑ in colostrum and transition milk, lots unknown
- **Take-home**: IgG should be the benchmark for colostrum quality, but can we pull up other beneficial nutrient profiles?

1508. Joint AAVI & ADSA AH and LB Symposium: The role of colostrum in programming immune development of dairy calves. Cid de la Paz and Rostoll-Cangiano, UW-Madison.

- Colostrum provides protection from extra- and intracellular pathogens
- Drives development of the calf immune system w/ long-term implications
- Accomplishes this through immunoglobulins, growth factors, immune cells, and bioactive molecules.
- **Take-home**: Colostrum immunity goes beyond IgGs, fighting pathogens and developing the nascent immune system through many mechanisms.

1509. Joint AAVI & ADSA AH and LB Symposium: The utility of whole colostrum and components in maintaining gut health and metabolism. Antunes et al. UW-Madison.

- Mouse study: hypothesized that therapeutic colostrum supplementation after antibiotic-induced microbial depletion would restore normal gut function.
- Colostrum therapy given following brief early-life antibiotics, tracked metabolic phenotypes across the lifespan.
    - Stimulates epithelial barrier function, goblet cell enrichment, and mucosal colonization
    - Maintained adipose tissue compartments, glucose tolerance vs. antibiotics
- **Take-home**: Colostrum could have a medical food approach in preventing chronic disease and metabolism concerns driven by antibiotic use.

1510. Joint AAVI & ADSA AH and LB Symposium: What can't colostrum do? Exploring the effects of supplementing colostrum after the first day of life. Renaud and Steele, U Guelph.

- Supplementing transition milk across 3 to 14 d of age:
    - Improves growth, reduces morbidity and mortality
    - Mechanism unclear, likely stimulates GIT development
    - Optimal dosage also unclear
- Colostrum supplementation to sick calves (as milk/colostrum mixed) for 3 to 4 d:
    - Improves diarrhea resolution and growth
    - After AMF alert, decreases likelihood of BRD (but not diarrhea)
    - Suggest exploring role as an alternative to antimicrobials
- Colostrum supplementation to stressed calves:
    - Weaning: improved growth but not GIT permeability

- **Take-home**: Colostrum and transition milk supplementation aids in calf growth, health, and (sometimes) gut physiology in under early-life, disease, and stress.

2075. *Colostrum quality and yield on Dutch dairy farms.* Veneman et al. De Heus Animal Nutrition Ede, the Netherlands. Wageningen U, Wageningen, the Netherlands.

- Cows (n=10-15/farm, n=37 farms) entering lactation ≥2 and calving w/in a 2-month period were enrolled. 401 colostrum samples from all farms and 254 Brix readings from 22 farms were collected.
- A pre-partum (-15 to -1 d) and post-partum (24-72 h) blood sample analyzed for BHBA, NEFA, and urea. Pre-partum pen-level feed intake and composition of far-off and close-up diets were determined over 3-4 d. Incidence of retained placenta, metritis, ketosis, and mastitis up to 21 d post-fresh were monitored.
- Colostrum yield avg 6.2 ±0.6 L and Brix avg 22.9 ±4.2%. Cows w/ clinical disorders tended ↑ colostrum yield (6.9 vs. 6.0 L, P=0.10), and ↑ postpartum NEFA ↑ colostrum yield (P<0.01). Cows fed close-up diet >14 d had ↑ colostrum yield vs. cows fed for 14 d (<14 d intermediate; 8.0, 5.4, and 6.2 L, P<0.01).
- 2nd parity cows ↓ Brix vs. ≥5 parity (21.8 vs. 24.1; P=0.01). Dietary items positively associated w/ Brix: prepartum serum urea (P=0.06), DCAD diff between close-up and far-off diets (P=0.04), far-off crude fat % (P<0.01), and diet proportion of concentrate + minerals (P=0.07). Items negatively associated w/ Brix: colostrum yield (P=0.01) and prepartum serum BHBA (P=0.06).
- **Take-home** – "Colostrum quality and yield associated with nutritional and health factors."

1150. *Joint ARPAS and ADSA Growth and Dvlpmt Symposium: Factors influencing colostrum production in multiparous Holstein and Jersey cows at multiple locations.* Erickson UNH.

- Regression models were developed using environmental and management factors and previous lactation data to evaluate factors influencing colostrum yield, quality and IgG yield.
- Holstein: # of d above thermoneutral zone ↑ colostrum but ↓ IgG yield (P<0.01).
- Jersey: Previous days open and days dry ↑ colostrum and IgG yields (P<0.02), while farm latitude ↓ colostrum and IgG yields (P<0.01).
- **Take-home**: The review can help guide research and management to limit colostrum yield and quality losses.

1538. *Identification of dam factors associated with immunoglobulin G mass in colostrum of dairy cows.* Goetz et al. U Guelph

- Data and colostrum (n=505) from dams collected, mixed linear models assessed variables associated with colostrum IgG mass (vol x concentration).
- Blood collected from a subset (n=205) to measure hematology
- Factors ↑ IgG mass: ↑ days past expected calving (+1 d = +8 g IgG, P=0.03), multiparity (+370 g vs. primiparous, P<0.01), ↑ dam gamma-glutamyl transferase (+446 g IgG, P<0.01), ↑ -2 and -3 wk albumin (+320-450 g IgG, P<0.03).
- Factors ↓ IgG mass: ↑ -2 wk DMI (-9 g IgG, P=0.05), ↑ -3 wk metabolizable protein (-94 g IgG, P=0.04), ↑ dam total protein (-67 g IgG, P<0.01)
- **Take-home**: Dam calving and hematology markers could be used to predict IgG mass and colostrum quality before and at calving.

1534. *Seasonal impact on colostrum quality and transfer of passive immunity in preweaned dairy calves in the Southeastern United States.* Roper et al. UGA

- Colostrum (n=1,151) quality and calf (n=699) TPI were measured over a year on a commercial GA, USA farm. Ambient temperature monitored every 15 min.
- Calves fed w/in 2 hr after birth, colostrum quality measured via BRIX refractometer, serum collected between 2-4 d of age to measure BRIX.
- Colostrum quality: Constant to Apr, ↓ thru June, ↑ to Oct (dilution effect from low vol?), ↓ thru Dec (P≤0.02)
- TPI: ↑ Jan to Apr, ↓ thru June, ↑ to July, ↓ to Oct (impaired AEA from in utero heat stress?)
- **Take-home**: Calf TPI follows trend of colostrum quality but is impacted by seasonal factors like colostrum volume and in utero heat stress in the southeast US.

1115. *Effect of breed and colostrum quantity on health and lymphocyte populations in blood of Holstein and crossbred calves.* Kovics et al., U of Guelph; UW-Madison.

- Newborn Holstein & Holstein x Angus calves (n=40; 10/breed/trt) fed either low (2.5 g IgG/kg BW) or high (5 g IgG/kg BW) quantity of CR (27.5% solids).
- Calves then fed CMR w/ weaning d 49-70. Fecal and respiratory scores recorded 2x/d; blood samples (n=20) on d 14 and 35 for blood cell counts and d 14, 35, and 84 for lymphocyte isolation and staining with monoclonal antibodies.
- NSD breed or trt on disease incidence. The proportion of IgM+ B cells expressing CD21 and CD32 tended ↑ in high vs. low colostrum-fed calves (P<0.08) and low colostrum-fed calves tended ↑ proportion of T cells (P=0.08). NSD of breed.
- **Take-home**: The level of colostrum fed impacted lymphocyte profiles but, in this study, had no impact on calf health. The breed of the calf had no effect.

2032. *Impact of breed and colostrum intake on IgG kinetics in Holstein and Holstein-Angus crossbred bulls.* McCarthy et al. U Guelph

- Holstein and HolsteinxAngus bull calves fed either low (2.5 g IgG/kg BBW) or high (5 g IgG/kg BBW) colostrum at 0 and 12 hours.
- Calves fed CMR at 6% BW from 24 to 48 hrs, blood samples hourly 0-6 hrs, 8, 10, 12, 15, 18, 21, 24, 36, and 48 hrs post colostrum fdg to assess serum IgG and apparent efficiency of absorption (AEA). Chromium dosing at 24 hr for gut permeability.
- Serum IgG ↑ in high calves (P<0.01) w/NSD by breed (P=0.17) but a breed x diet interaction – crossbred low calves ↑ vs. Holstein low calves (P = 0.04)
- AEA ↑ in low calves (P=0.03) w/NSD by breed (P=0.28) but a breed x diet trend - crossbred low calves ↑ vs. Holstein low calves (P = 0.08)
- Gut permeability ↓ in high calves and crossbred calves (P<0.04).
- **Take-home**: Crossbred calves better absorb low levels of IgG vs. Holstein calves.

2714. *The impact of colostrum fat concentration on IgG kinetics and metabolism in newborn Holstein-Angus crossbred calves.* McCarthy et al. U Guelph

- Holstein x Angus crossbred calves (n=16/trt) fed either low fat (LOW, 16% IgG, 11% fat, 49% prot, 32% lactose) or high fat (HIGH 12% IgG, 26% fat, 41% prot, 25% lactose) colostrum replacer at 0 and 12 hrs, both delivering 3 g IgG/kg BW.

- After colostrum, calves fed CMR at 7.5% BW and blood collected frequently (1 to 3 hr intervals, then daily to 7 d of age).
- LOW calves ↑ serum IgG and apparent efficiency of absorption vs. HIGH from 18 hr to 7 d of life (trt x time P<0.03).
- NSD between trt for insulin or glucose concentrations or insulin:glucose rati (P>0.05).
- **Take-home**: Formulated low-fat colostrum replacer promotes improved IgG absorption without impacting early-life glucose metabolism.

2074. *Factors associated with transfer of passive immunity in dairy calves.* Edwards et al. U of Guelph. U of Vt. Tavistock Veterinary Service, Tavistock, Ontario.

- Calf health records (n=2,022 calves, n=11 farms) were analyzed in a retrospective cohort study examining effects various parameters on STP.
- Whole blood was collected from calves between 1-7 d of age, measured for STP using an optical refractometer. Mean STP was 6.03 ±0.82 g/dL.
- Calves born in the summer (+0.16 g/dL) or fall (+0.23 g/dL) ↑ STP vs. winter (5.79 g/dL, P<0.001). Spring calves were intermediary and NSD.
- Calves fed colostrum w/ 24-25% Brix (+0.22 g/dL), 26% Brix (+0.28 g/dL), or ≥27% Brix (0.28 g/dL) ↑ STP vs ≤23% Brix (5.87 ±0.81 g/dL; P<0.001).
- Calves suckling colostrum from dam ↓ STP (-0.43 g/dL; P=0.02) vs. calves bottle-fed (5.89 ±0.69 g/dL). Calves born in the afternoon had ↓ STP (-0.15 g/dL; P<0.001) vs. morning (6.09 ±0.74 g/dL). Evening births intermediary.
- Calf BW, calving ease, and number of colostrum fdgs were reported as screened variables, w/ no results (likely NSD)
- **Take-home** – season born (winter = ↓ STP), colostrum Brix (↑Brix = ↑STP), suckling calves (↓ STP), and afternoon births (↓ STP) were all associated with calf STP.

1116. *Investigating the IgM and IgG B cell repertoires and expression of ultralong complementarity determining region 3 in colostrum and blood from Holstein cows at calving.* Altvater-Hughes et al. U Guelph

- Blood mononuclear and colostral cells were isolated from n=8 Holstein dairy cows to characterize and compare B cells and identify the B cell subset w/heavy chain ultralong complementarity determining regions (UL-CDR3)
- In colostral B cells, 4.2% of IgM and 7.1% of IgG cells contained UL-CDR3s. ↑ % of IgM and IgG B cells w/ UL-CDR3s in colostrum vs. blood (P<0.05).
- **Take-home**: Colostrum contains B cells with UL-CDR3 regions at a higher concentration relative to blood.

2496. *On-field application of near-infrared portable spectrometer for cow colostrum quality assessment.* Goi et al. U of Padova.

- Colostrum samples (n=709) were collected from Holstein cows and analyzed in a pocket near-infrared spectrometer (SCiO) and compared to tests measured by radial immunodiffusions, VDLUFA, Kjeldhal method, HPLC, and ICP-OES.
- SCiO w/ promising predictive performance for IgG, fat, and AA (R^2 ≥ 0.75) and excellent prediction for protein and sulfur (R^2 ≥ 0.93). Less predictive value for lactose, and other minerals (Ca, P, K, Na, Mg, Zn, and Fe).

- SCiO correctly identified 61% of poor-quality and 75% of good quality samples.
- **Take-home**: The SCiO provides accurate, quick determination of colostral components, including IgG with precision feeding potential.

2155. Impact of casein addition in colostrum replacer on neonatal calf serum immunoglobulin G concentration and dynamics. Pereira et al., U of Vt; Zinpro, MN.

- Holstein x Angus calves (n=72, 99.9 ±13 lbs) fed either a.) Zinpro Premolac Plus CR (85 g IgG/L), b.) Zinpro Premolac Plus CR w/ casein (85 g IgG/L + 95 g casein/L), or c.) MC (85 g IgG/L) at 300 total g IgG in 3.7 L via esophageal tube at 3 hrs after birth. The CR w/ casein matched casein concentration in MC.
- Blood collected 6, 12, 18, 24, 36, 48, & 72 h post feeding and analyzed for IgG (max IgG conc, time to max IgG conc, IgG area under the curve [AUC], and apparent IgG persistency [% AIP])
- Max IgG conc. ↑ in both the CR w/o casein and MC vs. CR w/ casein (29.5, 26.2, 21.1 ±1.3 g/L; P<0.01). NSD between trt for time to max IgG conc. (23.7, 29.1, and 24.9 hours for CR w/o casein, w/ casein, and MC).
- AUC ↓ for both CR + casein and MC vs. CR w/o casein (1719, 2197 vs. 2641 ±120, P<0.01). NSD between trt for % AIP (60, 48, 60 ±6.3%, P=0.21)
- **Take-home** – casein in colostrum replacer reduces maximum IgG concentration and total area under the curve in neonatal calves; "casein plays a role in IgG dynamics..."

2154. The effects of transition milk replacers with different IgG levels on growth performance of neonatal dairy calves. Shimada et al. U of Guelph.

- Calves (n=48) fed one of three isoenergetic transition milk replacers (TR, 4.9 L/d) from 1 to 5 d of age: Control (0 g IgG/L), Mid (12 g IgG/L), and High (24 g IgG/L).
- Before TR, calves fed colostrum replacer at 2 and 8 hr with 240 g total IgG. After TR, calves fed same CMR from 6 to 56 d of age. Hay, starter, and water ad lib. DMI and fecal scores daily, BW and ADG at 5-14 d intervals.
- High calves ↑ ADG at 56-65 d (1.33 vs. 1.07, 1.08 kg/d, P=?) but NSD for DMI, feed efficiency, or health scores.
- **Take-home**: Transition milk replacer promoted weaning-age growth but not FE.

2255. Effect of maternal or formulated transitional milk on gastrointestinal tract development and organ weight of neonatal dairy calves. Oliveira et al. U of Sao Paulo.

- Calves (n=48) fed one diet from 1 to 3 d of age: whole milk (WM, solids unknown), formulated transition milk (WM + 70 g/L colostrum replacer, 19.5% solids), and maternal transition milk (TM, 16% BRIX)
- All calves fed colostrum at 0-3 hrs with 23-25% BRIX. After TR, calves fed same whole milk at 6 L/d from 4 to ? d of age. At 21 d, n=5 calves/trt euthanized for organs weights.
- All calves w/ Excellent TPI at 48 hrs (11±2.0% BRIX).
- NSD for 21-d ADG, BW, spleen, liver, kidney, GIT, or forestomach weights (P>0.22).
- **Take-home**: No early-life benefits detected when feeding transition milk for 3 d.

2025. Feeding whole milk enriched with transition milk improves the performance and health of young calves. Carrari et al. WSU.

- Calves (n=64) fed whole milk enriched w/ transition milk for different time periods: T0 (control, 6 L milk/d), T1 (4 L milk + 2 L transition milk/d for 1 wk), T2 (same for 2 wks), and T3 (same for 3 wks). Assuming trts started following colostrum feeding.
- Following trt, calves fed whole milk to d 57, then weaning in 1-L/d step-down until d 64, kept until d 91. Calf health, fecal scores, and blood samples collected.
- Calves fed T2 and T3 ↑ DMI, metabolizable energy, and ADG during trt and at d 91 and ↑ serum IgG to d 63 (T2) or d 91 (T3, $P<0.01$).
- Calves fed T3 ↑ stature, BHBA, and total proteins (age not specified).
- T0 ↑ likelihood of calf diarrhea and fever vs. T2 and T3 ($P<0.01$)
- **Take-home**: Feeding 2 L of transition milk in whole milk for 3 weeks at moderate planes of nutrition improves calf growth, immunity, and health.

2161. Effect of extended colostrum feeding on the performance of Jersey heifers. Suresh et al. U of Maryland.

- Jersey calves (n=60/trt) fed colostrum at either control (2 fdgs) or treatment (6 fdgs) levels. Volume not stated. Spacing: 1st @ 0-4 hrs, 2nd @ 12 hrs, 3-6 @ 12 hr intervals.
- All calves switched to CMR after colostrum. Fed in AMF from 7 to 77 d of age (weaning). Weekly BW, stature, rectal temp, and fecal scores.
- Treatment colostrum calves ↑ weaning BW (81 vs. 74 kg, $P=0.03$) and ADG (0.75 vs. 0.66 kg/d, $P=0.04$) vs. control. NSD stature.
- **Take-home**: Extended colostrum promotes Jersey calf growth (preliminary data).

2259. Preweaning transition milk supplementation does not improve productivity or calving intervals in first, second, or third lactation animals. McDonald et al. MSU.

- Heifers (n=29-31) were retrospectively assessed through 3 lactations after being fed CMR, CMR + colostrum replacer (MR+CR), or transition milk (TM) at 3 fdgs/d for 3 d. Sample size ↓ to n=16-18 by lact 3.
- Production, reproduction, and culling records were assessed.
- NSD between trts for lact 1-3 milk, protein, and fat yield or SCC ($P>0.20$), except TM cows tended ↑ fat in lact 2 ($P=0.09$).
- TM heifers ↑ time to first calving vs. CMR (686 vs. 669 d, $P=0.05$) but NSD in hazard of leaving the herd.
- **Take-home**: Despite benefits in early-life growth, this study found no benefit of extended transition milk feeding on lactational performance.

2068. Colostrum supplementation as a therapy for neonatal calf diarrhea when administered at the time of a diarrhea alert generated by an automated milk feeder. Welk et al. U Guelph **see Health → Enteric disease**

2480. Evaluation of bovine colostrum replacer supplementation to improve weaning transition in dairy calves. Edwards et al. U Guelph **see Management → Weaning**

2196. Prepartum acetylsalicylic acid effects on colostrum and passive immune transfer in neonatal Holstein calves. Sorto et al. PSU; ISU. **see Maternal-fetal → Dry cow strategies**

2554. Intake of colostrum from cows with high or low somatic cell count at dry-off: Effects on the development of calves during the preweaning period. Tomaluski et al. U Sao Paulo. **see Maternal-fetal → Dry cow strategies**

2157. Colostrum from cows with high or low somatic cell count at dry-off: effects on the development of dairy calves during the neonatal period. Tomaluski et al. U Sao Paulo. **see Maternal-fetal → Dry cow strategies**

Health (22 abstracts)

Respiratory disease (BRD) (9 abstracts)

2070. *Evaluating case definitions of respiratory disease in calves: A scoping review.* Spohn et al. U Guelph

- Objective was to describe case definitions and diagnostic methods for BRD in pre-weaned calves via scoping review of 278 publications (57% observation, 29% controlled) with 352 case definitions.
- Diagnostic methods: clinical scoring system only (CSS, 40%), physical exam only (26%), thoracic ultrasound only (8%), CSS with add'l parameters (11%), farm treatment records (2%), and other methods (11%)
- Case definitions not cited 37% of the time; if cited, not consistent in detail or criteria. Only 1% and 28% reported validity and accuracy. The WI Respiratory Scoring System were most cited, case definition "total score of >4"(18%) or "≥5"(10%).
- **Take-home**: The review identified numerous, diverse BRD case definitions; standardization is needed – the authors are developing a core outcome set.

2202. *Predictors of bovine respiratory disease and its effect on growth and hazard of mortality in dairy calves.* Goetz et al. U Guelph.

- Holstein calves (n=1,100) monitored 2x/d for BRD signs (UC Davis Respiratory Scoring chart; score > 5 = BRD). BW weekly for from 3 to 77 d of age, STP upon arrival.
- Mortality rate = 9% (n=100 calves), BRD incidence rate = 44.1% (n=485 calves).
- Calves from auction or drovers 1.5x as likely to have BRD incidence compared with direct source (P<0.01). Previous diarrhea ↑ BRD likelihood 1.9x.
- Calves with "Excellent," "Good," and "Fair" STP (≥6.2 g/dL, 5.8 to 6.1 g /dL, and 5.1 to 5.7 g/dL, respectively) ↓ BRD likelihood vs. calves with "Poor" STP (<5.1 g/dL).
- Calves with BRD ↓ ADG (-0.13 kg/d) and ↑ mortality (hazard ratio=10.30, P<0.001)
- **Take-home**: Predictors of BRD incidence include calf source, previous diarrhea events, and STP. BRD negatively impacts growth and mortality.

2077. *Factors associated with lung consolidation in preweaned dairy calves.* Edwards et al. U of Guelph. U of Vt. Tavistock Veterinary Services, Tavistock, Ontario.

- Retrospective cohort study (n=2,276 pre-weaned calves, n=11 farms) examined factors assoc. w/ diarrhea, BRD and mortality.
- Thoracic ultrasound performed at 30 ± 7 d (linear ultrasound probe, depth=8 cm and 8.5 mHz). Calves considered lung consolidated positive if ≥1 cm^2 consolidated lung. Overall presence of lung consolidation was 50.8% (range 0 to 81.8% by farm).
- Variables screened in the univariable analysis included: season of birth, BBW, calving ease, first colostrum fdg volume, colostral Brix, number of colostrum feedings, time of birth, incidence of diarrhea, and TPI categories.
- Odds of lung consolidation ↓ if TPI was good (OR: 0.56; 95% CI: 0.38-0.82; P=0.003) or excellent (OR: 0.41; 95% CI: 0.28 – 0.61; P<0.001) vs. poor.

- Summer-born calves ↓ odds of lung consolidation vs. winter-born calves (OR: 0.72; 95% CI: 0.51-1.00; P=0.05). BW was associated w/ lung consolidation, where every 1 kg ↑ BW ↓ odds for lung consolidation (OR: 0.96; 95% CI: 0.94 – 0.98; P<0.001).
- **Take-home** – "These results emphasize the importance of achieving good transfer of passive immunity to reduce respiratory damage." Seasonal effects are likely associated with temperatures, ventilation, and air quality.

2072. Impacts of BRD and lung consolidation at weaning on growth performance in beef x dairy calves. Fernandes et al. PSU, U of Guelph. UW-Madison.

- Beef x Holstein calves (n=145, n=2 source farms, n=3 cohorts) assessed for diarrhea and BRD after arrival and ~4 d postweaning (d 57 ±14 d; new facility), d 83, and d 238. Calves fed CMR (1.85 lbs./d) and ad lib starter.
- Thoracic ultrasonography was performed to determine lung consolidation score (none, 1-2 cm^2, or 3 cm^2) and status (≥1 cm^2 in one lobe) at d 57 and d 83.
- 36 calves were reported w/ lung consolidation (none = 109, 1 to 2 cm^2 =10, 3 cm^2=26), and 11 w/ lung consolidation at d 83 (none = 132, 1 to 2 cm^2 =4, 3 cm^2=7). Effect of period x lung consolidation and period x status (P≤0.01).
- NSD between health status for prewean ADG (both 1.23 lbs. P=0.99), but healthy calves ↑ postwean, 83-d ADG (+0.26 lbs.; P=0.01) vs. calves with lung consolidation. Specifically, healthy calves ↑ +0.29 lbs/d post-wean ADG vs. calves w/ 3 cm^2 score (P=0.02). NSD between healthy calves and calves w/ 1-2cm^2 lung score (P=0.62).
- NSD between health status for 238-d ADG (2.65 vs. 2.82 lbs./d; P=0.19); mean final BW was 713 ±16.6 lbs.
- **Take-home** – "...lung consolidation at weaning has short-term effects on beef x dairy calf growth, but compensatory growth nullifies the impact w/in 238 d post-weaning."

1121. The association of lung consolidation with pathogen shedding, and performance effects in weaned calves. Fernandes et al. PSU, U of Guelph. UW-Madison.

- Same experimental design as above (abstract 2072)
- The top 50% ADG were calculated (>1.00 kg/d). Calves w/ lung consolidation were pair-matched to healthy controls by sex, cohort, and BW (n=37 case-control pairs)
- A triple-guarded nasopharyngeal swab was taken from each calf to assess bacterial pathogen shedding (*P. multocida, B. trehalose, M. Haemolytica, H. somni)*.
- Calves shed *P. multocida* (20 cases, 9 controls) and *B. trehalose* (1 case, 1 control).
- Healthy calves ↓ odds of pathogen shedding (OR: 0.22; P<0.001) vs. calves with 1-2 cm^2 lung consolidation post-wean. Calves w/ diff. lung consolidations (1 – 2 cm^2 or 3 cm^2) had similar odds of pathogen shedding (OR: 0.41; P=0.64). Neither high ADG (OR: 0.98; P=0.96) nor STP (OR: 0.60; P=0.11) impacted odds of pathogen shedding.
- **Take-home** – "lung consolidation was associated with the probability of a positive bacterial pathology ... but pathology was not associated with changes in growth" ... to d 238.

2641. Peripheral leukocyte transcriptomic changes in preweaning Holstein dairy calves with varying stages of bovine respiratory disease. Richmond et al. WSU.

- Calves (n=89) from 2 commercial Washington dairies were enrolled from 0 to 84 d of age with physical exam w/ thoracic ultrasounds weekly and blood pulled biweekly.

- Calves categorized based on presence/absence and duration of lobar consolidation: healthy (n=23), onset (n=31), chronic (n=17), or resolved (n=18). Leukocyte isolation from whole blood was conducted for each "state."
- Analysis identified 536 differentially expressed genes (DEG) for healthy vs. onset (i.e., *HSD11B1*, *ITGB5*), 152 DEG for healthy vs. chronic (i.e., *ILR2*, *LCN2*, *N4BP2*), and 99 DEG for healthy vs. resolved (i.e., *CTSD*, *DEFB1*, *RNF213*, *PRRC2B*). Genes listed have known role as pathologic indicators of BRD and inflammation.
- **Take-home**: Identifying potential biomarkers for BRD can help determine susceptibility and progression of BRD.

1124. *Evaluating the impacts of* Salmonella Dublin on health and growth factors in surplus dairy calves. Pharo et al. U of Guelph; Mapleview Agri, Palmerston, Ontario; Ohio State U, Columbus, Ohio.

- Blood collected from Holstein (n=344) and crossbred (n=40, 3-10 d of age) calves at arrival to calf-rearing facility and wks 4 and 12 to detect S. Dublin positivity via antibody ELISA. Calves declared positive if percent positivity >35%.
- Calves scored 2x/d for fecal consistency and respiratory score (UC-Davis). Calves were weighed at arrival and weekly until departure week 12.
- 44 (11.5%) of calves tested + for S. Dublin. One calf + at arrival, one + at wk 4 and remainder + at wk 12. Calves S. Dublin + gained -124.2 g/d vs. - calves (P<0.001).
- Calves S. Dublin + ↑ d w/ respiratory score >5 (incidence rate ratio = 1.76; P<0.001) vs. negative calves. NSD between S. Dublin + and d with abnormal fecal consistency score (P=0.22) or mortality (P=0.99).
- **Take-home** – Calves testing + for S. Dublin gained less and experienced more BRD than negative calves. Mortality and incidences of diarrhea were not different.

1125. *Test agreement for serum versus milk antibody ELISA for* Salmonella *Dublin*. Lyn et al. U of Guelph; Trent U, Ontario, Canada; U of BC.

- Questions: When testing for S. Dublin using a commercial antibody ELISA (PrioCHECK™ S. Dublin Strip Kit, Thermo Fisher Scientific), are serum and milk results from congruent? What is the "cut-off" point between a positive and negative result?
- S. Dublin testing conducted on 4 herds in BC w/ 3 bulk tank milk samples test + for S. Dublin over the last year. ~50% of the lactating herd (or 75 cows) were selected for testing w/ composite milk and blood samples taken <12 hrs apart.
- Of the 274 cows sampled, 9.5% and 33.9% were classified as + for S. Dublin on serum and milk tests, respectively, using a cut point of 35% positivity relative to positive control (per the kit protocol). S. Dublin prevalence ↑ to 19% (serum) and 50% (milk) at cut point lowered to 15%.
- Lin's correlation coefficient for milk and serum values was 0.67 (95% CI 0.62 – 0.72).
- The agreement between milk and serum was 75.6% at 35% cut point (Kappa=0.34) and decreased to 68.3% at 15% cut point (Kappa = 0.37, i.e., "agreement beyond chance"). When 35% used for milk and 15% for serum, i.e., different cut points, there was "moderate agreement" (Kappa =0.54)
- **Take-home** – "...results from milk and serum samples should not be used interchangeably, ... optimal dilution or interpretive cut points for serum and milk samples is needed."

1126. The efficacy of vaccination and improvements in cleaning on mitigating Salmonella *Dublin consequences in a NE US heifer raiser: A mathematical modeling study.* Llanos-Soto et al. Cornell.

- A mathematical model was used to determine S. Dublin outbreak probability and death, carrier, & abortion rates in heifers (per 100 hd/yr) through a 5-yr simulation period in scenarios a.) with or w/o 2-dose weaned vaccination & b.) increased barn scraping from 1x/week to 12x/d. Economic projections were also made.
- ↑ cleaning frequency ↓ baseline median death from 3.1 to 2.4/yr, carrier departure from 2.4 to 2.0, and abortions from 3.3 to 2.6 (on 100 hd/yr basis). Vaccinations ↓ deaths from 3.1 to 0.9 while "slightly" ↑ other rates (details not reported).
- Estimates were S. Dublin infection ↓ median operating income of a heifer raiser from $66,871-$56,932/100 hd and depending on cost, vaccination ↑ median operating income between $58,076-$60,112/100 hd, whereas ↑ cleaning had less impact.
- **Take-home** – vaccination for S. Dublin improved income due to decreased mortality, "cleaning improvements are also needed to lower its spread..."

Enteric disease (5 abstracts)

2069. The influence of diarrhea on growth, intake, and metabolic profiles in neonatal dairy calves. Souza Lima et al. VA Tech; U Cattolica del Sacro Cuore, Italy.

- Holstein calves (n=27) retrospectively classified into healthy or diarrhea groups (7-14 d old calves w/ 2 consecutive d fecal score ≥3 and rectal temp >103.1 °F).
- Calves housed in individual hutches and received 3.8 L of colostrum (Brix ≥21%) w/in 4 hrs of birth, then 24:20 CMR at 2 L, 2x/d for 2 d, then 3 L, 2x/d for 21 d. Ad lib grain (21% CP) from d 3. Daily monitoring of CMR and grain intake, rectal temps, and respiratory scores. BW recorded at birth and weekly, blood samples collected at 0 hrs (pre-colostrum) and d 2, 7, 14, and 21 to evaluate metabolic markers.
- Healthy calves ↑ starter intake overall and at 20 and 21 d (P<0.02) and ↑ BBW vs. diarrheic calves (104 vs. 97 lbs., P=0.02).
- Glucose conc. ↑ in healthy calves vs. diarrheic calves (P=0.04). The glucose/insulin ratio ↑ in healthy calves vs. diarrheic ones at 14 d (P=0.04), followed by a ↓ ratio in healthy calves vs. diarrheic ones at d 21 (P=0.01).
- **Take-home** – "...greater stress in diarrheic calves led to lower starter intake and consequently impaired nutrient absorption, such as carbohydrates from the starter."

1117. Gut permeability in calves with diarrhea. Zakia et al., U of Guelph, U of Il

- Calves 7-21 d old w/ either runny or watery feces (n=11) or normal feces and physical exam (n=12) were compared measuring blood bacteria and gut permeability (chromium-EDTA; 0.1 g/kg of BW orally and blood measures taken directly prior, 2 hr, and 4 hr later).
- Blood from bacteremic calves were cultured for *Clostridium* spp, *Staphylococcus* spp, *Enterococcus* spp, *Pasteurella* spp, and *Streptococcus* spp.
- Diarrheic calves ↑ plasma chromium conc. at 2 and 4 hrs (P<0.02) vs. healthy calves.
- Diarrheic calves, both bacteremic and non-bacteremic, ↑ higher plasma chromium conc. at 4 hrs (P=0.06) vs. healthy calves (both bactermic and non-bacteremic).

- **Take-home** – Gut permeability increases in calves with diarrhea but not differently with presence of bacteremia.

2314. *Associations between physical examination findings, blood parameters, and bacteremia in neonatal dairy calves with diarrhea*. Zakia et al., U of Guelph, Ontario, Canada; U of Illinois.

- Commercial calves <21 d of age monitored for diarrhea incidence using a 2x/d scoring and categorized as diarrheic if feces were runny or watery.
- Diarrheic calves (n=100) underwent physical exams and blood collection at diarrhea onset, 24 hrs and 48 hrs later for blood culture, complete blood cell count, serum biochemistry profile, venous blood gas and electrolyte analysis and l-lactate measurements. Bacteremia was determined by positive blood culture.
- Comparisons were made between controls (diarrheic nonbacteremic calves enrolled w/in ±4 d of the case) vs. diarrheic bacteremic calves.
- 37% of diarrheic calves were also bacteremic. On the d of bacteremia detection, ↑ blood pH (P=0.04) and albumin concentration (P=0.02) were associated with ↓ odds of bacteremia. On d +1 of bacteremia, ↑ rectal temps (P=0.08) and absolute neutrophil count (P=0.05) were associated w/ ↑ odds of bacteremia.
- **Take-home** –Lower blood pH and albumin concentrations and increased rectal temps and neutrophil counts were associated with higher odds of bacteremia.

2068. *Colostrum supplementation as a therapy for neonatal calf diarrhea when administered at the time of a diarrhea alert generated by an automated milk feeder.* Welk et al. U Guelph

- Calves (n=14) offered 15 L/d CMR via AMF from 3 to 28 d of age, monitored for diarrhea via alert (<60% milk intake and/or drinking speed). After alert, assigned either 1 L of colostrum replacer (CR, 130 g/L,? IgG conc) or 1 L CMR (150 g/Lfor 4 d, isoenergetic.
- Fecal consistency scored daily, diarrhea diagnosed as loose feces ≥ 2 d of watery feces ≥ 1 d, BW collected at birth, alert day, and 2x weekly after.
- Calves triggered alerts at 10 ± 3 d of age, diarrhea diagnosed at 11 ± 3 d of age.
- NSD between trt for diarrhea duration (4 vs. 5 d for CR vs. CMR, P=0.27), CMR intake (8 vs. 7 L/d, P=0.29), or drinking speed (0.4 vs. 0.3 L/min, P=0.36).
- CR calves tended ↑ ADG (1 vs. 0.6 kg/d, P=0.06) and ↑ BW at 7 d after alert (55 vs. 51 kg, P=0.05) but NSD for 14-d BW (64 vs. 61 kg, P=0.66).
- **Take-home**: Providing CR to calves at diarrhea alert did not impact diarrhea resolution but improved BW gain diarrhea incidence.

2195. Detection of neonatal calf diarrhea using suckle pressure. Xu et al. Cornell University. **see Behavior and Welfare → Feeding behavior.**

Disease prediction & prevention (6 abstracts)

2076. *Factors associated with morbidity and mortality in preweaned dairy calves.* Edwards, et al. U of Guelph. U of VT. Tavistock Veterinary Services, Tavistock, Ontario.

- See abstract 2077 in "Respiratory disease". Briefly, retrospective cohort study examined factors (seasonal, calving, and disease) associated w/ diarrhea, BRD and mortality (n=2,361 female dairy, n=11).

- Summer-born calves ↑ odds of diarrhea (OR 1.54, P=0.02) but ↓ odds of BRD (OR 0.67, P=0.04) vs. winter. Fall-born calves ↓ odds of mortality (OR 0.23, P=0.05) vs. winter.
- Calves w/ excellent STP ↓ odds of BRD (OR 0.71, P=0.04) vs. poor. Odds of mortality ↓ if STP was good (OR= 0.13, P=0.04) or excellent (OR = 0.34, P=0.05) vs. poor.
- Odds of mortality ↑ for calves w/ health event vs. those w/no health event (OR=20.18; P<0.001) and if calves had lung consolidation (OR= 2.65; P=0.05) vs. none.
- **Take-home** – "These results highlight the importance of improving TPI to reduce preweaning morbidity and mortality, and the effect of season on morbidity."

1120. *Prevalence and risk factors associated with respiratory and entero-pathogens from calves in Ontario: a cross-sectional study.* Umana Sedo et al., U of Guelph, Ontario, Canada; VA Tech; Teagasc Cork, Ireland.

- Ontario farms (n=100) visited 04-08/2022 to administer questionnaire and collect fecal samples (n=5 calves/farm, 2-35 d of age; final n=363 fecal samples from 83 farms) and nasopharyngeal swabs (n=5 calves, 21 to 122 d; final n=390 swabs from 80 farms).
- Fecal samples analyzed individually using multiplex PCR, nasopharyngeal swabs analyzed using one pooled sample per farm using bacterial culture and rtPCR.
- Most common entero-pathogens detected were *Cryptosporidium parvum* (67.4%) and *E. coli* K99+ (13.2%). Most common BRD pathogens detected were *Pasteurella multocida* (62.5%), bovine coronavirus (42.5%), and *Mycoplasma bovis* (21.2%).
- Presence of *C. parvum* was positively associated w/ herds with ≥61 preweaned calves/yr and feeding mainly whole milk. The presence of *M. bovis* was associated w/ herds that combined manual and AMF systems. Presence of bovine coronavirus was associated w/ >98 preweaned calves/yr
- Herds + for *C parvum, M. bovis,* or coronavirus had ↑ risk of prewean calf mortality.
- **Take-home** – Prevalent pathogens highlighted. Dairies rearing more calves and feeding whole milk or on autofeeders had higher incidence of entero- or respiratory pathogens.

1187. *The impact of maternal BLV status on daughters' status in Michigan dairy youngstock.* Sokacz et al. Michigan State U; CentralStar Cooperative, Lansing, MI.

- Heifers (n=254, n=5 farms) born to dams either BLV-infected (60%) or uninfected (40%) were blood sampled as neonates (5 ±2 d), before breeding (370 ±34 d), and 60 d following first breeding (490 ±43 d).
- DNA extracted from blood samples was screened using BLV qPCR and then dams and daughters were analyzed to perform a risk ratio analysis.
- BLV prevalnces in daughters continually ↑ and reached 14% by post-breeding. Of the 14% of infected daughters, 80% were born from an infected dam.
- Strong association between BLV status of dam and probability daughter infected (P=0.0001). Daughters born to an infected dam have ↑ risk of testing positive for BLV as youngstock vs. daughters born from uninfected dams (RR = 2.9).
- **Take-home** – "...daughters born from an infected dam have an increased probability of testing positive before reaching the milking herd."

2071. *Farm-specific machine learning models for early detection of respiratory disease in Holstein dairy calves using automatic milk feeder data.* Bousselmi et al. Université Laval.

- From n=5 commercial Quebec dairy farms, AMF data (consumption, drinking speed, and visits) and BRD treatments were collected for one year.
- Farm-specific prediction models and one all-farm model was generated to predict if a calf has BRD from the AMF -5 to 0 d before actual treatment.
- 105,759 data points on 2,358 calves; 73% healthy and 27% 1+ episodes BRD.
- Best model performances obtained on -2 d (72-77% accuracy, Farm 3 and 5), -1 d (63-65% accuracy, Farm 2 and 4), and 0 d (60% accuracy, Farm 1). Higher accuracy attributed to homogenous BRD detection on Farm 3 and 5.
- Farm-specific models outperformed the all-farm model on all farms except Farm 1 (62% accuracy).
- **Take-home**: Accurate BRD management can occur with farm-specific machine learning models with well-defined BRD detection protocols.

2203. Evaluation of automatic milk feeders for early detection of respiratory disease in dairy calves on 5 commercial farms. Bousselmi et al. Université Laval.

- Same experimental design as 2071 (above).
- Earliest significant diff between healthy and BRD calves' d before trt: -2 to -4 d for unrewarded visits (Farm 2 and 5, $P<0.05$), -1 d rewarded visits (Farm 1, $P<0.001$), -5 d drinking speed (Farm 3, $P<0.001$), and -5 d consumption (Farm 4, $P=0.03$).
- **Take-home**: Number of days and metric of interest varied between farms, suggesting early BRD detection should be tailored to individual farms.

1198. Dairy calf health and growth monitoring through camera phenotyping techniques. Liao et al. Virginia Tech.

- Calves monitored via automatic recording systems to predict BW and identify diarrhea. Management parameters not stated.
- Depth cameras captured videos of calves (n=20), images processed to extract body width, length, height, and volume. BW collected via scale for correlation (? age/time).
- Security camera captured calf posterior images (n=54) labeled as healthy, mild, moderate, or severe → predictive model.
- Strong, positive correlation between body metrics and BW (r=0.71 to 0.83). Predictive model from camera images had accuracy of 0.80.
- Diarrhea prediction model w/ strong prediction accuracies (0.94 to 1.0).
- **Take-home**: Camera technologies can monitor calf growth and health effectively.

Immunity, inflammation, and general morbidity (2 abstracts)

2497. Oral temperature as an indicator of fever in pre-weaned dairy calves. Gottwald et al. Cornell University.

- Holstein heifer calves (n=150) from one commercial New York dairy were enrolled from 0 to 28 d of age, housed in AMF (n=20 calves/pen) and allotted 11 L/d whole milk.
- Health scores, oral temperature (OT), and rectal temperature (RT) were measured at 1, 2, 4, 6, 8, 10, 14, 18. 22, and 28 d.

- 15.2% of calves had fever (RT≥39.5°C) w/ strong positive correlation (r=0.77) between OT (mean=39.5 ± 0.4 °C) and RT (40.0 ± 0.4 °C).
- Setting OT threshold at ≥39.1°C identifies fever w/ 94% sensitivity and 92% specificity.
- **Take-home**: OT can be used to detect fever and monitor health in dairy calves.

2497. *Mitochondrial function of dairy calf lymphocytes from birth to maturity*. Kesler and Abuelo MSU

- Whole blood was collected from n=4 calves at 0 (pre-colostrum), 1, 2, 3, 4, 6, 8, 16, and 24 wks of age, compared against 4 mid-lactation cows.
- Lymphocytes (B, CD4, CD8, and γδ T lymphocytes) were isolated and mitochondrial function was assessed.
- Minor patterns were found over time (i.e., CD4+ cells had higher non-mitochondrial oxygen consumption at 3 wk vs. 0 and 16 wks) but there was no overarching pattern of changes in any mitochondrial outcome across time.
- **Take-home**: This study does not suggest a progression in lymphocyte mitochondrial function with age, likely not a contributing factor to early-life vaccine effectiveness.

Antimicrobial resistance

No abstracts at ADSA 2024.

Physiology (9 abstracts)

Gut and gut microbiome (4 abstracts)

1122. High-resolution characterization of dairy calves' gut microbiota and identification of diarrhea-associated bacterial markers. Hawkins et al. Mississippi State

- From Holstein x Angus calves (n=25), collected fecal samples and scored at 4, 7, 11, 14, and 30 d to characterize gut microbiota and identify diarrhea associated bacterial markers using machine learning.
- Calves fed colostrum on d 1, CMR from d 2-14, and whole milk d 15+ (vol. not stated).
- Biodiversity ↑ w/age (P<0.001), 11 and 14 d had similar diversity (peak diarrhea), ↓ by 30 d in diarrheic calves.
- Gut microbiota tended to differ on d 14 between healthy and diarrheic calves (P=0.07) → ↑ abundance of *Fusobacterium mortiferum*, ↓ *Megasphaera elsdenii*. Antimicrobial resistant bacteria ↑ in diarrhea calves at d 14 and 30 (P<0.06).
- Machine learning 80% accurate, identified 7 bacterial species to predict diarrhea.
- **Take-home**: Diarrhea impacts the calf gut microbiota during and after incidence.

1123. Bacteria colonization and gene expression related to immune function in colon mucosa is associated with growth in neonatal calves. Nishihara et al. U Guelph.

- Colon tissue biopsies collected at D0 (2 hrs of age, pre-colostrum) and D5 (3 hrs post-morning CMR fdg) from n=20 Holstein bull calves to analyze mucosa-attached bacteria and colon transcriptome.
- NSD in α and β diversity of mucosa-attached bacteria between d.
- Diarrhea-related bacteria ↑ abundance in colon at D0 vs. D5 (FDR<0.05). E. coli ↑ but Bifidobacterium, Lactobacillus, and Faecalibacterium prausnitzii ↓ at D0 vs. D5.
- Pathways related to viral infection and immune function activated at D5 (FDR<0.05).
- **Take-home**: Growth and CMR impact bacteria and host immune function in early life, decreasing opportunistic pathogens.

2163. Temporal differentiation of enterotypes of young ruminants during early life shapes the characteristic growth phenotype. Zhuang et al. China Ag U

- Fecal samples (n=1,045, n=408 newborn calves) were sequenced to "characterize the invasion and dynamic changes of core taxa."
- Multi-omics analyses and fecal microbiota transplantation (FMT) in mice used to reveal and confirm how enterotype shapes the calf growth phenotype.
- Four calf enterotypes were identified (dominated by *Bifidobacterium* and *UCG-oo5*). Conversion between enterotypes was variable to stable, influenced by age and diet.
- Authors report a "potential pro-growth effect of *Bifidobacterium*, (which) may be implemented by promoting carbohydrates, activating the synthesis of volatile fatty acids, amino acids, and vitamin B6, and inhibiting methane production in the gut."
- The FMT "confirmed the beneficial effect of a *Bifidobacterium*- dominated microbiota on animal growth and gut development."
- **Take-home** – the gut microbiota enterotypes characterized in this study highlight the potential beneficial effects of *Bifidobacterium* on calf growth.

1118. Transport duration affects gastrointestinal permeability in preweaned calves. Goetz et al. U Guelph **see Behavior and Welfare → Transport.**

<u>Rumen development (3 abstract)</u>

1237. Unraveling the multifaceted mechanism of residual feed intake in Holstein female calves: A comprehensive muti-omics analysis across distinct digestive sites. Chen et al., China Ag U Beijing; Animal Nutrition Inst., Sichuan Ag U, Sichuan, China.

- Female Holstein calves (n=80, 92 lbs.) fed a consistent diet and weaned at 56 d, remaining in hutches until 84 d w/ daily records of starter and milk intake and biweekly BW. Rumen fluid collected d 84 prior AM feeding, feces taken 2x/d and pooled daily from d 78-84. Digestibility was estimated.
- Calf residual feed intake (RFI; Δ actual vs. expected FI) was calculated based on BW, ADG, and DMI, then calves divided into two groups (n=40/group): positive RFI (ate ↑ than expected, inefficient) or negative RFI (ate ↓ than expected, more efficient)
- *Erysipelotrichaceae_UCG-002*, rumen fluid marker in low RFI, was associated with carbohydrate metabolism. *Rikenelaceae_RC9_gut_group*, fecal marker in high RFI, showed associations with lipid metabolism. (more enzymes = more digestion)
- Metagenomic analysis: ↑ enzymes and genes related to carbon and nitrogen utilization pathways in low RFI calves, whereas high RFI ↑ in FA synthesis pathway."
- **<u>Take-home</u> –** "These findings align with the observation that protein and starch digestibility negatively correlate with relative feed intake, whereas fat digestibility positively correlates with relative feed intake."

1163. Effects of microbial inoculum on the transcriptome and meta-transcriptome of rumen, reticulum, omasum, and abomasum epithelium in calves. Fregulia, et al. Oak Ridge Inst. for Science & Education

- Holstein bull calves (n=15) received microbial inoculum collected from 4 adult cows that was either: either a.) autoclaved (control), b.) bacteria-enriched as an inoculum, or c.) protozoa-enriched as an inoculum. Inoculum dosed intraruminally 1x/wk, 3-6 wk of age.
- Calves were weaned at 7 wks and euthanized at 9 wks. Stomach chamber tissues were analyzed for transcriptome and meta-transcriptome including DEG analysis ($P<0.05$), differential microbial abundance, microbial community structure, and taxonomic analysis.
- 9,628 DEG in rumen vs. abomasum, 4,821 DEG in rumen vs. omasum, 2,212 DEG in rumen vs. reticulum, 9,219 DEG in abomasum vs. reticulum, 8,728 DEG in abomasum vs. omasum, and 3,557 DEG in reticulum vs. omasum.
- 204 microbial taxa were differentially abundant in rumen vs. abomasum, 204 taxa in rumen vs. omasum, 126 taxa in rumen vs. reticulum, 190 taxa in abomasum, vs. reticulum, 174 taxa in abomasum vs. omasum, and 159 in reticulum vs. omasum.
- Animals w/ either bacterial- or protozoa-enriched inoculum had changes in microbial structure community in all stomach chambers. The abomasum clustered differently across all other stomach chambers regardless of trt, and both inoculum left strong microbial signature on the abomasum (6 microbial taxa).

- **Take-home** – microbial inoculation affects the epithelial transcriptome and meta-transcriptome in all stomach chambers, however, the microbiota on the abomasum differs from other chambers regardless of inoculum added.

2712. *Shifts in rumen profiles of Holstein steers fed antimicrobial and starch diets*. Golder et al. Scibus, The U of Sydney, Arm & Hammer

- Holstein steers (n=72, 3-7 d old) fed CMR and ad lib wheat straw added to pre-starter grain (d 0-24), starter (d 25-94) and finisher diets (d 95-452). Grain diets formulated as either a.) 38% starch, 50 ppm monensin and 20 ppm flavophospholipol, or b.) 47.5% starch.
- Calves housed indoors (pens of 6/replicate) w/ outdoor access. Concentrate intake recorded daily. Rumen fluid sampled by stomach tube <3 hr after feeding at d 100, 200, and 438 (14 d before slaughter) from 24 calves (n=2 per pen/replicate).
- Rumen fluid was analyzed for pH, ammonia, lactic acid, VFA conc, bacterial 16S ribosomal DNA, and ruminal bacteria genera abundance over trt and time.
- Calves over 14.5 months had metabolic profiles consistent w/ subclinical ruminal acidosis. The lower starch diet ↑ final BW (1,267.6 vs. 1,245.6 lbs, P=0.03).
- Calf rumen fluid from high starch diet ↑ butyrate on d 438 (P=0.05), ↓ ammonia on d 100 but ↑ on d 200 (P<0.001), ↓ acetate, propionate, and total VFA (P<0.04).
- Microbiota variation between rumen fluid from calves on the two diets ↑ over time (8.6%, 10.9%, and 19.2% for d 100, 200, and 438) indicative of "different diets lead to different microbial successions."
- **Take-home** – "Antimicrobials and low-starch diet produced better weights than a higher starch diet and had more fermentation control."

Mammary development (2 abstract)

1151. *Unlocking the "potential" of bovine fetal mammary stem cells*. Podles et al. U Maryland.

- Fetal bovine mammary tissues were assessed by stage (bud to secondary sprout) to identify when the mammary stem cell niche forms.
- Early bovine mammary bud cells co-express genes related to specification, luminal factors, and basal factors → cells uncommitted but primed for differentiation.
- Over 5 propagations of new cell lines were generated from conditional reprogramming cultures.
- **Take-home**: Research characterizes mammary stem cell origin and helps understand mammary reprogramming.

2677. *Repeated biopsies performed in calves, heifers, and first lactation cows*. Vang et al. UW-Madison

- Abstract describes methods for sequential mammary biopsies in dairy heifers to avoid culling for tissue collection.
- Biopsies are ultrasound-guided in 8- and 10-wk old calves using a disposable biopsy punch (2-mm). Repeated biopsies can be performed, herein at 6, 9, 12 mo of age; 5, 7, and 8 mo gestation; and 1, 45, 90, 150 and 270 DIM (6-mm punch)
- Incision size ranges from 0.5-1.5 cm leading to 1 mm x 0.5 cm tissue to 5 mm x 4 cm tissue, depending on punch size.

- Healing occurs 7-10 post-op and few complications were reported (i.e., infection, excessive bleeding). NSD of biopsy on milk production (P > 0.05).
- **<u>Take-home</u>**: The technique is safe and reliable and could allow longitudinal assessment of mammary development on milk yield.

Management (37 abstracts)

Housing (11 abstracts)

1575.Effects of individual versus pair housing on cortisol, growth, and health of dairy calves during the preweaning period. Pempek et al. USDA-ARS

- Calves were housed individually (INDV, n=10) or paired (PR, n=10 pairs/20 calves) and monitored for signs of stress: tail hair cortisol at 0, 35, and 63 d, BW at 0 and 56 d, daily disease assessment, and weekly lung ultrasounds.
- CMR: 3 L 2x/d until 49 d, then 1x/d until 56 d. No info on housing size
- NSD for trt hair cortisol concentration, but declined by age (P not listed); NSD for ADG, disease, or abnormal lung ultrasound scores
- Trend for trt x sex interaction: female PR calves ↑ 6 kg vs. INDV, but male PR calves ↓ 4 kg vs. INDV (P not listed).
- **Take-home**: In the present study, there was no strong influence of pair-housing on calf stress response.

1576. Impact of paired social housing on behavior and growth of organic dairy calves. Black et al. UC Extension

- Calves were housed individually (IH, 2.4 m^2, n=28), paired in double hutches (PD, 4.8 m^2, n=16), or paired in a large single hutch (PS, 3.5 m^2, n=16) and assessed for growth (BW, hip and wither height at birth and weaning) and lying behavior (leg loggers).
- Combo of Jersey, Holstein, and crossbred in each trt. Cow-calf contact until 4 d of age, then 2 L pasteurized milk 2x/d, step up to 8 L, 2x/d by 60 d, weaning at 104 d. Data analyzed w/ calf as experimental unit.
- NSD for trt ADG or stature increase, NSD for daily lying bout frequency or bout duration.
- IH calves tended to ↑ total lying time vs. PS (17.3 vs 16.8 hrs/d, P=0.07) but NSD vs. PD (17.2 hrs/d, P=0.23)
- **Take-home**: In the present study, pair-housing maintained performance and may influence calf activity depending on the size of the hutch.

2672. The effect of pair housing on immune development in response to weaning and social mixing in dairy calves. Pachniak et al. U of Mn

- Calves were outdoor hutch pair-housed (n=10 pairs) or individually housed (n=10), weaned from 43 to 56 d, then socially mixed at 63 d of age.
- Whole blood collected at d 36, 43, 44, 46, 48, 50, 63, 64, 66, 68, and 70 for white blood cell gene expression analysis.
- NSD for gene expression of *IL1B*, *TNFa*, *MPO*, *SELL*, or *TLR4*.
- **Take-home**: The data thus far indicates there is no difference in post-weaned, social-mixing immune development after different pre-weaned housing conditions.

2055. Effects of pair-housing and season on dairy calf health and growth. Bonney-King et al. UF

- Calves (n=90) were individually housed (IH, n=50 calves) or paired (PH, n=50 pairs) from birth to weaning from either warm (May-Oct) or cool (Nov-Apr) seasons in FL.
- Calves fed 8 L/d CMR (2x/d) w/ 10-d stepdown weaning starting at 43 d. Scours assessed daily using the WI Calf Health Scoring. Calves weighed at 0, 43, and 53 d.

- Pairing x cool season ↑ starter intake, ↑ weaning ADG, ↓ fever d ($P<0.03$)
- Cool season ↑ % of calves finishing milk at 2 wks of age ($P=0.04$)
- 100% scours prevalence, NSD on duration between trt but warm season ↑ duration vs. cool season (9 vs. 7 d, $P=0.01$).
- Age at scouring w/ housing x season effect: Warm season = 6.6 vs. 6.5 d for PH vs. IH; cool season = 9.4 vs. 6.9 d (i.e., calves scoured later in PH when cool, $P=0.04$).
- **Take-home**: Pair housing led to elevated benefits primarily in cooler weather, indicating heat stress might be playing a role in effectiveness.

1577. Effects of modified wooden group hutches on dairy calves' growth and behavior. Abdelfattah et al. UC-Davis

- Calves were housed in wooden hutches individually (IH, n=21), or grouped (GH, n=21, 2 middle dividers removed) and assessed for growth (BW and hip height at 0, 1, 4, and 8 wks) and lying behavior (leg loggers).
- No info on hutch size or milk program. Data analyzed w/ calf as experimental unit.
- NSD for trt BW at any time, NSD for daily lying time, lying bouts, or motion index ($P>0.77$).
- **Take-home**: In the present study, minimally modifying wooden hutches for group housing did not influence performance or lying behaviors.

2020. Group housed dairy calves have greater body weight gain during preweaning than individually housed calves: A meta-analysis. Donadio et al. Universidad Esadual Paulista.

- Meta-analysis from 27 studies investigating housing type (group vs. individual) on calf performance (i.e., grain intake, ADG, and wean wt)
- Group-housed calves ↑ starter intake ($P=0.02$, +0.04 kg/d), ADG ($P=0.001$, +0.06 kg/d), and wean wt ($P=0.04$, +1.4 kg) vs. individually housed calves. Covariates incl. wean age, calf sex, and pen area/calf influenced ADG.
- Starter intake and ADG had high heterogeneity (>50%, $P<0.05$).
- **Take-home**: Group-housing promotes improved weaning performance metrics over individual housing.

2049. Familiarity influences social proximity for some groups of dairy calves. Burke et al. UF

- Holstein calves (n=87) were paired at birth, then moved to group housing at 16 d of age: 9 groups, 10 calves/pen (5 former pairs).
- Using real-time location tracking system, social network matrices were constructed from pair-wise interactions w/in 1 min over 4-d periods for 6 wks. Calf dyads from previous pairs denoted as "1" and non-paired dyads denoted as "0"
- Prior-pair assignment a significant predictor of proximity networks in 3 of 9 groups ($R^2=0.12$ to 0.42, $P<0.01$) but not significant in 6 of 9 groups ($R^2=0.01$ to 0.06, $P<0.10$).
- **Take-home**: Prior familiarity from pair housing can contribute to group-housed proximity interactions, but the social network structure varies greatly.

2050. Associations between health status and social network centrality in group-housed dairy calves. Gingerich et al. UF

- Holstein calves (n=90) were group housed in AMF at 2 wks of age (9 groups, 10 calves/pen). Health scores recorded 2x/wk and lung ultrasounds 1x/wk for BRD detection. Calves fed 8 L CMR/d, 10 d stepdown weaning at 47 d.
- Using real-time location tracking system, social network matrices were constructed from pair-wise interactions w/in 1 min over 4-d periods per wk. Tested effect of health status (clinical BRD, lung consolidation, diarrhea) on social network centrality measures.
- Pre-weaning BRD status (3, 5 wks; 15-24% clinical, 18-30% lung cons.): calves w/ clinical BRD or lung consolidation had lower strength and higher closeness, NSD eigenvector centrality.
- Weaning BRD status (6, 7 wks; 26-30% clinical, 26-35% lung cons.): ↓ eigenvector centrality for calves w/ lung consolidation (P = 0.05).
- **Take-home**: Changes in social behavior under BRD depend on stage of development.

1648.Long-term effects of preweaning social housing on heifer performance and reproductive development. Lindner et al. UF

- Heifers individually housed (IH, n=55), paired (PH, n=55 w/ 1 focal heifer/pair), or grouped (GH, n=53, 10 groups w/focal heifers selected) from 0 to 9 wks.
- From 6 to 12 mo of age collected BW and hip height weekly; monitored for behavioral estrus weekly (confirmed by ultrasound for CL). Calving outcomes reported.
- NSD for trts for BW or age at estrus expression (P>0.23), but GH ↓ stature vs. PH and IH (122 vs. 124-125 cm, P<0.001).
- Preliminary (n=34-50/trt) data on calving outcomes: NSD age at calving (P=0.36), but PH tended ↑ BW at calving (657 vs. 632-636 kg, P=0.06, no info on % mature BW).
- **Take-home**: Pre-weaned housing may have long-term implications on heifer growth with less of an impact on reproductive performance.

2057.Effects of preweaning social housing on behavior of pregnant dairy heifers experiencing a housing change. Clein et al. UF

- Heifers individually housed (IH, n=20) or paired (PH, n= 20 w/ 1 focal heifer/pair) pre-weaning, then mingled. Heifers moved to freestall 3 wks before expected calving, observed via 24-hr camera for stall use and feeding behavior.
- Heifers balanced by season (cool [Nov-Apr] vs. warm [May-Oct]), stocking density (SD; ≤75% [low], 75-100% [medium],≥100% [high]), and BW (covariate).
- Interaction effect (housing x SD): At high SD, IH heifers ↑ stall time (49 vs. 31 min/hr) and ↓ fdg time (4 vs. 9 min/hr, P<0.02) w/ fewer fdg visits/hr vs. PH.
- IH heifers ↑ likelihood of displacement from stall (85 vs. 44% of heifers) and less likely to enter a stall adjacent to an occupied stall (70 vs. 78% of visits, P<0.05).
- IH heifers ↓ walking time (2.3 vs. 1 min/hr, P=0.02) vs. PH, especially at pen intro.
- **Take-home**: Pre-weaned housing likely impacts a nulliparous heifer's ability to adapt to a novel environment, particularly under the competitive pressure of high SD.

1581. Behavioral and hair cortisol responses of heifers raised in barn or on pasture. Hall et al. USDA DFRC.

- Holsteins heifers (hfr, n=64, 4.8±0.5 mos) were housed in a barn and fed TMR (n=4 groups, 8 heifers/group) or rotationally fed on cool-season pasture w/ VTM grain (n=4 groups, 8 heifers/group) from May to August 2023. No info on heat abatement.
- Hair cortisol assessed pre-trt and 6 and 14 wks after. Behavior observed 2x (every 10 min for 12 hrs) at ~ 4 and 8 wks, reported as min or incidents per heifer.
- Eating/grazing time ↑ pasture vs. barn (403 vs. 243 min/heifer). Vocalizations ↑ pasture vs. barn (0.96 vs. 0.15 times/heifer). Hair cortisol ↑ pasture vs. barn (18 vs. 5 pg/mg hair; all P<0.001).
- Barn heifers ↑ drinking, grooming, and stereotypy incidents vs. pasture (P<0.03).
- Pasture heifers tended to ↑ standing (491 vs. 468 min/heifer) and ↓ lying (229 vs. 252 min/heifer) vs. barn heifers (P<0.08).
- **Take-home**: Hair cortisol and time budget data suggest heifers housed in a barn are less stressed compared to pastured heifers.

Environment (9 abstracts)

1225. Impact of heat stress abatement on growing cattle's response to respiratory disease. Savegnago et al. UGA

- Calves (n=17/trt, 21 d of age) were provided heat abatement (CL, fans) or not (HT) then inoculated with *Mannheimia haemolytica* to induce BRD.
- Calves were fed CMR 2x/d, starter ad lib. Health scores and thermoregulatory response measured daily, BW weekly; plasma collected before and after inoculation; lung lesions scored after euthanasia.
- Calves under CL ↓ respiration rate, rectal temp, and fecal scores, ↑ starter intake (P≤0.09), NSD on BW.
- Calves under CL ↓ nasal scores and lung lesions, ↑ lymphocytes after BRD (P<0.05)
- **Take-home**: Under BRD challenge, providing heat abatement does not alter immune factors but reduces clinical outcomes of BRD.

2698. Impact of heat stress abatement on humoral immunity in preweaned calves prior to and following bovine respiratory disease. Savegnago et al. UGA

- Calves (n=8/trt, 21 d of age) were provided heat abatement (CL, shade+fans) or not (NC) then inoculated with *Mannheimia haemolytica* at 22 d of experiment (DOE) to induce BRD.
- Calves vaccinated against BRD at -14 and 7 DOE. Serum collected before and after to measure viral antibody titres. Also collected before and after inoculation to measure BRIX and D2DX (humoral immunity test) scores. Higher score = greater immunity.
- Before inoculation, NSD for BRIX but D2DX tended ↑ in CL vs. NC (P=10). After inoculation, CL calves ↑ BRIX and ↓ D2DX scores vs. NC (P<0.03).
- CL calves ↑ BVD1b antibody at 7 DOE, NSD for trt on other antibodies.
- **Take-home**: Heat abatement maintains greater humoral immunity and following BRD challenge elicits a stronger humoral response.

2232. Seasonal effect on growth of dairy calves in the southeastern United States. Roper et al. UGA

- Calf performance was compared between summer (Jun-Aug, n=48) and winter (Nov-Jan) in the Southeast to determine seasonal impacts on growth.
- Calves managed similarly – individual hutch housing and sand bedding, 26:17 CMR (vol not stated), ad lib starter, 1x step-down weaning 43 to 49 d, moved at 63 d.
- Ambient temp (AT) and relative humidity (RH) recorded hourly, coefficient of variation (CV) of hourly or daily AT used to determine w/in-day and day-to-day AT variation.
- Summer ↑ AT (27 vs. 13°C) but not RH, lead to ↑ respiration rate and rectal temp (P<0.01) vs. winter calves.
- NSD on pre-weaning starter intake, but summer ↑ starter intake at 9 wks vs. winter leading to ↑ 9 wk-ADG (P<0.01, NSD on BW)
- Pre-wean ADG weak negative correlation with w/in day AT variation during winter (R^2 = 0.11) and day-to-day AT variation in summer (R^2 = 0.06, P<0.01).
- **Take-home**: For Southeastern US weather, summer might promote better calf performance vs. winter, but variation in both seasons inhibits ADG.

2229. Effects of thermal range on animal physiology, intake, nutrient digestibility, and performance of dairy calves. Gomes al. U Federal de Minas Gerais

- Calves (n=17/trt) enrolled in climate chambers w/ controlled temp and humidity, set to control (CON, temperature humidity index [THI] = 66 for 24 hrs) or thermal range (TR, THI = 84 for 9 hrs, THI = 66 for 6 hrs, THI = 54 for 9 hrs) from 1 to 28 d of age.
- No info on diet. Thermoregulation and health recorded daily, weight recorded weekly, rumen parameters biweekly, and digestibility trials at 9-12 and 23-26 d of age.
- AT THI=84, TR calves ↑ respiration rate by 82% and rectal temp by 0.49 °C (P<0.05).
- NSD of trt on feed intake, nutrient intake, 28-d weight, ADG, or stature measures (P>0.10), but water intake ↑ 32% in TR group vs. CON (P<0.01).
- NSD rumen and digestibility parameters except ↑ C2:C3, ↓ fat digestibility at 9-12 d, and ↑ fecal N at 23-26 d in TR calves
- **Take-home**: Thermal fluctuation modifies calf thermoregulation without greatly impacting performance parameters, but digestibility parameters are of interest.

2412. Effects of heat stress on animal physiology, intake, nutrient digestibility, and performance of dairy calves. Neves al. U Federal de Minas Gerais

- Calves (n=17-18/trt) enrolled in climate chambers w/ controlled temp and humidity, set to control (CON, THI = 66 for 24 hrs) or heat stress (HS, THI=82 for 9 hrs, THI = 66 for 15 hrs) from 1 to 28 d of age. Same measures as above abstract.
- HS calves ↑ respiration rate and rectal temp, ↓ nutrient intake, ↑ water intake (P<0.01) vs. CON. NSD in BW, ADG, or blood parameters.
- Due to intake diff, HS ↓ rumen ammonia, acetate, and propionate, ↓ digestibility of DM, fat, and gross energy, and ↑ urinary N (P< 0.05).
- **Take-home**: Early pre-weaning heat stress impacts calf thermoregulation and metabolism, though more information on diet is needed.

2695. Rectal temperature is positively correlated with body surface temperature using infrared thermography in Holstein dairy calves. Silva al. Embrapa Gado de Leite

- Calves exposed to control (CTRL, THI = 66, n = 17) or heat stress (HS THI = 82 for 9 hrs, n=18) for 28 d. Assuming same trt group and methods as above abstract.
- Diet: 6 L milk 2x/d, ad lib 19% CP starter. Rectal temp and surface (eye, flank, and perineal) temp measured at 0600, 1000, 1400, and 1600 h.
- Rectal temp and surface temp ↑ under HS vs. CTRL (RT: 39.1 vs. 38.7 °C, P<0.05) except for 0600 h surface temp.
- Positive correlation between rectal and surface temp (r = 0.42-0.52, P<0.01).
- **Take-home**: Due to increase under HS and positive correlation to rectal temp, authors suggest surface temp could be used as a non-invasive measure.

1177. Evaluating the use of infrared thermal imaging of the eye as a non-invasive, rapid diagnostic tool to assess body temperature in calves. Glassman et al. UGA

- Calves (n=12) enrolled at 4 d of age and assessed weekly for 5 wks, whereby infrared eye and rectal temp were collected in a shaded barn to assess relationship.
- The left eye warm and cool point infrared temps were related to rectal temp (P<0.05, R^2 not given), but NSD for right eye (authors suggest difference in lighting).
- NSD of ambient environment but older calves ↓ rectal temp (P<0.05).
- **Take-home**: More work is needed to establish infrared thermography as a proxy for core body temperature.

1247. Micro-cooling interventions improved the resilience to heat stress of Italian Holstein heifers. Meli al. U of Milan.

- Heifers (n=12/trt, 14 mo old) assigned to 3 trt: water-cooled mattress and micro-cooling system at feeders and waterers (F), no coolers/fed 2x (N), and no cooler/fed 1x (C).
- Temp, humidity, and THI recorded. Thermoregulatory measures (rectal, skin temp, respiration rate) recorded 2x/d. Feed, DM, and water intake daily. BW, ADG, and feed conversion ratio (FCR) weekly.
- F heifers ↓ thermoregulatory measures (P<0.05) when THI>75, ↑ DMI, and ↑ ADG at wk 3 (0.76 vs. -0.66 vs. -0.43 kg/d, P<0.05) but NSD water intake, BW, or FCR.
- **Take-home**: Micro-cooling improved heifer thermoregulation and some productive measures.

2055. *Effects of pair-housing and season on dairy calf health and growth.* Bonney-King et al. UF **see Management → Housing.**

Growth (8 abstracts)

2673. Investigating effect of Holstein heifer growth pattern on first-lactation performance based on cluster analysis. Jiang et al. Xinjiang Ag U

- Dataset from 2,841 Holstein cows incl. calf and heifer performance metrics to predict 1st lact performance: BBW, wean wt, 6-mo wt, 12-mo wt, age at first breeding (AFB), age at first calving (AFC), ADG1 (birth-wean), ADG2 (wean-6mo), ADG3 (6-12 mo), disease days, and disease frequency.

- Key prediction factors: total disease d pre-weaning, disease freq pre-calving, wean wt, and ADG1.
- Best-performing heifer growth model → avg wean wt = 103 kg, ADG1 = 1.11 kg/d, ADG3 = 0.63-0.71 kg/d. Recommended AFB = 13.4-13.5 mo, AFC 22.9-23.8 mo.
- **Take-home**: Numerous pre-weaning factors shown to have good predictive capacity for first lactation performance in the dataset herein.

2717. Effects of pre-weaned calves' daily gain and feed intake on first-lactation performance: A meta-analysis. Jiang et al. Xinjiang Ag U

- Meta-analysis conducted from 13 studies to determine impact of pre-weaning ADG and feed intake on first-lactation milk yield and composition.
- Response variables: 1st lact 305-d milk yield, fat yield, and protein yield. Explanatory variables: ADG, liquid feed DMI (LDMI), and starter dry matter intake (SDMI).
- Significant correlation between milk yield and ADG ($P<0.01$, R^2 not stated) w/ highest milk yield when ADG = 0.65 kg/d.
- Multiple regression indicates 1st lactation performance impacted by ADG, DLMI, and SDMI; ADG accounts for ~15% of milk and fat yield variance; LDMI for 22-25% and SDMI for 60-77% of milk, fat, and protein yield.
- **Take-home**: Promoting solid milk and starter intake, thus influencing ADG, can impact 1st lactation milk and component yield.

2430. Influence of ADG in pregnant heifers on subsequent milk production and composition. Oliveira Neto, et al. U Federal de Viçosa, Minas Gerais, Brazil; WSU

- Holstein (5/8's) x Gyr cross heifers (n=20), 70 d gestation, housed in tie-stalls were assigned to a.) fed for moderate ADG (0.81 lbs./d) or b.) a high ADG (1.59 lbs./d).
- Post-calving, all heifers were on the same diet, milked 3x/d and weekly milk yield recorded. Monthly milk composition assessments were also conducted.
- NSD between trt on 305-d milk yield or fat corrected milk ($P>0.49$). Heifers on moderate ADG diet pre-calving noted ↑ ($P<0.05$) % fat in milk, but NSD in % protein ($P=0.43$). Total solids tended ($P=0.07$) ↑ in moderate ADG heifers.
- The high ADG group tended ↑ MUN ($P=0.06$), but NSD ($P>0.10$) in lactational globulin, albumin, total proteins, glucose, thyroxine, or IGF-1. Triiodothyronine ↑ ($P<0.01$) in high ADG heifers at 4 & 9 mo.
- **Take-home** – Moderate ADG (0.81 lbs./d) during gestation (vs. high ADG, 1.59 lbs./d) noted increased % fat in milk, but no difference in milk yield.

2425. Effects of moderate or high ADG in pregnant Holstein x Gyr heifers on diet digestibility and microbial nitrogen synthesis. Oliveira Neto et al., U Fed de Viçosa, Brazil. Wash St. U.

- Same experimental design as above (abstract 2430)
- BCS, BW, feed intake and diet digestibility measured every 30 d.
- BW at 270 d gestation ↑ (1,329 vs. 1,198 lbs.; $P=0.02$) in high ADG heifers. NSD for BCS at 70 d ($P=0.67$) but parturition BCS ↑ (3.7 vs. 3.23; $P<0.01$) in high ADG heifers. NSD in nutrient digestibility, but nitrogen of microbial origin at 4 and 5 mo gestation was ↑ in moderate ADG heifers. NSD in efficiency of microbial N-synthesis ($P=0.32$).

- **Take-home**- No effect on nutrient digestibility or efficiency of N-synthesis when comparing moderate and high ADG in heifers during gestation.

2675. Development of body weight estimation equations using LiDAR scanning and machine learning in growing dairy cattle. Kato et al. Hiroshima U

- Holstein heifers (n=691) were LiDAR scanned from left and upper body to measure: chest girth, withers height, hip height, body length, horizontal body length (HBL), chest depth, and hip width. Measures used to predict BW.
- 3 stages of heifer growth: calf (<18% MBW), pre-conception heifer (18-55% MBW), and pregnant heifer (>55% MBW).
- Best models to predict BW: calf = all measures (R^2 = 0.96, RMSE = 4.9 kg), pre-conception = all except chest depth and hip width (R^2 = 0.98, RMSE = 10.2 kg), pregnant heifer = chest girth, body length, and HBL (R^2 = 0.99, RMSE = 5.1 kg)
- **Take-home**: Skeletal growth occurs primarily in initial growth phase w/ rates and "importance" of width, height and length measures diminishing with age.

1149. Joint ARPAS and ADSA Growth and Dvlpmt Symposium: Exploring symbolic regression for body weight prediction in dairy calves. Casella et al. UW-Madison

- Holstein calves (n=67) were weighed and pictured from 2 to 8 weeks of age to evaluate the use of symbolic regression (i.e., a machine learning approach using genetic algorithms to find analytical equations) versus gradient boosting trees to predict BW.
- From 400 3D dorsal images, 27 biometric features were extracted (i.e., area, volume, length, 11 heights and widths along dorsal area, eccentricity, and extent).
- SR had better predictive performance vs. GBT: root mean square error of prediction = 6.0 vs. 7.7 kg, mean absolute error = 4.9 vs. 5.8 kg, R^2 = 0.67 vs. 0.59, concordance correlation efficient = 0.86 vs. 0.78.
- High ranked equations included: BW = a + b x Volume; BW = SqRt(Area) + Width6; BW = $(\text{Width5} + c)^d$ (where a=31.53, b=0.22, c=12.14, d=1.16).
- **Take-home**: With low input, SR showed potential to predict BW with simple equations that generalize well.

2676. CalfSim Tool: A free and user-friendly tool for tailoring calf nutritional strategies and growth. Da Silva and Costa, U of Vt

- Developed a tool to simulate calf performance under diff nutritional planes based on NASEM starter intake and nutrient reqmt guidelines.
- How it works: Enter calf BBW, weaning age, avg temp (ambient?), starter composition, milk or CMR composition, and diff feeding curves.
- After running model, analyze outcomes based on desired KPI (i.e., final BW, ADG, age at target starter intake)
- **Take-home**: The CalfSim Tool can aid farmers and consultants in optimizing nutrition plans based on KPIs.

1198. Dairy calf health and growth monitoring through camera phenotyping techniques. Liao et al. Virginia Tech. **see Health → Disease prediction**

Management surveys (5 abstracts)

1571. *What does quality assurance look like at the international level? A review of animal care standards for dairy calves.* Saraceni et al. ACER Consulting

- Interviewed 10 quality assurance programs from 8 nations (Canada, US, France, UK, Ireland, Denmark, Austria, the Netherlands) to investigate differences in calf health and welfare standards
- *Management*: 60% mandate group-housing (at least weaning age), 90% require pain management for disbudding, transport based on regulations
- *Nutrition*: Most set colostrum at 10% BW, focus on 8L+ milk plane (variation in min.)
- *Specific groups:* 40% w/standards for surplus calves, no standards for cow-calf contact but "monitoring this topic closely"
- **Take-home**: QA programs using research to guide decisions, trends towards group-housing, pain management for procedures, and higher planes of nutrition for calves.

1572. *Producer perceptions of dairy calf management, behavior, and welfare.* Doyle et al. UF

- Surveyed n=93 dairy producers on perceived relationship between calf management practices on behavior, welfare, and performance (i.e. growth and health).
- Social housing and social play viewed positively for calf comfort (not performance; $P < 0.01$), esp. if using social housing (56% of respondents). Positive association between greater interaction with calves on perceived benefit of human contact.
- ↑ milk (>7.6 L/d) viewed positively for comfort and performance for those feeding elevated planes ($P < 0.04$). Abnormal oral behaviors viewed negatively, mixed thoughts on solutions.
- **Take-home**: Social housing and ↑ plane of nutrition are valued by dairy producers, especially if they are implementing the practices.

2479. *Calf-rearing practices in pasture-based and organic dairy farms in the Midwest United States.* Gonçalves da Costa et al. U of Mn

- Surveyed n=13 pasture-based dairy farmers (8 organic [1 not yet certified], 4 organic + grass-fed, 1 pasture-based [non-certified]) using in-person interviews.
- Median herd size = 76 cows (34-321 cows).
- 67% separated cows and calves 1 to 48 hrs after birth w/ other 33% offering > 3 d full or partial cow-calf contact. Group-housing (75%) predominant (outside or in combination with cow-calf contact).
- Milk allowance = 2.4 to 16 L milk/d (66% offering ≤ 6 L), variety of feeding methods but 92% used step-down weaning.
- 82% report BRD as most challenging disease, vaccination used on 33% of farms.
- **Take-home**: Pastured and organic dairies manage calves in a wide variety of practices.

2480. *A survey of preweaned calf transportation practices on US dairies: Colostrum management and age at transport for replacement heifers, beef-dairy crossbreds, and dairy bull calves.* Machuca et al. CSU

- Nationally surveyed n=72 dairy farms (80-1,000+cows/farm) transporting 285k dairy replacement heifers (RH), 263k BxD crosses (BD), and 33k dairy bull calves (BUL).
- 58%, 82%, and 81% of farms reported transporting RH, BD, and/or BUL.

- 100% reported providing colostrum, mostly w/in 2 hrs (86% RH, 80% BD, 76% BUL) but fewer (68, 50, and 44%) fed based on BRIX quality (≥ 22%).
- Calves most frequently transported 4 to 7 d (24, 29, and 35%), followed by < 24 hrs.
- **Take-home**: Survey highlights need for transportation stress mitigation strategies in young calves, thought most farms are at least providing colostrum before transport.

2200. Perceived producer barriers to the implementation of best management practices for the control of Salmonella Dublin. Brunt et al., U of Guelph, U of PEI

- Dairy farmers (n=28, n=5 focus groups) analyzed 4 themes related to *S. Dublin* – 1.) info preparedness, 2.) structural factors that influence disease mitigation, 3.) motivational drivers of disease mitigation, and 4.) shifts in biosecurity engagement.
- Participants largely aware of the pathogen, not concerned about their farm becoming infected, and stated they were not prepared to handle an outbreak.
- Participants discussed how regulatory orgs, gov't and academia could improve surveillance and dispense best practices.
- Motivational barriers include perceptions about daily biosecurity priorities and perceived low-risk, Intrinsic barriers like money and labor to implement. Producers who had experienced an outbreak shifted from these perspectives.
- **Take-home** – until perceived risk increases, motivation to overcome barriers to adopt best practices will likely remain low.

Weaning (4 abstracts)

1152. The weaning transition in dairy calves: Why so traumatic? J.K. Drackley. U of Ill.

- Stressors such as "nutritional inadequacy, along w/ environmental and social stresses" make the weaning transition difficult in dairy calves. Most post-wean growth is inadequate and BRD and coccidiosis are prevalent.
- Gut fill may contribute over 25% of measured BW gain, the GIT mass ↑ allometrically during the weaning transition, requiring much energy and AA.
- Starter intake pre-wean is key to success. Many transition protocols only cover maintenance requirements, and enhanced early milk intake (gaining popularity) aggravates this situation.
- When transitioning to TMR, use 1:3-4 TMR to starter grain ratio.
- **Take home** - Don't wean too early, wean gradually, feed high quality starter with good water management, do not stack stressors at weaning, and do not allow ad lib access to alfalfa forage.

2480. Evaluation of bovine colostrum replacer supplementation to improve weaning transition in dairy calves. Edwards et al. U Guelph

- During step-down weaning (57 to 64 d), calves fed 1x/d either CMR (CON, n=31, 3.8 L at 150 g/L) or a colostrum replacer (CR) supplement (COL, n=34, 1 L CR + 3 L CMR).
- From 1 to 56 d, calves housed individually and fed up to 12 L/d CMR (150 g/L). BW collected at 0, 57, 60, 64, 70, 77, and 84 d. Starter intake and respiratory scores daily from 56 to 70 d. Serum BHB and lung consolidation at 57, 64, and 70 d. Intestinal permeability markers at 56 and 65 d.

- COL heifers ↑ BW at 77 and 84 d vs. CON (+2.8 kg, P<0.01) and tended ↑ 77-84 d ADG (+0.1 kg/d, P=0.08). NSD for health, BHB, or permeability outcomes
- **Take-home**: Supplementing CR during weaning improves latent growth post-weaning w/ less impact on health or gut permeability.

2494. Effects of calf gut-originated probiotics and weaning pace on health measures, hematology, and productivity in Holstein dairy calves. Rasmussen et al. U of Idaho, Moscow; U of Alberta, Edmonton. **see Nutrition → Additives in CMR, whole milk, or starter grain.**

1242. Effect of calf starter, weaning, and butyrate supplementation on hindgut development in Holstein calves. Sayles et el., U of Alberta, Edmonton. U of Idaho. Adisseo. **see Nutrition → Additives in CMR, whole milk, or starter grain.**

Behavior and welfare (13 abstracts)

Transport (3 abstracts)

2054. The effect of meloxicam administration on the behavior of transported surplus dairy calves. Longer et al. U Guelph

- Surplus calves received either injection of meloxicam (n=78, 0.5 mg/kg BW SQ) or saline (n=82, CON) immediately after transport (3-10 d of age, ? feeding program).
- Leg loggers placed to monitor calf behavior from 1 to 12 d post-transport, 24 hrs/d.
- Calves receiving meloxicam ↓ lying time vs. CON (-0.3 hrs/d, P=0.01), NSD for other behaviors like transition bouts, steps, or motion index (i.e., total activity).
- **Take-home**: Authors conclude meloxicam may minimize fatigue, prompting more strength for standing post-transport (but could also be related to calf comfort).

1119. The effect of meloxicam administration on the health and growth of transported surplus dairy calves. Longer et al. U Guelph

- Same experimental design as above – meloxicam vs. saline injected.
- Upon arrival, blood collected at 0, 24, and 48 hrs for TPI, creatine kinase (CK), NEFA, and haptoglobin (Hp). Health scores daily for 13 d, BW at 0-6 and 14 d.
- NSD for CK, NEFA, Hp, BW, or ADG between trts.
- Meloxicam ↓ incidence of abnormal fecal scores in 14 d post transport (CI 1.08 to 7.83, P=0.04), especially for larger calves (P=0.03).
- **Take-home**: Meloxicam might influence diarrhea incidence but not greater health and growth parameters.

1118. Transport duration affects gastrointestinal permeability in preweaned calves. Goetz et al. U Guelph

- Calves (n=25; male/female and Holstein/BxD, dist. not specified) were continuously transported by road for 6, 12, or 16 hrs at 3 to 18 d of age (median = 11 d).
- Upon unloading, calves observed for clinical health and administered chromium-EDTA (Cr-EDTA) orally with blood draws at 0 and 2 hrs relative to administration.
- Calves transported for 16 hrs had ↑ serum Cr-EDTA vs. 6 hrs transport when assessed 2 hrs. post administration (P=0.004). NSD for 12 vs. 6 hrs transport (P=0.66).
- **Take-home**: Transporting calves for 16 hrs increases gut permeability.

Pain management (4 abstracts)

1573. Wound characteristics following hot-iron and 4 approaches to caustic paste disbudding in dairy calves. Drwencke et al. UC Davis

- Calves (n=24/trt) were disbudded using 1 of 5 methods: hot-iron, 0.2 or 0.3 mL paste on shaved or unshaved horn bud (plus non-disbudded CON) to compare wound characteristics. Age at disbudding not specified, nerve block and pain relief provided.
- All disbud trt ↑ mechanical nociceptive threshold (MNT, i.e., wound sensitivity) vs. CON up to 4 wks post-disbudding (P < 0.01), but NSD between trts (P>0.40).

- 0.3 mL paste ↑ wound size vs. 0.2 mL paste (22 vs. 19 mm, $P < 0.01$), shaved site ↑ vs. unshaved (22 vs. 19 mm, $P < 0.01$).
- Paste ↑ time to re-epithelialize vs. hot-iron (14-19 vs. 7 wks , $P < 0.01$).
- **Take-home**: Disbudding of any kind prompts wound sensitivity but pasting (esp. shaving and additional paste) increases wound size and healing time.

1574. Effects of a maternal bovine appeasing substance on heifer dairy calf stress response to disbudding. Spencer et al. TAMU

- Calves (n=25-30/trt) were disbudded 1 d after arrival to a calf ranch in 1 of 4 trts: disbudded CON; MBAS: maternal bovine appeasing substance – 5 mL on muzzle, 5 mL on behind poll 24-hr prior; AA: analgesic and anesthetic 10-min prior; AA-MBAS: both MBAS and AA at respective timepoints.
- Blood was collected 1 h before disbudding (covariate) and 4 h after, and tail hair was collected at arrival (covariate) and 14 d after to measure cortisol.
- NSD between trts for 4-hr blood cortisol or 14 d hair cortisol concentrations ($P>0.29$)
- **Take-home**: Different pain management for disbudding, including MBAS (i.e., FerAppease®), did not influence cortisol concentrations post-disbudding, but other metrics for pain and healing were not measured.

2051. The impact of a maternal bovine appeasing substance on productivity and treatment frequency in Holstein dairy calves after caustic paste disbudding. Hajny et al. TAMU

- Same experimental design as Abstract 1574 (above).
- BW at 0, 14, and 28 d, ADG calculated. Treatment frequency to 14 d recorded.
- MBAS ↑ 14-d ADG vs. other trts (1.14 lb/d vs. 0.9-1.0 lb/d CON, AA, AA-MBAS, $P=0.03$). NSD on treatment % (56-60% all trts, no stats reported in poster).
- **Take-home**: Using MBAS at disbudding improved early life ADG but didn't impact disease treatment.

1571. What does quality assurance look like at the international level? A review of animal care standards for dairy calves. Saraceni et al. **see Management → Surveys.**

Feeding behavior (4 abstracts)

1580. Development of abnormal oral behaviors in dairy cattle in the first 6 months of life. McDonald-Gilmartin et al. UC-Davis

- Holsteins (n=24) and Jerseys (n=6) monitored 1x every 2 wks to 24 wks for abnormal oral behaviors: tongue rolling (TR) and non-nutritive oral manipulation (NNOM). Data recorded in 5-min intervals and reported as % of observations.
- Observations categorized by feeding type: milk in bottle, milk in bucket, step down weaning (6-7 wks), TMR and starter, TMR only.
- TR (7%) and NNOM (48%) ↑ during step down weaning and bucket feeding (10%, 44%) compared to all other feeding types ($P<0.001$). NNOM lowest on TMR only (23%)
- Jerseys ↑ NNOM and TR vs. Holsteins (27 vs. 20%, 39 vs. 31%, $P<0.05$)
- **Take-home**: Abnormal oral behaviors elevated before and around step-down weaning compared w/ later in life.

2053. *Investigating dairy calf behavior after being fed electrolytes.* Longer et al. U Guelph

- Healthy calves (n=69) fed either 2.7 L electrolyte (252 mOsm/L) or milk via bucket from 23 d of age, 2x/wk for 2 wks at the AM meal. Each calf received 2 milk and 2 electrolyte fdgs.
- Leg loggers placed to monitor calf behavior in 8 hrs between fdgs.
- Electrolyte-fed calves ↓ steps (89 vs. 66 steps), ↓ motion index, ↑ lying time (390 vs. 370 min, P<0.01 all) vs. milk-fed calves.
- **Take-home**: Authors interpret that electrolyte-fed calves may be more fatigued and less active in between feedings. Consistent milk meals are recommended.

2194. *Descriptive characteristics of suckle physiology, milk intake, and health in neonatal dairy calves.* Seely et al. Cornell University

- Holstein heifer calves (n=50) from one commercial New York dairy were enrolled from 1 to 21 d of age. Calves were backgrounded from 1 to 5 d in groups of 5, then enrolled in AMF with n=20 calves/pen and fed 11 L/d whole milk.
- Suckle pressure measured at 1, 3, 5, 7, 10, 14, and 21 d (15-sec suckle on a nipple wrapped in impression film). intakes recorded 5 to 21 d, health scores 1 to 21 d.
- Impression image density, saturation, and entropy across sampling d were 0.4 ± 0.1, 65.4 ± 27.8%, and 346 ± 124 bits, respectively. Metrics ↑ at 3 d vs. 21 d (P<0.01).
- Milk intake ↑ from 5 d to 21 d (3 vs. 7 kg/d, P<0.01). Diarrhea (9 to 13 d) and BRD (10 to 21 d) lead to consistent patterns in suckle pressure (general trend of ↓ saturation, density, and entropy, not quantified yet).
- **Take-home**: Quantifiable suckle physiology could help with early disease detection. Authors hope this research will help inform novel suckle sensor design.

2195. *Detection of neonatal calf diarrhea using suckle pressure.* Xu et al. Cornell University

- Same experimental design as 2194 (above), investigation into diarrhea detection.
- Suckle pressures measured daily after diarrhea diagnosis (watery feces that sift through bedding); n=349 images from n=54 diarrheic calves.
- Machine learning models to determine if images could accurately detect a diarrheic vs. non-diarrheic calf. The Easy Ensemble (EE) model had the best performance (87% accuracy, 90% precision, recall = 87%).
- **Take-home**: Machine learning techniques on quantified suckle pressure provides a novel, accurate method for diarrhea detection in pre-weaned, nipple-fed dairy calves

Cow-calf contact (2 abstracts)

1579. *Dairy calves weaned and separated after either 4 or 6 months of full cow-calf contact show signs of stress.* Wegner et al. Swedish University of Agricultural Sciences

- Dam-calf pairs (n=16 Swedish Red, n=9 Swedish Holstein) were housed together in a freestall with 24-hr cow-calf contact and automatic milking for 4 or 6 mo. (n/trt = ?).
- Calves weaned via fenceline separation. Spacial proximity (i.e., ≤ 4m indoors or ≤ 8 m outdoors) assessed 3 d pre-weaning. Calf activity monitors 6 d pre-weaning to 11 d post (leg loggers).

- NSD special proximity on step counts. NSD in trt step count, but post-weaning ↑ from ~2,500 to 10,800 steps/d w/lying time ↓ from 15 to 8 hr/d. Trt x time interaction for lying time where 4-mo calves ↓ early post-weaning (P <0.001).
- **Take-home**: Weaning in a cow-calf contact system greatly influences calf lying and walking behavior, and a younger age at weaning slightly heightened the response.

2767. Hiding behavior of dairy calves kept with their dams for the first week of life. Roussac et al. Swedish University of Prince Edward Island

- Calves (n=7, n=3 female/4 male, n=3 Holstein/4 Hol x Ang) were kept with their dams from d 0 to 7 and a hiding area made of 3 panels was offered (107 x 76 cm each).
- Behavior data (bouts and duration in/near area) collected continuously from 1-5 d.
- The poster demonstrates immense variability w/in the n=7 calves.
- Descriptive statistics: Calves hid inside area for 319 ± 249 min in 11 ± 6 bouts. Calves spent 240 ± 177 min near the area across 28 ± 7 bouts.
- **Take-home**: Calves used the hide structure with great variation, but this exploratory research can help inform the design of dam-calf pens for calf comfort and choice.

Beef x dairy/veal (10 abstracts)

Beef x dairy (10 abstracts)

1127. Joint CSAS/ADSA B & G Symposium: Beefing Up Dairy - Nutritional Management of crossbred calves: Can they be a sustainable source of beef? Steele, et al., U of Guelph.

- Dairy beef and cow/calf beef are reared dramatically differently: dairy beef separated from dam at birth, fed restricted levels of CMR and weaned before 2 mo age, while native beef reared with dam, fed ad lib milk and weaned after 6 mo age.
- Crossbred calves offer opportunities for management interventions to improve health, productivity, and carcass quality, such as prenatal diet manipulation to program calves and macro- and micronutrients of milk and grain to alter outcomes in the finisher period. Remember: Phenotype = environment and genotype.
- Some ideas discussed: explore root causes of liver abscesses, practice of underfeeding milk or colostrum, too high starch too early; the beef industry focuses on the feedlot and not enough early-on.
  - Liver abscesses cost $60/hd, $1 B globally and $60 M in the USA w/ 50% of incidence beef x dairy (further stats: 23% incidence in native cattle and 39% in straight dairy breed calves).
  - Transportation stress, incl. age at transport. Perhaps a big impact later in life.
  - Feeding not just adequate colostrum d 1 but also colostrum the first days of life, which is biologically normal in cow/calf environment.
  - Underfeeding milk → study of low (500 g/d) vs. high milk (1000 g/d): high milk feeding results in ↑ carcass fat at 12 wks age. LOL research showed ↑ choice grade when feeding more milk. When underfeeding fat, you're over feeding lactose and ash. Early and abrupt weaning is also a stressor that likely has long-term effects. Adding extra vitamin A in prepartum diets manipulates marbling in offspring.
- **Take-home**: Dairy beef rearing is dramatically different than rearing native calves, and it is an excellent opportunity for interventions that may improve productivity and carcass merit.

1128. Joint CSAS/ADSA B & G Symposium: Beefing Up Dairy - Insemination trends and the rise in beef and sexed sire semen in N. America. Fleming, et al. Lactanet Canada, Guelph. U of Guelph.

- In Canada, Holstein sexed semen represented ~18% of inseminations in 2023, up from 4% in 2016. Jerseys ↑ to 40% sexed semen in 2023. Both show steady ↑ since 2005. Sexed semen increases the likelihood of a heifer calf to 95% and speeds genetic improvements.
- Fewer pregnancies to yield a heifer leaves room for more beef male mating. 25% of Holstein cow inseminations in 2023 were from beef bulls; Angus was predominant, then Limousin. Jersey implementation similar. Prioritized traits are fertility and calving ease w/ minimal motivation to select for growth and carcass merit.
- Beef sire evaluations need to be expanded to provide dairy producers with info to ID optimal beef sire genetics to benefit dairy and beef industries.
- Lactanet Services has 150k insemination records (2023?) and 40 M since 2000. Female fertility rate, sire semen fertility, conception data, predicted calving dates, and assist % could all be analyzed.

- **Take-home** – Beef on dairy has exploded in growth and is here to stay. But it needs genetic evaluation and management tools to improve the end product.

1129. *Joint CSAS/ADSA B & G Symposium: Beefing Up Dairy - Beef-on-dairy? Ireland has been doing that since flip phones were cool.* Berry, DP. Teagasc Fermoy, Co. Cork, Ireland.

- Why intensifying interest in beef x dairy in Ireland?
  - Improved repro performance of dairy females means fewer heifers needed.
  - Use of sexed semen, fewer dairy females needed to create replacements,
  - Dairy herd expansion curtailed or even retracted in regions
  - Exploitation of heterosis
  - Fill in gaps in milk price variability with a highly liquid asset (beef)
  - Exploiting greater economic opportunity with crossbred males vs. purebred,
  - Mitigating mounting consumer dislike of fate of male dairy calves,
  - Traditional fragmentation of Irish dairy farms favors retention of a dairy beef enterprise.
- The Irish Cattle Breeding Federation is a non-profit centralized database that enables storage of genetic evaluation across breeds and a "single source of truth" for all actors in the beef x dairy "pipeline."
- This structure gives access to a beef x dairy breeding index. Dairy farms access a sire advice mating tool suggesting matings between beef bulls and dairy females. The index creates a commercial beef value index predicting future profit per calf based on additive genetic merit. The speaker reported the mating should create a minimum 280 kg (617 lbs.) carcass. The index is made publicly available at the time of auction.
- **Take-home** – The beef x dairy cross calf is not new to Ireland. Their centralized database evaluating beef bulls for both calving performance and beef value warrant further evaluation.

1130. *Joint CSAS/ADSA B & G Symposium: Beefing Up Dairy - Beef-on-dairy, sexed semen, and IVF. A producer perspective.* M. Bowers. L'Alliance Boviteq, Canada.

- Advanced breeding strategies are pivotal, facilitating selection of desired traits and accelerating genetic progress within the herd.
- Sexed semen maximizes production of beef progeny from dairy dams. Producers can tailor breeding strategies to meet market demand and increase profitability. Sexed semen allows reducing the number of heifer calves and increase beef calves from the herd.
- **Take-home** – Sexed semen and in vitro-fertilization optimizes beef on dairy systems.

2674. *Evaluation of the NASEM (2021) energy requirement models by using dairy-beef crossbred calf data.* Klipp et al., ISU, Ames, IA.

- Objective: Evaluate the NASEM 2021 energy requirement models against the data from young dairy x beef crossbred calves.
- Male newborn Angus x Holstein calves (n=117) were fed 22:20 CMR (4.81 Mcal/kg of DM) until weaned at 56 d and either a.) high starch (26% starch, 20% protein, 7% fiber) or b.) low starch (13% starch, 20% protein, 11% fiber) calf starter until 9 wk.

- The grain ME content estimated w/ a “dairy-calf model accounting for the nutrient digestibility varying with age (Quigley et al., 2019).” Estimated ME content of high and low starch grain varied from 2.25 and 3.33, and 2.08 and 3.13 Mcal/kg of DM.
- Weekly BW and daily CMR and starter grain intake were monitored. Formulas for ME maintenance, gain, and impact from thermoregulation described in the abstract.
- **Take-home** – “Overall, NASEM (2021) models were associated w/ significant bias in describing ME requirements of Angus x Holstein bull calves. Reparameterizing the extant models to represent energy digestibility and ME efficiencies of dairy-beef crossbred calves may be required”

2670. Performance and beef grading of F1 Holstein cattle in northern Mexico fed in the preweaning stage with a high volume of milk at 14% solids. Carrillo-Moreno, et al., Universidad Autónoma Agraria Antonio Narro Torreón

- Holstein x beef cross (breed not identified) calves (n=80, n=40 male/female) fed 450 L/calf of either a.) whole milk at 11% solids, (109 lbs.) or b.) milk + CMR (Land O’Lakes Ultracare®, 22:15; milk, soy, bovine plasma protein) to achieve 14% solids (~139 lbs).
- Milk fed 0-60 d w/ Brix solids measured. For the 14% group, whole milk set at 80% target intake then CMR achieved 14% solids. No details of whole milk source or quality, starter grain, feeding curve, or presence of dietary forage/fiber.
- Calves fed 14% solids had ↑ final pre-weaned BW (+14.6 lbs; P<0.01) and ADG (2.2 vs. 1.9 lb/d, P<0.01) vs. calves fed 11% solids. NSD in weaned BW or ADG between males and females at 14% (221.8 vs. 216.6 lbs) or 11% solids (211.2 vs. 200.1 lbs).
- NSD between trt for age at sale (419 vs. 426 d, 14% and 11% solids) but final BW ↑ under 14% solids (1,179.5 vs. 1,153 lb, P<0.05). Carcass weight (685 vs. 661.2, P<0.01) and % grading choice (47.5 vs. 36.9%, P<0.05 ↑ in 14% vs. 11% solids.
- **Take-home** - calves fed 450 L of milk with 14% vs. 11% solids noted increased pre-wean ADG, increased 14 months sales weight (+2.3%), and increased carcass weight (+3.5) with +10.7% more grading choice.

2073. Factors associated with reduced growth of Angus x Holstein dairy calves. Ferdman et al. U of Guelph, U of Vt.

- Holstein x Angus cross calves (n=1,124) reared commercially in Ontario enrolled upon arrival between May and Nov 2023 and weighed at arrival and 7 wks to determine factors impacting growth: calf gender, number of treatments, season at enrollment, calf transporter, and farm of origin were extracted from farm records.
- Mean calf BW upon arrival and at 7-wks were 112.1 ±0.4 lbs. and 166.8 ±0.5 lbs., respectively, with a 1.34 ±0.38 lb/d ADG.
- Calves receiving 2, 3, or 4 disease treatments (-0.13, -0.24, and -0.40 lbs/d; P<0.001) were associated w/ ↓ ADG vs. calves receiving no treatments. Calf transporter was associated with ADG (P<0.001) indicating differences in management practices.
- Male calves tended ↑ ADG vs. female (+0.04 lb/d.; P=0.07) and summer arrivals ↓ ADG vs. fall arrivals (-0.11 lbs./d; P<0.05). Calves w/ heavier arrival BW (>132.6 lbs.) tended ↓ ADG vs. those with arrival BW <94.8 lbs (-0.04 lbs.; P=0.08).
- **Take-home** – disease may have the greatest impact on ADG in crossbred dairy calves.

2201. Comparison of health and performance of Holstein and Holstein-Angus crossbred calves reared under the same conditions. Kovacs, et al. U of Guelph, Mapleview Agri.

- Records of 340 Holsteins and 40 crossbred calves commercially reared under the same conditions from arrival until 12 wks of age, monitored for health and growth.
- All calves were fed up to 8 L/d of CMR (13% solids). Water and grain offered ad lib and weekly grain intake monitored. STP and BW measured at arrival, then BW weekly. Fecal scores taken 2x/d for the first 15 d and respiratory scores taken daily.
- NSD for arrival BW (104.7 lbs.), but STP tended ↑ for Holsteins vs. crossbreds (5.44 vs. 5.27 g/dL, P=0.10). NSD between breeds for ADG (2.4 lbs./d).
- Holsteins ↑ d w/ respiratory score >5 (incidence ratio 2.44, 95% CI 1.73 to 3.42; P<0.01). "Specifically, Holsteins exhibited a high respiratory score (≥5) for an avg of 2.36 d, whereas crossbreds had an average of 0.98." NSD in d w/ diarrhea.
- **Take-home** – Holstein-Angus cross calves may experience a lower level of respiratory disease, otherwise, growth and health are like purebred Holsteins.

2032. Impact of breed and colostrum intake on IgG kinetics in Holstein and Holstein-Angus crossbred bulls. McCarthy et al. U Guelph **see Maternal-fetal → Colostrum**

2072. Impacts of BRD and lung consolidation at weaning on growth performance in beef x dairy calves. Fernandes et al. Penn State U. U of Guelph. UW-Madison. **see Health → Respiratory disease**