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Individual paper listed by abstract number in summary statements. **91 dairy-calf pertinent abstracts.** Dave Wood, Animix, 920-342-9039. Biowood10@gmail.com

Summary statements (each research paper in "two lines"), segregated by topic. More complete analysis, with statistics and details, later in this paper (also, a summation of several reviews that did not include original research):

Abbreviations: BW = Body weight; d = days; GIT = gastro-intestinal tract; g = gallon or g = gram, depending on obvious context; wk=week; m = minutes; cfu = colony forming units; fdg = feedings; NSD = no significant difference; MC=maternal colostrum. Assume water was always offered (didn't repeat it to save space) ad lib. If grain is mentioned assume ad lib feeding unless different protocol mentioned. Typically, I only mention differences (P<0.05 or better) and trends (P<0.10) and if something obvious like ADG is not mentioned, that means no statistical difference.

Alternative proteins in CMR (1 Abstract)

1. 90 lbs./calf (26:20) fed in 56 d of whey, 5%, or 10% pork plasma. NSD ADG, G:F, scours, meds, or resp. disease. ↓enteric/↑respiratory incidence. Animix/Mapleview. P350.

Additives in milk replacer, whole milk, or starter grain (15 abstracts):

1. Alltech TM + Biomos + DFM in both CMR and grain outperformed non-additive control only if hi-plane (70.4 lbs. CMR) nutrition (46 lbs CMR no effect). Hubbard, Waseca. P345.
2. Perdue probiotic added to colostrum and pasteurized milk on organic dairy noted NSD in diarrhea or recovery, NSD on ADG or culls/med treatments. Heat stressed. CSU. P149.
3. Nucelotides (Ribofeed, Italy) reduced in vitro measured inflammation and improved oxidative balance in blood samples from calves fed 5 g/d of 40% nucleotides. Italy. 263.
4. L-glutamine included in CMR at 1% tended to improve pre-wean G:F and post-wean ADG. Otherwise NSD in health or growth. Purdue. 262.
5. Echinacea (3g/d) fed in CMR for 56 d ↓inflammation as measured in blood markers like haptoglobin. A d 14 – 28 strategy was intermediary in results. Mapleview/Guelph. 174.
6. In meta-analysis of 30 yeast studies, live yeast ↑ADG & solids intake pre-wean but not post-wean while yeast extract ↑ADG & solids intake post- but not pre-wean. China. 175.
7. Effect of Lysophosphatidylcholine on calf neutrophils in vitro show ↑H_2O_2 production, maintains cellular viability, ↑inflammatory cytokines, ↑E coli killing. Cornell. 269.
8. Tributyrin in CMR: no effect on growth or grain intake. ↓scour frequency, ↓markers of oxidative stress, ↑villous length, ↓crypt depth, changed microbiota. China. 260.

9. Holstein calves fed 1 B cfu/d Lallemand boulardii yeast in CMR noted trend to ↑BW and ↑grain intake. Half of calves were stressed via delayed milk fdg. S. Africa. 258.
10. Weaned heifers (84 d age) fed monensin, sodium butyrate or both. Additives ↑DMI, tended ↑BW. Monensin ↑G:F vs. butyrate. Butyrate ↓cocci oocysts. U NH. P244.
11. Supplementing CMR (6L/d) w/2 g/d Kemin beta glucan did not affect fecal bacteriome in fecal samples from weeks 1, 2, 4, & 8. U of Sao Paulo, Brazil. Kemin. P344.
12. Fdg combo Celmanax (14 g/d) + B. subtilis (0.25 B cfu/d) prewean ↑adj. 305 d fat yield. NSD in MY, protein yield, odds of removal or % entering milking herd. UC Davis. SC142.
13. Fdg Smartcare in CMR & NutriTek in grain ↓lung pathology, ↓lung ultrasound score, ↑proinflammatory response, ↑fatty acid mobilization with BRD challenge. ISU. 107.
14. Meta-analysis of dairy calf studies on live yeast prewean: 9 studies fit selection criteria. NSD on milk or grain intake. Tendency to ↑ADG. ↑heterogeneity. UC Davis. P339.
15. Oregano extract (60 mg/kg BW) d 3 – 53 ↑diversity of rumen bacterial population, ↑abundance of several gram+ & ↑abundance of most gram-. U Fed RG, Brazil. P333.

Amino acid nutrition/supplementation (1 abstract)

1. Supplementing milk with either glutamine or glutamine + branched chain a.a. during gradual wean ↓post-wean BW and ↓post wean grain intake. ISU. P480.

Colostrum, colostrum replacers (CR), and feeding transition milk (9 abstracts):

1. Measure of IgG gut receptors (FcGRT) in s. intestine note IgG uptake 48 h post birth. Also, reported 25% of IgG is excreted in colostrum, 75% in transition milk. Cornell LB100.
2. A highly worthy review of post-gut closure feeding of either maternal colostrum, transition milk, or colostrum powder by Michael Steele U of Guelph. S132.
3. Colostrum replacer supplemented at 55g/L d 2 – 6 noted numeric (+7 lbs.) but NSD BW at 60 d wean, and numeric (+17.6 lbs.) but NSD adj. 365 d BW. n=60. Brazilian. P248.
4. Colostrum acidified with formic to pH 4.0-4.5 noted no effect on fecal microbiota at any week (measured to wk 8), except ↑Fecalibacterium bacteria wk 1. U of PA. 259.
5. 39 colostrum samples analyzed for bacterial load. Bacilli, Pseudomonas, and coagulase found in 61.5%, 33.3%, & 20.5% respectively. 15.3% >10,000 CFU/mL. U of GA. SC163.
6. In tropical stressful environs (SE Brazil) adequate colostrum status may not be enough to prevent morbidity and mortality. ↑PTA milk sire = poorer calf health. UC Davis. 182.
7. Jersey close-up dry period ↑ days dry+ ↑daylength = ↑colostrum volume; ↑daylength = ↓BRIX. Far off dry period ↑period length + ↑daylength = ↑BRIX. VA Tech. SC150.
8. IgG shows poor heritability (0.14) and high variability (st. error ±0.14). IgG correlates phenotypically with IgA (0.52, ±0.04). Analysis 672 samples/cows. Italy. 407.
9. Scoping review colostrum mngt found 264 qualifying trials. Wide variation of topics. IgG most common assessment measure. Quality compared to timing, quantity. Guelph. 181.

CMR and milk feeding rates and strategies (3 abstracts):

1. Calves fed 2.5 lbs./d noted ↑parenchymal development vs. 1 lbs./d (pair-fed on grain). Ultrasound is accurate measure of parenchymal tissue in pre-wean calf. UW Mad. P150.
2. 8 L/d vs. ad lib on autofeeder. Holsteins, Grazecross, ProCROSS, Limousin cross. +35 lbs. wean wt & ↑ADG ½ lb for ad lib. NSD health. Limousin ↑ G:F. U MN, Morris. 108.
3. Fdg waste milk, either pasteurized or not, did not affect gastrointestinal development to d 60 as compared to whole milk. Holstein/Gyr cross calves fed 6 L/d. U Fed, Brazil. P332.

Dry cow strategies and their impact on the calf (6 abstracts):

1. Supplementing rumen protected choline (12.9 g choline ion/d) for final 3 weeks of gestation had no effect on calf health or growth. Large field study. Balchem. U Fla. 173.
2. Cows fed hi starch diets pre-partum noted ↑colostrum insulin and ↓IgG. Hi starch pre and hi fiber post-natal ↑transition milk fat & protein yield. Guelph. 356.
3. Fdg. Zeolite prepartum for 14 – 21 d at 500g/cow/d resulted in ↑colostrum IgG concentration & helped maintain normal calcemia in the cow. Brazil. UW Mad. P260.
4. Heifer calves from heat stressed cows in FLA summer w/o soakers & fans saw ↓BW, ↓gest., ↓mammary dev. at birth & wean & ↓cell proliferation. U FLA & UW Mad. 429.
5. NSD in future milk yield from calves born of dams of differing parities or body condition score. Winter calves noted ↑growth & ↑future MY. U Fed, Parana/Castrolanda. P295.
6. Heifers and cows monitored 14 d pre-calving using pedometer: ↑lying time in heifers vs. cows, heifer vs. bull births, and w/more calving assistance vs. less. Penn St U. SC169.

Fats and oils nutrition (4 abstracts):

1. Med chain FA (caprylic and capric) ↑post-wean ADG, ↓NEFA prior wean, NSD in response to vaccine challenge, cytokine, or health measures. Purdue. 424 & 425.
2. ↑Med chain FA (caprylic & capric) NSD ADG. ↑MCFA =↑GH & IGF-1 & ↓IL-6. ↑wk 41 progesterone indicating % ovulating ↑from 19% to 61% in ↑MCFA. ZENRAKUREN. P268
3. Tributyrin ↑body weight during transition and post-wean. Added medium chain FA (caprylic and capric) ↑G:F d 23 – 49. BHB and GLP-2 NSD. ZEN-RAKU-REN. P348.
4. 24:22 (1.5 lbs./d) with fat composed of lard, tallow, lard/tallow blend, or palm oil blend, performed comparably. Trend ↑grain intake post-wean palm over lard. Waseca. P343.

Health, respiratory Disease (BRD), enteric disease, and immune function (5 abstracts):

1. *E coli* isolated from feces from calves fed whole milk with antibiotic residue were resistant to amoxycillin, ampicillin, ceftiofur, cefoperazone, enroflaxacin. Brazil. P331.
2. Calves tracked 10 – 13 d post BRD antibiotic treatment. Relapsed (re-treated for BRD) calves had ↑lying time, ↓steps, ↓activity, less change in grain intake. KY. Guelph. 179
3. Cross seasonal study on 8 farms showed Autofeeder data monitoring individual drinking behaviors is a useful tool to detect early scours, BRD, and naval infections. Guelph. 178.

4. Large Ontario survey (180 farms) found not crowding calving environment and keeping heifer environment clean both play key roles in ↓Johne's transmission. Guelph. 293.
5. An. Health Lab Guelph. AB screening of E coli & Salm cases from '07 to '20 noted stable or ↑incidence of resistance that occurred more in calves ≥2 wks vs. 1 wk. Guelph. 180.

Management and housing (38 abstracts) (key topics: housing, heat stress, behavior, transport, surveys of calf raisers, genetics, disbudding, and pain management):

1. A portable hutch with weigh platform on the floor that uses solar energy from its roof accurately (R^2 =0.92) measured starter intake and BW gain (0.71). U Sao Paulo. P336.
2. Multiparous cows gave ↑milk yield w/no change in preg rate if calf birth weight >90.4 lbs. Primiparous cows were opposite. Grazing cow records on 4,350. Ireland. P163.
3. Paired calves consumed more grain pre-wean and during weaning vs. individual housed. NSD in scours or in ADG pre- or post-wean to 2 months out on pasture. U of FLA. P111.
4. Group housed autofeeder fed calves show individual personality behaviors. Calves that avoid unfamiliar calves note ↑isolation, ↑lying, ↑milk intake. U of FLA. P112.
5. Merging 3 polyethylene hutches at d 7 on a dairy in CA resulted in the same 70 d BW and the same high incidence of BRD & scours as individual housed calves. UC Davis. 177.
6. Review of data on group housed vs. individual and data on keeping dam and calf together. U of MN, Morris. Brad Heins. S134.
7. Using auto-feeder to ID disease? ↓milk intake (5 – 7%) w/disease (BRD, scours, naval) had highest sensitivity (55 – 59%) to detect. Drinking speed next highest. U Guelph. 178
8. Transport ↓daily lying time and ↑lying bouts on the day of transport. Calves hauled for 12 & 16 h spent more time lying than 6 h for multiple days post-transport. Guelph. 172
9. Calf transport 16 h had ↑scours vs. 6 h transport. ↑age = ↓scours. NSD in BRD unless FPT, then longer transport ↑. More BRD in winter transport. U of Guelph. 186.
10. Survey of Ontario dairy operators reports male calves receive same colostrum, ↓milk as female, are sold by 14 d (82%), 46% go to calf raiser (34% auction). U of Guelph. 185.
11. Scoping review of young calf transport found 54 articles. Time & distance of travel were lead focus of studies. Papers were too diverse to compare findings. U of Guelph. P152.
12. Simmental x dairy ↑growth vs. Limousin. Limousin sire ↑ carcass wt & Ribeye. Lim x Angus sire ↑marbling. Analysis of 81,039 growth & 73,183 carcass data points. ISU. 298.
13. Survey of Ontario farmers. Colostrum fdg 3.6 L. Wk 1 fd 6.3 L of milk. 38% fd CMR; 37% fd saleable milk; 13% fd waste milk. Vet is primary calf care influencer. U of Guelph. 184.
14. Heavier calves at arrival to veal facility are healthier. Calves were tracked birth to arrival. ↑birthweight, ↑age = ↑arrival wt. Health & transport time no effect. Guelph. P151.
15. Computer model: max income over semen costs + adequate heifers from using sexed semen on 1st breeding 2nd lact cows & otherwise 100% beef semen. UW Mad. S150.
16. Calves from heat stressed dams (Fla) that were not cooled w/fans & soakers had ↓crypt depth (ilium; birth), ↑villi length (jejunum; 63 d) & ↓ colostrum A.E.A. U of Fla. SC143.
17. Calves from heat stressed dams (Fla) not cooled w/fans & soakers: ↓gest. length (3d), ↓birthweight (8.8 lbs.), ↓placenta wt, ↓cotyledon no. & surface area. U of Fla. 333.

18. Calves from late gest. heat stressed dams note poorer ability to mitigate heat (↑rectal & skin temp) due to ↓sweat glands, poorer heat mitigating hair coat. U of Fla. 334.
19. Using fans to cool preweaned calves in Florida summers ↑air flow, had minor impact on ↓ air temp and ↓ rectal temp. ↓hyperthermia. NSD on health or growth. U Fla. P245.
20. Heat stress (96F, RH 70%) ↑rectal temp & resp rate, ↓DMI, ADG & G:F, minimal rumen microbiome changes, negatively affected s. int. microbiome. VetAgro NSD. Cornell. 434.
21. Infrared temp measures on neck, rump, & forehead correlated to rectal & hutch temp but correlation very bad in cooler weather. Infrared deemed inaccurate. U of Ill. P120.
22. 1 naval dip of 7% Iodine tincture at birth had no effect on incidence of naval infection. Dirty calving pen ↑incidence. Variable incidence between farms. Guelph. P146.
23. Calves fed 15 L/d (vs. 6) healed from disbudding more quickly. A 2nd NSAID administered 3 d post hot iron disbud slowed healing, ↑activity. Limit fdg ↓calf activity. Guelph. 168.
24. White willow bark did not reduce inflammation from disbudding. Lo, med, and hi oral administration tested. Banamine did reduce inflammation. U of MN. Morris. 101.
25. Neuropathy with splayed forelimbs (JNS) afflicts est. 300 Jersey calves annually. Birth defect from common 1995 ancestor in 6% of the Jersey genetic pool. USDA/ARS. 199.
26. Post-wean video monitoring for 1st 78 h in wean pens did not reveal substantiative difference in behavior between individual and pair-housed calves. U of MN. 394.
27. Calves suckling cow ↑90 d wean BW & ADG vs auto-feeder fed or hutch housed calves fed 8 L/d. NSD at 120 d. Auto-fed ↑scours. Suckling calves dirtier. U MN Morris. 444.
28. Paired calves (2 hutches/sand 48 ft^2 apron) fed 3x/d video monitored for 1st 10 d. Over time ↑interaction time inside hutch. ↓active noon (heat; 83% time resting). CSU. P105.
29. Cow/calf contact: a.) allowed to suckle, b.) no suckle but adjacent pen, c.) removed at birth. Cow-calf contact didn't affect calf health; ADG ↑ if suckled. Wageningen. 421.
30. Genotypes of calf hair, dam hair and on-farm pooled colostrum analyzed. Genetics referred to in abstract beyond my scope. The Hebrew U, Israel. P158.
31. Survey of Ontario producers on disbudding reported all used cautery disbudding. 93% reported using Meloxicam, 86% use lidocaine. Pain control made job easier. Guelph. 167
32. Survey of IN and OH calf producers reported ↓ vol. and poorer quality colostrum given to bull calves. ↓vaccines. Particularly if destined to auction. OSU Columbus. 171.
33. Lit review of environmental enrichments. Calves prefer mechanical brushes over stationary ones. Calves groom around mealtime. Data on topic meager. VA Tech. SC159
34. RNA of rumen tissues noted 2,026 pre- & 2,074 post-wean long noncoding transcripts for rumen tissues, resp. 30 & 78 in pre-and post-wean tissues only, resp. Beltsville. P165
35. 59% of calves interact non-nutritive oral behavior w/humans. Calves that interact w/human more likely to lie down. NSD between paired and ind. housed. U of Fla. P110
36. Survey of 13 Ontario calf raisers note 12 use computerized records. Scours 13/13 alertness, 10/13 fecal score, 3/13 temp. Pneumonia, 10/13 temp. U of Guelph. 300
37. Telephone survey of UK producers on foster cow/calf vs. conventional. Anecdotes. Reads like an editorial in a newspaper. Harper Adams U Newport, Shropshire. 345

38. Survey of W. Canadian producers – key concerns: health, growth, behavior, ease, consistency, habits, facilities, environment & equip, wean success. U of BC. P306.

Physiology (particularly gut microbiome) 1 abstracts):

1. Dosing 25 g/d fecal donor material d 8 to 12 noted ↑(p=0.06) 35 d ADG, no incidence of diarrhea, and ↓ Enterobacteriaceae (associated w/scours) microbiome. SDSU. 176

Starter grain & forage feeding (6 abstracts):

1. Roasted beans ↓grain intake & ADG. Adding dextrose ↓ADG. Alltech additives (Bioplex, Sel-plex, Biomos, Ess oil) ↓scours but NSD on performance. Hubbard, Waseca. P342.
2. Calves fed whey-based pellet NSD in d 0 – 77 ADG or rumen dev. vs. grain-based starter, regardless of if fed 15 or 6 L/d CMR. Whey pellet ↑ prewean fd intake. Guelph. 423.
3. Texturized starter composed of hi or low levels steam-flaked corn with or w/o hi or low levels extruded corn. NSD in ADG, DMI, G:F, health across 4 treatments. Waseca. P340.
4. Calves fed barley straw pre- & post-wean noted ↑post-wean grain intake vs. those fed solely alfalfa hay pre- and post-wean, or mixture barley pre- and alfalfa post. IRTA. P347.
5. Supplementing 75 g/d of either alfalfa hay or oat hay starting d 30 ↑rumen function but NSD in ADG, G:F, or body dimensions thru post-wean. Nominal ↓scours. China. P349.
6. Holstein calves (on pasteurized milk) fed fresh-cow TMR pre-wean performed (health & growth) as well as calves fed starter grain (20%CP) or mix grain & silage. China. P353.

Weaning (2 abstracts)

1. 2 x 2 factorial: early (6 wks) or late (8 wks) & wean abruptly (3d) or gradual (14d). Late wean ↑ADG & grain intake, ↑rumen pH changes, & ↑respiration rate. U Alb. SC120.
2. ↑drink speed & ↑grain intake correlate with grain intake & ADG. ↑feeder visits ↓grain intake. ↑activity level NSD. Autofeeder data may predict wean success. U KY, Lex. P118.

More complete analysis of each ADSA 2021 research paper:

Alternative proteins in CMR (1 Abstract):

1. *15% or 30% of CP replaced as spray dried pork plasma?* Auction and/or calf broker derived Holstein bull calves were fed 26% CP, 20% fat CMR composed of either a.) all-milk (WPC) protein, b.) 5% pork plasma (15% of CP), or c.) 10% pork plasma (30% of CP) in a step-up (650g in 6L gradually increasing to peak 1,040 g in 8L wks 4 & 5) and step-down (780 g in 6 L wk 6, 520 g in 4 L wk 7 and 325 g in 2.5 L wk 8) fdg strategy (app. 90 lbs. of powder/calf). All diets were standardized using synthetic a.a. to 2.4% total lysine, 0.8% total methionine, and 1.6% threonine. No meds or additives were included in any CMR or mixed independently via the milk tank. NSD in serum total protein (STP; mean 5.73 g/dL; 14% FPT incidence). Ad lib 20% CP texturized starter grain was offered until wk 8 when transitioned to whole corn/pellet (18.1% CP) with 2% straw until study close at 77 d. Scour scores (0 – 3) and respiratory scores were monitored daily, and meds

recorded. Calves were individually weighed arrival and d 7, 14, 21, 28, 35, 42, 49, 56, and d 78. NSD in mortality (3.4% total). NSD in diarrhea incidence between groups, however, scour score 3 (watery feces) occurred for just 1.71, 2.1, and 2.4 d for whey-, 5% plasma-, and 10% plasma-fed calves, respectively. A very high incidence (65% were treated) of respiratory disease occurred with no differences noted between groups. NSD in CMR or grain intake. BW gain pre-wean averaged 93 lbs. and NSD between the groups. NSD in ADG or G:F at any measure. BW d 77 was greater (P=0.02) for control calves vs. calves fed formulas composed of 5% plasma (255.3 vs. 250 lbs., respectively). ADG d 1 – 77 was 1.92, 1.83, and 1.92 lbs./d for whey-, 5% plasma-, and 10% plasma-formulas, respectively. n=320. Mapleview Agri. Animix. APC. P350.

Additives in milk replacer, whole milk, or starter grain (15 abstracts):

1. *Effect of an Alltech blend of organic TM's, Biomos and DFM in both CMR and grain.* Holstein heifer calves were fed either a.) 20:20 CMR fed at 1.23 lbs./d (46 lbs./calf total), or b.) calves a 24:20 (actual measures 25.5 and 26.5% CP) fed in a step-up to 1.85 lbs./d then step down (1x/d commencing d 36) to wean d 49 (70.5 lbs./calf total) and either with or w/o Alltech additives (Bioplexes, Sel-Plex, Biomos, and DFM) in both the CMR and grain in a 2 x 2 factorial. Inorganic TM's were used in the non-Alltech additive formulas. Inclusion of Alltech additives and use of organic or inorganic TM's in the 22% CP texturized Deccox containing starter grain corresponded with the milk replacer. NSD in fecal score or incidence of scours. Med costs per calf were greater ($1.46; P≤0.05) for the calves fed high-plane of nutrition and with Alltech additives vs. all other groups (low-plane of nutrition groups were $0.41 and $0.42). D 1 – 56 ADG was greater (P<0.05; +11 lbs. in the growth period) for calves fed Alltech additives vs. inorganic TM's when fed 70.5 lbs. of CMR (ADG d 1 – 56, 1.56, 1.56, 1.54, and 1.74 lbs/d for low plane of nutrition w/o additives, low plane with Alltech additives, high plane w/o additives, and hi plane with additives, respectively. D 1- 56 calf starter intake increased (P<0.05) +14.2 lbs. in the hi plane nutrition group supplemented Alltech additives in both CMR and grain, as compared to those fed high plane nutrition w/o Alltech additives, and a G:F improvement corresponded (P<0.05) to starter intake. n=109, Hubbard Feeds & U of MN Waseca. P345.
2. *Effect of "Establish Calfbel" (Perdue AgriBusiness) probiotic on calf health and growth used on an organic certified dairy in Colorado.* Holstein heifer calves pair housed in hutches with sand bedding from July to Oct 2020 were fed either a.) no probiotic, or b.) 2 g of "formulation 1" in each colostrum feeding and 1 g "formulation 2" in the morning pasteurized whole milk meal 3x/week up to weaning (d 65). Further details of milk feeding strategy were not reported, nor was grain mentioned. Temperature/humidity index (THI) was monitored hourly during the duration of the study and the author reported calves were exposed to heat and humidity stress the first 1.5 months of the study. Mean THI was 75 ±0.44 units during the 65-d study. Serum total protein (STP) was measured d3 ±1 d (NSD, P=0.06) and health assessment was performed 3x/week. "At

least one calf in each pair presented diarrhea during the study period." NSD in median time to first diarrhea (P=0.78; control 10 d, probiotic 11 d). NSD in median time to recovery from diarrhea (P=0.10; control 5 d, probiotic 7 d). NSD in number of diarrhea events (P=0.28; control vs. probiotic 1.06 poisson regression). NSD in prewean ADG (P=0.67; control 1.24 vs. probiotic 1.26 lbs./d). Number of calves either needing antibiotic treatment (and thus culled on an organic farm), died, or euthanized was not different (P=0.73; 17.7% of all calves; control 21 calves vs. probiotic 20 calves). n=116 pairs (n=232 total calves). CSU and Universidad Tech de Pereira Manizales, Columbia. P149.

3. *Nucleotides?* Male, Holstein calves (abstract reported n=20, oral reported n=80). Calves were fed colostrum for 3 days and then CMR, Starter, and hay to end of study d 25. Colostrum is rich in nucleotides so pooled colostrum was fed. Blood samples drawn d 0, 3, 7, 15, and 25. Half of calves received 5 g/d of an additive containing 40% of yeast free nucleotides 5'monophosphate (Ribofeed, Italian company), and the control were given 20 ml of fresh water per day. Glutathione peroxidase (GPx), Antioxidant capacity (ABTS radical scavenging assay and FRAP ferric reducing ability of plasma) was higher in calves supplemented nucleotides (P<0.01). Cell viability after challenge with LPS, hydrogen peroxide and ConA did not show differences between treatments. Concentration of free radicals in the intracellular space both in cell culture and after challenge with hydrogen peroxide: free radicals where higher in the control group than the nucleotide-fed group after challenge with hydrogen peroxide. Matrix metalloproteinases-9 is a marker for inflammation in bovines and was lower (P<0.05) in calves fed nucleotides. n= either 80 or 20, not sure. U of Bari A Moro Bari, Italy. 263.
4. *L-glutamine?* Holstein heifer calves blocked by STP were fed 3.8 L/d of 12.5% solids 24:17 CMR either with or w/o 10 g/kg (1% inclusion) L-glutamine. Calves were housed in individual hutches and weaned d 56 and then grouped in 5 calves per pen post-wean until the study ended d 70. Starter (17% CP) was offered ad lib. 2 calves fed no glutamine died of scours; one glutamine fed calf was euthanized due to a joint infection. Calves were weighed weekly prewean and NSD in ADG at any measure. Also, no difference at any measure in average daily feed intake. Prewean G:F tended (P=0.07) greater (+13%) for calves fed L-glutamine. Calves supplemented L-glutamine tended (P<0.10) greater (+17%) G:F post-wean. NSD in fecal score or respiratory score. Author noted L-glutamine lacks AAFCO definition as an additive for calves, however, glutamate can be fed. n=30. Purdue. 262.
5. *Echinacea purpurea?* The common purple coneflower in prairies was used by native Americans as medicine. Holstein bull calves were randomly assigned to one of three rooms for placement. STP did not differ (5.54 g/dL; P=0.99). Calves were supplemented via CMR solution either a.) control, b.) 3 g Echinacea/d split of 2 milk feedings from d 14 – 28, or c.) 3 Echinacea/d split over 2 milk fdgs from d 1 – 56. Blood was collected d 1, 14, 28, and 57. Segmented neutrophils were higher (P=0.04) in control vs. in calves fed echinacea for 56 d (3.91 vs. 3.3 x 10^9/L; 14-d echinacea fdg group intermediary).

Lymphocytes were higher (P=0.04) in calves fed echinacea for 56 d vs. control (4.4 vs. 4.02 x 10^9/L), and, again, the 14-d echinacea group was intermediary, tending (P=0.07) higher (4.37) than the control. The total white blood cell count did not differ (P=0.68). Haptoglobin was lower (P=0.05) for calves fed Echinacea for 56 d vs. control; 14-d echinacea strategy was intermediary and tended lower vs. control. "Overall, Echinacea purpurea … reduced inflammation, particularly when fed across the whole milk feeding period." Morbidity measures taken but not yet tabulated. n=117. U of Guelph. Mapleview Agri. 174.

6. *Meta-analysis of yeast-derived products in dairy calves*. 30 articles from 1992 to 2021 were included in the meta-analysis examining ADG and solid feed intake. StataSE 15 was used to evaluate experimental treatment, number of calves, weaning stage, solids feed intake, and ADG for pre- and post-wean ADG and feed intake. During pre-wean, fdg live yeast increased ADG 42 g/d and increased solids feed intake 460 g/d, while yeast extract had no effect. Post-wean, yeast extract increased ADG 56 g/d and solid feed intake 270 g/d, while live yeast had no effect. n=30 articles evaluated. No mention of how many calves were represented in the analysis. Northwest A & F U Xianyang, China. 175.
7. *Lysophosphpatidylcholine (LPC)*? Lysophosphatidylcholine is a bioactive lipid synthesized from the hydrolysis of phosphatidylcholine by PLA2. LPC has been shown to increase survival of mice induced with experimental sepsis (Yan et al, 2004). LPC supplementation to calves was evaluated on bovine neutrophil hydrogen peroxide production, tumor necrosis factor-alpha production, and on E coli killing. Three, 2 – 5-week-old Holstein calves were used, their neutrophils isolated and then cultured to grow. Saturated LPC increased hydrogen peroxide production. When bound with albumin, LPC maintains cellular viability. LPC enhanced bactericidal functions. LPC was also shown to enhance TNF-alpha and IL-6 production when cells were challenged with LPS (P<0.001). LPC-18:0 may be priming the immune cells. LPC showed E coli killing capabilities. Rate of killing was nearly one log higher with LPC-18:0. n=3 269.
8. *Rumen protected tributyrin*. Compared to butyrate, tributyrin has a longer half-life in plasma, longer serum levels, and more favorable odor, according to the author. Holstein bull calves were fed either a.) milk replacer solution containing 3.12% fat and 3.51% protein (drink milk), or b.) same CMR supplemented with 8 g/d of unprotected solid powder containing 35% tributyrin adsorbed on silicon dioxide, or c.) the same CMR supplemented with 16 g/d of a commercial tributyrin product. All calves were started on 4 L/d and stepped up to peak of 8 L/d of milk replacer solution to d 42, then weaned in a step-down fashion with 4 L/d 50 – 56 d. Calves were housed in individual hutches, straw bedded. All had STP ≥5.5 g/dL. No serious illness reported in any calf. Daily fecal score and starter intake were recorded. BW and measures every two weeks. Six calves from each treatment group were slaughtered d 56 2 hours after the morning feeding, GI tracts evaluated, and gut microbiota assayed. Blood collected d 28 and 56. Results: NSD in starter intake (0.77 lbs./d; P=0.82), bodyweight, ADG (1.14 lbs./d; P=0.97), or withers height. Frequency of diarrhea tended less (P=0.07) and increasing tributyrin level was

associated with a negative trend response in diarrhea frequency (P=0.02). Supplementing tributyrin had no effect on IgG or IgM, but it tended (P=0.077) to reduce IgA at 56 d, tended (P=0.079) to reduce serum amyloid A (SAA), and reduced (P=0.001) IL-1Beta, thus indicating reduced oxidative stress if the calf was fed tributyrin. Villus length (P<0.001) of jejunum increased by nearly two-fold from supplementing tributyrin, however, crypt depth of the colon decreased (P=0.07) when calves were supplemented tributyrin. In the jejunum, the predominant bacteria in tributyrin fed calves were Ruminococcaceae, Lachnospiraceae_NK4A136, I achnospiraccae NK4A136, Prevotella_9, and uncultured bacterium Prevotella 9. n=30. China Ag U, Beijing. Inst of An Sci, Guizhou, China. 260

9. *Lallemand Saccharomyces cerevisiae boulardii for calves*? Holstein heifer calves with successful passive transfer (>5.5 g/dl STP at 3 d of age) reared near Cape Town, South Africa were assigned at 5 d of age to CMR either with or w/o live yeast (1 billion cfu/d fed in 23 mg 2x/d of yeast product) and either with or w/o stress in a 2 x 2 factorial study design. The stressor introduced was inconsistent feeding times on 3 d of the week during morning milk feedings when milk was fed 2 hours later than usual. Calves were blocked by date of birth, body weight, and STP. Stress had sig effect on starter intake pre-wean (d 68 to d 89, 17 days when stressed calves had sig less starter intake, P<0.05). Yeast had sig effect (P<0.05) on starter intake 8 days (d 73, 75, 76, 77, 79, 85, 86, 89). Body weight was greater in calves with no stress on week 8, 10, and 12 only (P<0.05). Stellenbosch U, South Africa. RUM&N Consulting, Italy. Lallemand, France. n=80
10. *Sodium butyrate, Rumensin, or both in post-wean grain?* Holstein heifers mean age 82.4 d (±1.2 d) and avg initial BW 220 lbs. (±4.9 lbs.) blocked by date of birth were fed starter grain with either a.) 100 g of soybean meal carrier, or b.) 0.75 g of sodum butyrate (Ultramix GF, Nutriad, 68% butyric acid, 21% Na+ and 10% maltodextrin)/kg of BW (app. 75 g/calf) + soybean meal carrier, or c.) 1 mg of monensin/kg of BW + soybean carrier, or d.) combination of 1 mg of monensin/kg of BW and 0.75 g of sodium butyrate/kg of BW + soybean meal carrier. Treatments adjusted weekly according to individual BW. Heifers trained to calan doors wk 12 of age and study began wk 13 and remained on study to wk 25 (12 wks). TMR was fed in individual feed tubs to allow daily intake measures. Fed to amount to feed refusals of 10% or less. Amount fed adjusted daily according to individual intakes. Treatments were hand mixed into each heifer's feed. Feed: haylage (37.5%), corn silage (33.9%), corn/beet pulp/molasses mix (12.5%), soy/urea mix (11.9%), Provail blood meal/methionine mix (3.9%), and VTM (2%); CP 15.7%, ADF 27.8%, NDF 43%, starch 14.4%, NFC 32.5%, ME 2.51 Mcal/lbs. DM. Digestibility measures taken d 21 to 27 and d 63 to 69 of the study. TMR samples taken d 1 to 5 and individual ort samples collected d 2 to 6. Fecal samples via rectal grabs taken d 4 to 7 every 6 h to represent 24 h cycle and pooled. Feed, orts, feces analyzed, and digestibility determined. Results: Initial BW was lighter (P=0.05) for all additive treatment groups vs. control (232.6, 209.4, 218.7, and 219.3 lbs. for control, sodium butyrate, monensin, and combined butyrate and monensin-fed calves, respectively. all

additive treatment groups tended (P=0.09) greater final BW vs. control (418, 425.1, 428.1, and 434.5 lbs., for control, sodium butyrate, monensin, and combined butyrate and monensin, respectively). Feeding additives tended to improve heart girth measures vs. control (P=0.06). DMI improved (P=0.03) for additives vs. control. Monensin supplemented heifers had a 12% greater G:F as compared to heifer supplemented sodium butyrate. No differences in DM, CP, ADF, starch, hemicellulose, OM, or fat digestibility. Additives tended (P=0.08) to improve NDF digestibility. Supplementing sodium butyrate reduced coccidian oocysts and author hypothesizes this occurs either by sodium butyrate "repairing the epithelial tissue or directly affecting the coccidia that reside." n=40. U of NH. Adisseo, GA. P244.

11. *Beta-glucan effect on fecal bacteriome.* Holstein calves fed 6 L/d of 14% solids 24:18.5 CMR were fed either with or w/o 2 g/d Beta-glucan (Aleta brand, Kemin). Starter offered ad lib. Calves were colostrum-fed and blocked by sex, date of and weight at birth. Fecal samples collected week 1, 2, 4, and 8. Samples were amplified by PCR and sequenced by Ilumina MiSeq platform and analyzed using DADA2 pipeline. NSD in diversity (Shannon and Simpson), richness (Chao1) and evenness (Pielouw) were observed. Beta-glucan supplementation did not affect fecal bacteriome in dairy calves. n=14. U of Sao Paulo, Brazil.
12. *Does feeding probiotics/prebiotics prewean effect future first lactation performance*? Holstein heifer calves (n=1,801) on a commercial dairy were block randomized at birth to 4 treatment groups and fed in their milk either a.) no supplement, 2.) yeast culture enriched with MOS (Celmanax, 14 g/d; Arm and Hammer), 3.) Bacillus subtilis (probiotic, brand not disclosed, 0.25 B cfu/d) or, 4.) both Celmanax and Bacillus subtilis, same dose of each but symbiotically not alone. Milk feeding and grain feeding strategy were not discussed. Supplements were administered twice daily in the milk feeding period (60 days). Herd inventory (mortality or removal) and first lactation milk data were collected. Milk (305 d adjusted) yield was not different (24,054, 24,484, 24,621, and 24,636 lbs. for no supplement, Celmanax, Bacillus subtilis, and combo, respectively, NSD; SD on MY was 251, 264, 260, and 256 lbs. respectively). Milk fat yield (305 d adjusted) was 1005 (b), 1034 (ab), 1032 (ab), and 1043 (a), for the same 4 treatment groups, respectively (P<0.05; SD was 11, 11, 11, and 11 lbs., respectively in the aforementioned treatment groups). Milk protein was similar ranging from 770 to 791 lbs. (305 d adjusted) and NSD between groups. Odds of removal before first calving (vs. control) was 0.8, 0.95, and 1.05, and during first lactation was 1.11, 0.67, and 0.95 for the Celmanax-, Bacillus subtilis-, and the combo-supplemented calves, respectively (NSD in either instance). Proportion of calves entering the milking herd was 78%, 75%, 77%, and 79%, for control, Celmanax, Bacillus subtilis, and, combo, respectively (NSD. SD was 2% in each of the four treatment groups). Calves fed the combination of Celmanax and B. subtilis noted +37.5 lbs. more milk fat vs. control. NSD in 305-d adjusted milk yield, milk protein yield, or odds of removal. n=1,581. UC Davis. Scibus, Australia. Arm and Hammer, NJ, USA. SC142.

13. *Smartcare (yeast+ product) in milk and NutriTek (yeast) in grain. Effect on BRD*. Holstein-Angus cross calves with adequate passive transfer were fed either with or w/o Diamond V Smartcare (1g/d) in milk and Diamond V NutriTek (5 g/d) in grain. Supplements were split between two feedings each d. Calves infected w/BRSV (bovine respiratory syncytial virus strain 375; ~10^4 median tissue culture infectious dose, $TCID_{50}$) via aerosolized inoculation at d 20 – 22 followed by Pastereulla multocida strain P1062 type A:3 (~10^7 CFU intratracheal inoculation) 6 days later (d 27 - 29). Each of the two infections were introduced over a 3 d span to individuals within both groups. Liver biopsy taken 7 d prior BRSV challenge to determine baseline. All calves euthanized and necropsied 10 d post Pasteurella challenge. NSD in ADG (control 516 g/d; yeast-products 522 g/d). NSD in starter intake (95 and 118 g/d for control and yeast-products, respectively). No treatment effect on clinical disease scores (body temp, respiration effort and respiration rate, lung sound and coughing, discharge, or ear position) post viral infection, however, thoracic ultrasound score measuring lung consolidation was improved d 7 (P=0.023) and d 10 (P=0.089) post infection for the yeast-treated calves. Yeast treated calves also tended (P=0.06) less lung damage (lower lung pathology score) post-mortem. NSD in lung viral loads. BRSV was detected in fewer yeast-fed calves (5 of 12) compared to control (3/13). NSD in bacterial lung loads (P=0.34). Author reported Pasteurella multocida infection was restricted to cranial lung lobes in the yeast-product fed calves, which differed from the control, where infection occurred in the caudal lobes as well. Blood glucose levels fell (P<0.0001) post disease challenge, as expected, and in both groups, however, NEFA concentrations increased (P=0.031) and BHB tended to increase (P=0.082) in yeast-supplemented calves vs. control indicating improved reprioritization of nutrients (such as fat breakdown) in immune compromised calves if fed yeast. Circulation of IL-6 tended to increase (P=0.074) 7 d post infection if fed yeast. Numeric increase in haptoglobin on d 7 if fed yeast, but NSD (P=0.339). However, by d 10 both serum Il-6 and haptoglobin were the same whether fed yeast or not. n=27. Iowa State U. Diamond V. 107.
14. *Meta-analysis of yeast studies in preweaned calves.* Criteria for research study inclusion: published in English/Portuguese/Spanish, controlled, dairy calves, yeast (live) supplemented, growth and health outcomes reported. Meta package R stat software was used. 9 studies of 3088 published studies examined fit the criterion. These are the 9: Panda et al 1995; Pinos-Ridriguea et al 2009; Terre et al, 2015; Hassan et al, 2016; He et al, 2017; Fomenky et al, 2017; Lee et al, 2019; Renaud et al, 2019; Villot et al, 2019. All but Panda were randomized. 7 of 9 used Holstein breed calves. 5 supplemented yeast in CMR, 1 in whole milk, 1 in starter, 2 orally administered. Days supplemented varied from a low of 21 to high of 90 d. Concentration of yeast supplemented daily low was a low of 1.5 million CFU (I assume per d) to a high of 20 billion (per d?). All but one started yeast supplementation 10 days of age or less. 4 of 9 evaluated milk intake, no effect on milk intake (P=0.64), and between study variation (I^2), i.e., low heterogeneity (which is variation by chance) of 3.1%. 7 of 9 evaluated grain intake and it had no effect

(P=0.36) from feeding live yeast; also, low heterogeneity (I^2=27%). 8 of 9 measured ADG and NSD (P=0.12; tendency) and there was substantial heterogeneity (I^2=85.8%). 6 of 9 measured feed efficiency and NSD (P=0.84) was reported and there was considerable heterogeneity (I^2=65.5%). n=9. UC-Davis. U of Guelph. P339.

15. *Oregano extract's effect on rumen microbiota.* Male Holstein calves were randomly assigned to either supplementation of 60 mg of oregano extract (Oreganol) per kg of BW per d or no supplementation between d 3 and 53. Calves were 6 Ld of CMR, grain, and coast cross hay. Calves were sacrificed d 54 and rumen contents analyzed. Shannon index of bacterial abundance and diversity was analyzed using ANOVA. Gram negative bacteria (Proteobacteria, 3.08% vs. 16.45%, Bacteriodes, 0.81% vs. 1.52%, Succinivibrio, 1.68% vs. 6.61%, Frischella, 0.38% vs. 8.96%) increased (P<0.05), as did gram positive bacteria (Roseburia, 2.3% vs. 5.23%, and Spirochaetes, 0.58% vs. 1.38%) P<0.05) due to oregano extract supplementation. Some gram-negative bacteria (Barnesiella, 1% vs. 0.25%, Actinobacteria, 1.33% vs. 0.75%, Clostridium IV, 1.95% vs. 0.4%, and Ruminococcus, 4.19% vs. 1.96%) decreased (P<0.05), as did some gram positive (Prevotella, 53.24% vs. 38.99%, Bacteriodetes, 56.84% vs. 41.02%, and Dysgonomonas, 2.18% vs. 0.77%, (P<0.05) due to oregano supplementation. Oregano increased the diversity of bacteria (3.303 vs. 3.165; P<0.0001). n=10. U Federal do Rio Grande do Sul Porto Alegre, Brazil; U of Santa Cruz do Sul Santa Cruz, RS, Brazil. P333.

Amino acid supplementation (1 abstract):

1. *Glutamine or Glutamine + branch chain amino acids supplemented at weaning*? Holstein heifer calves 35 d age were step-down weaned from 9.0 to 3.0 L/d and not fully weaned until they individually consumed ≥1.0 kg/d grain intake. Calves were fed either a.) no amino acid supplementation to whole milk during weaning, or b.) glutamine supplemented at 1% of DM into the milk at weaning, or c.) Glutamine at 1% of DM + 17, 10, and 11 g/d of Leu, Ile, and Val, respectively. Respective treatment started 3 d prior wean and continued until 7 d after partial weaning process commenced. Plasma leptin, serum haptoglobin and metabolites were measured from 1 d before until 7 d after partial weaning. Starter intake, ADG, and body dimensions were not different pre-wean (d 28 – 35). Negligible starter intake occurred pre-wean when calves were fed 9 L/d whole milk (70 – 90 g/d). During weaning, days to wean (d 35 until reaching 1.0 kg/d starter intake), starter intake, body dimensions and ADG first week of wean process NSD. ADG after the 1st week tended (P=0.091) greater for control during the wean period. Post-wean (the period from when completely weaned until d 70) noted increased (P=0.001) starter intake and increased (P=0.012) body weight for calves in the control group over calves in either glutamine supplemented alone or glutamine + branch chain amino acids. NSD in body dimensions. No effect on serum metabolites (essential or non-essential amino acids, glucose, urea) prewean or post wean with exception of post-wean BHBA being lower (P=0.022) in glutamine fed calves vs. control (glutamine + branch chained a.a. intermediary). Haptoglobin increased as milk became

more restricted (P=0.024) but NSD between treatments. Average BW was 8.8 lbs. lighter during the 3-week period post-weaning if calves were either supplemented glutamine alone, or glutamine + branch chain a.a. in their milk during weaning, furthermore, supplementing glutamine or glutamine + branched chain amino acids in milk during weaning reduced post-wean grain intake. n=33. ISU. P480

Colostrum, Colostrum Replacers (CR), and feeding Transition Milk (9 abstracts):

1. *Does IgG absorption continue beyond generally recognized timeframes? 12 hours? 24 hours? 48 hours?* The author notes data to date does not directly examine the IgG receptor FcGRT in measuring IgG uptake, instead, indirect measures of plasma IgG are taken and these are widely variable between individual calves and there are also unknown adverse effects of delayed feeding of colostrum possibly causing more stress physiology than optimized calf physiology. Also, the author pointed out several studies from the 60's and 70's, and one recent one, showing much later uptake of IgG in the neonatal calf that is generally accepted. The study: neonatal calf intestine samples taken every 100 cm in the duodenum, jejunum and ilium were examined for FcGRT (the IgG receptor in the calf's gut) concentrations. Calves were sacrificed and intestines examined at either 0, 12-, 24-, 48- or 7-days post birth, and calves were fed 1st feeding colostrum (4 L) at 1 h, 2nd fdg (2 L) at 12 h, 3rd fdg (2 L) at 24 h, 4th fdg (2L) at 48 h. Next, FCGRT expression was measured by a process called QPCR and it was found that this IgG receptor increases in concentration to 48 hours. In the duodenum FcGRT experienced a 3-fold increase by 48 h, and it stabilized in concentration at the 7-d measure. A similar magnitude of increase over time occurred in the jejunum and ilium. Publicly available neonatal calf gut genomes were datamined for genes that were consistent with short-lived role of IgG absorption, and several were identified (MMDC4 and DAB2) as accurate biomarkers for IgG absorption. Direct visualization of IgG uptake in the jejunal enterocytes at 24 h was shown. Author also reported 25% of IgG produced in the cow is excreted in her colostrum and 75% of IgG is excreted in transition milk. n=16. Cornell. LB100.
2. *Colostrum in post-gut closure applications.* Phase feeding for early life programming is well established in other calf models and are needed in calves. The first week of transition milk containing more nutrition and "bioactives" needs consideration. Pyo et al 2020 showed a 50:50 mix of transition milk or of colostrum for 6 meals after the initial colostrum meal noted far greater (+150 microns improvement) improvements in intestinal development compared to continuing with whole milk after the initial colostrum feeding. Hare et al, 2020 indicated later absorption of IgG than initially expected (supporting abstract LB100) because the extended feeding of colostrum or the 50:50 blend of colostrum in a 2nd feeding at 12 hours noted increased serum IgG (increasing it from 20 to 30 mg/ml from 12 h to 24 h) vs fed milk. The persistency of IgG content also improved. Colostrogenesis is an area of much needed research and research needs to expand beyond just placement of IgG in assembling colostrum, and

that colostrogenesis in the dam is likely occurring for several months prior calving. Fischer-Tlustos et al, 2021 and Hare ASAS/CSAS abstract 528 are citations referred to in reference to colostrogenesis and energy intake in the dam. Prepartum starch intake prepartum reduces IgG content in colostrum. Oligosaccharides approach grams per liter in content in colostrum and even milkings 2 and 3 (transition milk) are elevated in oligosaccharides. Oligosaccharides are prebiotics for bacteria in the gut. In other animal models oligosaccharides effect IgG uptake. Beef cow research shows fdg more prepartum metabolizable protein results in significantly reduced Colostral fat (Hare et al 2019). Primiparous cows had more fat in colostrum (Fischer-Tlustos et al, 2020) while volume of colostrum was the same compared to multiparous cows. Wilms et al (in review) showed higher DHA and EPA in colostrum from primparous cows and are higher in colostrum and slowly decline in later milkings. Butyric acid (C4:0) is 39% lower in colostrum than later milkings (Wilms et al) likely because it results in gut development, which is counterproductive to keeping IgG absorptive capabilities. Hiltz and Laarman, 2019, showed supplementing butyrate decreased IgG absorption. Soberon and Van Amburgh, 2011, showed enhanced nutrition (1300 kg/d) vs. 600 g/d noted large increases in organ weight at wean, Hare et al 2019 and Leal et al 2019 showed gene expressions are altered, large changes, (Leal et al 2021) in metabolomics from better early nutrition that carries to wean and to d 330. CMR composition is typically higher in lactose (45% vs. 37%) and lower in fat (31% vs. 18%) as is osmolarity (300 vs. 400 – 600 mmol/L). Welboren et al 2021 (JDS) showed high fat diets week one resulted in much higher ADG than high lactose, indicative of need for phase feeding. Liver weight and liver glycogen was also greater. Abomasal emptying rate was slower with high fat diet vs. high lactose diet. Wilms (unpublished research) followed up showing metabolic fingerprint was different for high protein, high lactose, and high fat diets. Echeverry-Munera et al 2021 showed high lactose fed animals will consume more milk in attempt to consume more metabolizable energy (vs. high fat). Michael Steele. S132.

3. *Brazilian study examining post-gut closure feeding of spray dried colostrum and effect on 12-month BW gain*. Holstein heifer calves (86 lbs.) from one herd received either 60 g of supplemental colostrum replacer (CR) powder or no supplemental colostrum from d 2 to 6 of life. CR powder was dissolved in 6 L of milk achieving a total 18% solids. Control calves received 6 L of milk with 55 g/L of a 22:19 CMR powder added to achieve the same 18% solids. All calves received via esophageal feeder 4 L of maternal colostrum after birth and 2 L again after 6 h. All calves presented adequate immunity (>10 g IgG/L). From d 6 all calves received the same quantity of 18% solids milk (whole milk with added CMR) and ad lib starter grain. Day 30, all calves received 4 L/d milk and were weaned d 60. 52 of the 60 calves (26 in each group) were maintained post-wean in the same environment and weighed the same d at 12 months and body weight adjusted for 365 d and ADG analyzed using a mixed model, treatment as a fixed effect with birth weight as a covariable and heifer within treatment considered random effect. NSD, however CR group were +7 lbs. heavier at weaning (+0.11 lbs. ADG). BW at 12 months

age NSD (802.5, ±55 lbs. vs. 820.1, ±70.5 lbs. for control and CR, respectively; ADG 2.02 vs. 2.09 lbs., for control and CR, respectively). No health or body dimension measures reported. Brand of CR not disclosed. No poster provided, only the abstract. n=60. U Federal de Jatai Jatai, Goias, Brazil. Milk Mais consultoria Rio Verde, Goias, Brazil. P248.

4. *Acidified colostrum effect on microbiome.* Holstein heifer calves were fed 8 quarts within 1 – 2 h of birth and 2 quarts the next meal of colostrum acidified with 9% formic acid. Approximate pH of the colostrum was 4.0 to 4.5. Calves were subsequently fed acidified whole milk until weaned at 8 weeks age. Grain was offered ad lib commencing d 7 – 10. Hay was offered week 7 onward. Fecal samples were collected rectally at 24 h, 48 h, and 1x/wk for 8 weeks. Fecal samples were analyzed for DNA and other parameters. Observed alpha diversity and Shannon diversity found no differences P>0.05) between acidified and non-acidified colostrum fed calves. Beta diversity (between community comparisons) did not differ between groups (>0.05). These measures determined there are no differences in microbiome at the community level from use of acidified colostrum. Six genus-level genera were found different (P<0.05) between groups in the study: Atropodium, CF231, Collinsella, and Vellonellaceae were found to be higher in the control group (P<0.05), while Clostridiaceae and Faecalibacterium were higher in the acidifed group. Faecalibacterium is was 5x greater in acidified colostrum group at 1 week age, otherwise, NSD. Faecalibacterium was reported by the researcher to have probiotic properties and to have been shown to result in reduced diarrhea and improved ADG in calves (Foditsch PLosOne 2015) and is a butyrate-producing bacterium (Ploger Ann NY Acad Sci 2012). Optimum pH for faecalibacterium growth is pH 5.5 to 6.7. No weights, STP, IgG or fecal scores were collected on the calves. n=10. Penn Vet New Bolton Center. 259.
5. *Bacterial evaluation of fresh and frozen colostrum.* Colostrum samples were either administered fresh (n=5 of the samples) or frozen and then thawed (n=17) in a hot water bath and administered to individual calves (n=22). Brix measures using Digital Dairy #DD3 refractometer and bacterial analysis conducted. Blood taken 48 – 60 h of age (STP conducted on 16; BRIX % on 22). Health data recorded on all calves. 2 of 5 colostrum samples fed fresh were from Jersey cows and 2 of 17 colostrum samples frozen and thawed and fed were from Jersey cows, the rest from Holstein cows. Petrifilm analysis for colony counts proved to have high correlation with actual professional lab results in measuring for staph aureus and for bacterial colonies (P≤0.05), but, of course, lacks the bacterial specificity measure of a professional lab. 39 colostrum samples were lab analyzed for specific bacteriology; 29 bacteria species isolated; Bacilli present in 61.5% (author reports this is spread in parlor; aseptic fusions prevent spread), Pseudomonas present in 33.3% (spread thru contaminated inflations/water; clean water troughs and milking equipment), coagulase present in 20.5% (skin source; milkers wear gloves, use teat dip appropriately); further results of the 39 samples: Staph aureus (17.9%), Strep uberis (15.4%), E coli (2.6%), Enterobacter (0%), Yeasts/molds (5.1%) and Prototheca (10.3%). 15.3% of samples had count >10,000

CFU/mL. Calf results: overall average BRIX 9.8% and STP 6.5 g/dL (only 1 calf failed). Calves fed fresh (n=5) 9.8% BRIX; calves fed thawed (n=17) 8.7% BRIX. NSD in disease incidence between fresh and frozen, but small calf group and minimal disease outbreak. n=39 colostrum samples. n=22 calves. U of GA, Athens. SC163.

6. *How genetics and tropical environment (Brazil) impact the effect of serum total protein on pre-wean calf health*. A retrospective cohort study was conducted between 2012 and 2018 using pre-and post-birth calf level data from 6,011 crossbred calves from a single herd in S.E. Brazil. All calves were produced via in-vitro embryo transfer and data were segregated as either ≥50% Holstein genetics or ≤50% Holstein genetics (majority Gyr, a Brazilian tropical dairy breed). Avg temperature ranged from approximately 77 to 88 F and relative humidity ranged from approximately 50 to 70%. All calves received colostrum from their dam if BRIX ≥22%, otherwise calves were given colostrum from the farm's banked colostrum. Median value for STP was 7.2 g/L. Calves were reared on tethers with free choice water, pail fed milk, and with access to optional shade on paddock. Calf pedigree, season of birth, occurrence of retained placenta, serum total protein measured by refractometry from blood taken at 24 h age, morbidity (classified as scours, BRD, or tick-born disease), mortality, and birth and weaning weight (and thus ADG) were determined on all calves. DVM monitored data collection. No breed differences noted in BW gain, however, predominantly Holstein calves were born with greater incidence of retained placentas (12.0% vs. 7.6%), noted greater incidence of disease (56.9% vs. 45.7%), and experienced greater mortality (7.5% vs. 3.0%) as compared to predominantly Gyr calves. A cox proportional hazard model was used to determine the risk factors associated with failure of passive transfer and data showed breed composition (P<0.0001), dam's parity (P=0.0034), and retained placenta at birth (P=0.0188) were highly correlated. Season of birth was not correlated to STP. Season of birth (P<0.0001), breed (P<0.0001; predominantly Holstein greater risk than predominantly Gyr), dam's parity (P=0.0015), sire PTA milk (P=0.0408), and birth weight (P=0.0002) were all risk factors associated with morbidity. Overall incidence of disease was 53% with scours (at 41%) being the leading cause (18% BRD; 10% tick-born illness). Risk factors associated with mortality were breed composition (P<0.0001), sire PTA milk (P=0.0194) and incidence of FPT (P=0.0008). Overall mortality was 6%. If using a STP threshold of 5.2 g/L, predominantly Gyr calves had much improved probability of being healthy as compared to predominantly Holstein calves, and if using STP threshold of 7.6 g/L, the same was noted, however, with much lesser variability. Predominantly Holstein calves with less than 5.2 g/L STP had much greater probability of death as compared to predominantly Gyr calves with similar poor colostrum status. Calves with FPT (cut off point 5.2 g/L STP) noted reduced ADG (average being 1.4 lbs./d). Selecting for increased production may affect calf's ability to respond to challenges. FPT was a poor predictor of morbidity and mortality, even at higher cut-off points. In challenging environs successful transfer may not be enough to prevent morbidity and mortality. n=6,011 (3,933

predominantly Holstein & 2,078 predominantly Gyr). UC Davis. U Federal de Minas Gerais Belo Horizonte school of veterinary medicine, Brazil. 182.

7. *Does daylength exposure in dry cow period effect colostrum production?* Colostrum volume and BRIX recorded, and sample collected on all colostrum collections from 2 Jersey herds in Virginia that had similar rations and management, similar protocols, similar exposure to natural photoperiods for entire dry period and similar vaccination schedule. Daily light exposure calculated from local weather station (within 10 miles from each dairy) each day dry. Far off dry period daily light exposure was 760.6 and 771.8 minutes (12.7 and 12.9 hours) for farm 1 and 2, respectively. Close up dry period daily light exposure was 752.5 and 853.2 (12.5 and 14.2 hours) for farm 1 and 2, respectively. Overall dry period daily light exposure was 756.5 and 812.7 (12.6 and 13.5 hours) for farm 1 and 2, respectively. Results: as far-off dry period daylength increases by +1-minute, BRIX score is predicted to increase by 0.04 and as close-up daylength decreases by -1-minute, BRIX score is predicted to increase by 0.05 (this was the anomaly in the data set). For each additional day dry, BRIX score is predicted to increase by 0.11. Stats on these three intercept calculations: r=0.6573; P<0.001. Regarding colostrum volume: as close-up daylength increases by +1-minute, colostrum volume is predicted to increase by 0.04, and for each additional day dry, colostrum volume is predicted to increase by 0.16. Stats for this intercept are r=0.2855; P<0.001. NSD in colostrum component values. n=43. Virginia Tech. SC150.
8. *Genetic aspects of colostrum quality traits?* IgG, IgA, IgM heritable in Italian Holstein cows? Genetic variation? Are they correlated? 672 colostrum samples from the same number of Holstein cows were collected within 6 h after calving on 9 NE Italy dairies from spring 2019 to spring 2020. Colostrum was stored -4 C on farm and periodically picked up and Ig status determined at U of Padova lab using radial immunodiffusion (RID). Genetic parameter estimation: herd (n=9), parity order (1,2,3,4, ≥5), season (n=4), and year (n=2) were fixed effects in ASReml v4.1 analysis thru multivariate 3x3 analysis. “A” was the pedigree-based relationship matrix (cows + 6 generations of ancestors); “A” size was 6,714 individuals. Heritability (h^2) and phenotypic (r_p) and genetic correlation (r_a) were calculated using conventional formulas. Regardless of parity, colostrum IgG, IgA, and IgM averaged 93.2, 4.9, and 5.2 g/L, respectively, accounting for 90%, 5%, and 5% of globulin proteins, respectively. Heritability was 0.12, 0.37, and 0.18 for IgG, IgA, and IgM with standard error being high at 0.14, 0.16, and 0.14, respectively. Phenotypic genetic correlation between IgG and IgA was 0.51, and between IgG and IgM was 0.59 and between IgA and IgM was 0.50 (standard error ranged between 0.03 and 0.04). Author noted prior studies in Charolais (Martin, 2021) cattle reported IgG heritability of 0.28 (S.E. 0.14) using RID and a heritability of 0.08 (S.E. 0.12) using ELISA. IgG is the least heritable Ig and genetic correlations between Ig were weak. n=672 colostrum samples. U of Padova Legnaro, Padova, Italy. U of Bologna, Bologna, Italy. 407.
9. *A scoping review of colostrum management practices associated with FPT.* Searched 6 electronic databases (PubMed, CAB Direct, Scopus, Agricola, Web of Science, ProQuest)

and 3 conference proceedings (ADSA, WBC, AABP) 1997 – 2020. The review included controlled trials and cohort, cross-sectional, or case-control studies in calves blood sampled 1 – 9 d age. All studies excluded beef calves and measured calf blood IgG, STP, Brix %, or gamma-glutamyl transferase. All studies measured pertinent colostrum management topics (issues pertaining to either the dam, calving, colostrum mngt, or calf mngt.). The scoping review identified 264 trials in data synthesis. 48% published between 2010 and 2020. 54% in N. America and Europe. 76% controlled, 22% cohort, 2% cross-sectional studies. Leading topics were colostrum management, then calf management, then issues pertaining to the dam, and very few pertained to calving. In controlled studies (n=200 studies) examining the source of colostrum (n=58) was the leading study investigation and 79% were examining colostrum replacers/supplements, 7% examined pooled colostrum, 3% looked at breed differences in colostrum, 3% looked at cow diet effect on colostrum, and 8% examined other parameters. Colostrum quality was measured in 36 controlled studies (2nd leading number of controlled trials) and one-third of these examined amount of colostrum powder to add. In cohort studies (n=58 studies) colostrum quality was leading parameter measured (n=33; 46% of these measured colostrum IgG concentrations, 21% used colostrometer, and 18% used Brix %), & dam age/parity was next in frequency (63% measured number of parturitions, 25% measured primiparous vs. multiparous). In all trials 80%+ looked at IgG measure and radial immunodiffusion was used in 64% of these studies with ELISA measures being used for 20%, and turbidimetry 7% of measures (4% did not report, 5% used other methods). 113 trials used serum total protein to measure FPT and 28% of these used a refractometer, 19% used kit and/or analyzer, 15% used digital refractometer. 65 studies reported FPT cut-off values of which 63% used <10 g/L IgG, 8% used STP <5.2 g/dl, 5% used STP 5.5 g/dl. n=264 trials in scoping review. U of Guelph. U of PEI. 181.

CMR and Milk Feeding Rates and Strategies (3 abstracts):

1. *Are ultrasound mammary gland images accurate measures of development of parenchymal tissue in preweaned calves? If so, how does milk feeding strategy effect pre-wean mammary gland development?* Calves 5 – 7 d age were pair-fed 2 diets for 8 weeks, one calf on low fdg (1 lbs./d 22:15) and one calf on high fdg (2.5 lbs./d 27:20) rate of CMR and the low-feeding rate (CMR) calf was pair-fed starter grain based on what the high calf ate. Care was taken to pair calves of similar birthweight. Individual weights and mammary gland ultrasound measures were taken biweekly on all calves and mammary gland biopsies were collected at 8 weeks age on half of the calves. Weaning began on d 42. Calves fed the higher fdg rate noted increased average body weight after the 1st week ($P<0.0005$; weights not reported). Calves fed the higher feeding rate noted larger parenchyma ($P<0.05$) at 8 weeks, greater average parenchymal area after 6 weeks ($P=0.0079$), and greater parenchymal perimeter and maximum length (stats not reported). Parenchymal area during the two measures taken week 8 were 56 and 81 mm^2 and 46 and 58 mm^2 ($P<0.05$) for calves fed the high and low

CMR feeding strategies, respectively. The average number of mammary gland ducts were 8.2 and 6.6 for high- and low-feeding strategies, respectively, with the author reporting inadequate n to do stats on this measure. n=30 (with half biopsied at 8 weeks). UW-Madison. P150.

2. *8 L/d or ad lib access to pasteurized whole milk fed via autofeeder to beef cross dairy cattle.* Calves (mix of heifers and bulls born either fall 2019 or spring 2020 and either Holstein, ProCROSS (Holstein, Viking Red, Montbeliarde), GrazeCROSS (Jersey, Viking Red, Normande) or Limousin-sired) were fed 13% solids pasteurized whole milk and texturized starter (18% CP). Calves from 5 d of age were randomly assigned and fed via a Holm & Laue automated calf feeder either a.) 8 L/d, or b.) ad libitum whole milk. No ramp-up, hold, or ramp-down phases of milk feeding were used. Calves were weighed weekly and health scores were recorded 1x/week. Calves were weaned at 56 d of age when the study ended. Weaning weight was greater (P<0.05; 201.5 vs. 236.8 lbs.), as was hip height, ADG (1.94 vs. 2.49 lbs./d), and total milk consumed (406.5 vs. 567.1 liters) for ad-libitum vs. 8 L/d milk feeding strategies, respectively. Drinking speed was greater (P<0.05) for 8 L/d vs. ad libitum milk consumption (1,475 vs. 1,106 ml/min) and daily milk intake was approximately +3L/d for the ad lib intake group. NSD in health scores (scour score, respiratory score, appearance scores) but fecal score was greater (P<0.05) when calves were fed ad lib milk (0.32 vs. 0.42 F.S.; score 0 – 3 range) vs. 8 L/d and the researcher attributed this as a non-pathogenic slight nutritional scour. Avg cost per d was $2.55 vs. $3.54/d for 8 L/d vs. ad lib. Total costs increased +$50/calf to feed ad lib. NSD in ADG between breeds, however, Limousin cross calves consumed less milk (about 50 liters) compared to Holsteins and Grazecross calves, but ADG was not different, indicating increased efficiency. NSD in health between breeds. All calves were healthy. Limousin cross calves noted lowest total cost ($160 to $161), significantly (P<0.05) less cost to 56 d than Holsteins ($175.22), ProCROSS ($183.50) or Grazecross ($172.31) calves. n=91. U of MN, Morris. 108.
3. *Does pasteurization of waste milk impact gastrointestinal tract development of the calf?* Waste milk is typically mastitis milk that has a high bacterial load and presence of antibiotics. Crossbred male calves (Holstein/Gyr) received 10% of BW as 25% BRIX colostrum and they also received transition milk the first 3 days of life. Ad lib grain was offered. Calves were then fed 6 liters of milk daily in a 2x/d fdg strategy. Trial period d 4 – 60. Calves were fed either a.) whole milk, b.) waste milk, or c.) pasteurized waste milk (plate pasteurization, 73 C for 16 seconds). Day 60 calves were euthanized, and GI tract tissues evaluated. NSD in ruminal or omasum papillae height or area and NSD in villi height or area. Antibiotic milk tended (P=0.09) greater in duodenal villi height (P=0.09). NSD in depth gland, crypt depth, or cell proliferation in the abomasum. NSD in mitotic index of the rumen or omasum. Mastitic milk (pasteurized or not) did not affect GI tract development. n=45. U Federal de Minas Gerais Belo Horizonte, Brazil. Embrapa Dairy cattle Juiz de Fora, Brazil. P332.

Dry cow strategies and their impact on the calf (6 abstracts):

1. *Rumen protected choline supplemented to cow in late gestation, effect on the calf?* Holstein cows (633 primiparous, 370 multiparous) at 252 d in gestation received either 0 or 12.9 g/d of choline ion as a top dress until calving. Heifer calves born were randomly assigned to receive colostrum from dams that either did or did not receive rumen protected choline. Offspring were monitored for weight gain d 0, 30, 60, and 82 and pulmonary lesions were assessed via ultrasonography and morbidity evaluated daily on calves that were either a.) born from dams given no supplemental choline and not given colostrum from a dam supplemented choline, b.) born from dam supplemented choline but fed colostrum from a dam not supplemented choline, c.) not born from a dam supplemented choline, but received colostrum from a dam supplemented choline, or d.) born from a dam that received choline and got colostrum from a dam that received choline. A 2 x 2 factorial. No report of STP between groups. No report of mortality. No report of nutrition fed to the calf in the study. Result reported: no effect of rumen protected choline supplementation to the cow in the dry period on the calf, either via colostrum or in utero or both. n=1003 cow/calf pairs. U of Florida. Balchem. 173.
2. *How does prepartum dietary starch content and post-partum dietary fiber content affect colostrum and transition milk composition?* (Author reports insulin concentration in colostrum is 65x that of whole milk and that insulin is essential for calf gut development and enzymatic activity). Cows house in tie-stalls and fed experimental TMR 1x/d at 8 am in individual bunks were fed in a 2 x 2 factorial study design diets either low starch (14%, 1.54 Mcal/kg DM) or hi starch (26.1%, 1.63 Mcal/kg DM) prepartum introduced 4 wks prior calving and either a hi fiber (33.8% NDF; 25.1% starch; NE_L 1.64 Mcal/kg DM) or hi starch (27.2% NDF; 32.8% starch, NE_L 1.71 Mcal/kg DM) postpartum. Colostrum (n=87) and transition milk (milkings 2 – 6; n=51 cows) was harvested and analyzed for bio-actives. IgG (RID), insulin and composition analyzed. NSD in colostrum yield (5.7 L average). 94% had colostrum IgG >50 g IgG/L and 42.5% > 100 g of IgG/L. Colostrum from cows fed hi starch diets pre-partum noted lower (P<0.05) IgG concentration compared to colostrum from cows fed low starch diets but no effect of pre-partum diet on colostrum IgG yield or Brix % and IgG yield was high (avg. 92 g IgG/L). Cows fed hi-starch diets prepartum noted increased (P<0.05) colostrum insulin concentration (app. 40 vs. 29 mcg/L) compared to cows fed lower starch content pre-partum, but NSD in insulin concentration in transition milk. Also, cows fed hi-starch prepartum had greater plasma insulin concentration 10 d prior to calving. (Author hypothesizes that insulin may prompt earlier gut closure diminishing IgG absorption). Transition milk yield was not impacted by either pre- or post-partum diet differences. However, transition milk from cows fed hi starch pre- and hi fiber post-natal diets noted increased (P<0.05) milk fat yield during 5th and 6th milkings vs. transition milk from cows fed low-starch diets pre-combined with either hi fiber or hi starch post-natal. Hi-starch pre- and post-natal was intermediary. Likely due to greater fat mobilization post-natal. Hi-starch pre- and hi-

fiber post-natal cows also noted increased (P<0.05) transition milk protein yield milkings 2, 4, and 5. Author hypothesizes this is due to decreased rumen pH. n=87 (51 multiparous and 36 primiparous cows). U of Guelph. U of Alberta, Edmonton. 356.

3. *Zeolite fed prepartum improves colostrum quality.* Holstein cows were fed either a.), control, containing positive DCAD (+190 mEq/kg) and a low potassium corn silage, or b.) negative DCAD (-64.71 mEq/kg), or c.) Positive DCAD (+277.4 mEq/kg) supplemented with 500 g/d X-Zelit (Zeolite). Diets were fed 21 d prior calving, ionized calcium was measured before and after the first milking (colostrum), and colostrum weight, Brix, IgG, and total calcium concentration of colostrum were measured. To be eligible to enter the data set all cows had to be on the diet a minimum of 14 d, have been milked within 12 h of calving, and have not been treated with bovikalc after or before calving. Cows were lactation 2 – 6. The author reports colostrum creation pre-calving is a significant drain on the cow's calcium reserves and results in this study determined that X-zelit supplemented cows noted higher (P<0.001) ionized calcium concentrations in serum before and after milking the colostrum. NSD in colostrum weights or BRIX but colostrum did have increased (P=0.04) IgG content from cows supplemented with zolite (91.4 mg/dL for colostrum from zeolite supplemented cows, vs. 78.9 and 80.7 for positive DCAD and negative DCAD fed cows, respectively). NSD in total Ca in colostrum. n=108. U Federal de Minas Gerais Belo Horozontes, Brazil. UW Madison. P260.
4. *Effect of late gestation heat stress on the calf.* Review of research: Dado-Senn et al 2020 and Laporta et al 2020 found THI≥68 (Temp/humidity index) resulted in a newborn heifer calf with poorer growth and metabolism, impaired immune function resulting in poorer survival and welfare that later resulted in poorer mammary development and lesser future milk production. Data shows 3 – 5 kg lesser daily milk over multiple lactations if the future cow was heat stressed in utero (Skibiel et al. 2018a, 2018b; Geiger et al 2016; Soberon et al 2012). Why? Smaller alveoli and greater connective tissue area in the mammary gland if heat stressed in utero. Abstract's research: Aug – Dec 2020 on a commercial dairy in Florida dams entered the study ~56 d prepartum by either being kept cool via shade of the barn and soakers and fans or provided only the shade of the barn (no soaker and no fan). Calves not euthanized at birth were fed a gallon of high-quality colostrum. 8 calves from each group were euthanized within 4 h of birth and the rest were raised together and fed 1.92 lbs./d CMR powder and grain ad lib and euthanized d 63 (calves were weaned by half feeding d 49 – 56). Organs were harvested and gross morphology of the mammary gland was conducted. Results: THI was maintained about 68 for the approximately 54-d prenatal period. Dams exposed to heat stress with no heat abatement strategies noted increased (P<0.05) respiration rate and increased (P<0.05) skin temperature compared to dams provided soakers and fans. Birth weight was lesser in heifer calves from dams that lacked the extra heat abatement strategies (P<0.05) and, also, gestation length shorter (P<0.05) in dams experiencing greater heat stress. Mammary gland weight, either trimmed, as fat pad, or as parenchyma were lesser (P<0.05) at birth in heifer calves from heat stressed dams and

trimmed and fat pad measures (but not parenchyma) corresponded less (P<0.05) at weaning as well in heat stressed vs. control heifer calves. Mammary gland length, distance front to rear teats, and distance between front teats was lesser (P<0.05) d 0 in heifer calves from heat stressed dams vs. control, and by d 63 only the gland length difference was maintained (P<0.05). Parenchymal histology: in utero heat stressed heifers note reduced parenchymal ductal structure area early in life (P<0.05). Parenchyma cellular proliferation was also reduced (P<0.05) in heifers born of heat-stressed heifer dams vs. cooled dam control. n=82. UW-Madison. Zinpro. U of Fla Gainesville. 429.

5. *Effect of body condition score at calving, seasonality of calving, and parity on performance of cow and calf.* Holstein cows from one commercial farm in S. Brazil that calve a female calf were evaluated. Calves from primiparous parity noted lesser (P<0.01) birthweight (86.1 vs. 91.3 lbs.) and increased ADG (2 vs. 1.94 lbs./d) vs. calves from multiparous cows, however, NSD in weaning weight (P=0.48; app. 266.6 lbs.) age at first calving (P=0.84; app. 720 d), daughter 100 d milk yield (P=0.84) or daughter 305 d milk yield (P=0.89), total culled (P=0.11), culled until weaning (P=0.79), or breedings per pregnancy (P=0.2). As expected, multiparous dams produced more 100 d and 305 d milk (305 d was 19,032 vs. 23,724 lbs.; P<0.01 for both measures) vs. primiparous cows. Calves born in winter had greater birth weight (P<0.01), and greater weaning weight (P<0.01) vs. all other groups, and greater ADG (930 g/d) vs. calves born in summer (870 g/d) (P=0.03). Calves born in winter noted lesser age at first calving (694 d, P=0.04 vs. spring, 737 d or summer 736 d) and increased 305d MY (23,942 lbs.) vs. summer (21,188 lbs.) or fall (19,319 lbs.) (P=0.01). Daughter 305d milk yield was lesser for calves born in the fall (14,916 lbs.) vs. any other season (20,313 lbs. winter, 21,957 lbs. in spring, 17,111 lbs. in summer) (P=0.03). Calves born from higher body condition score cows were heavier at birth (P<0.01) but noted NSD in ADG or weaning weight, also, NSD in age at first calving or dam 100 d milk yield. Dam 305d milk yield tended (P=0.06) more in higher body condition score cows. NSD in daughter 100 d or 305 d milk yield (P=0.77 and 0.99) due to dam body condition score at calving, and NSD in cullings or breedings per pregnancy, either. n=521 cow and female calf pairs evaluated. U Fed do Parana, Brazil. Negocios Leite, Castrolanda Cooperativa Agroindustrial Castro, Parana, Brazil.
6. *The associations between cow activity patterns the final 2 wks of the dry period and calving events.* To be productive and healthy via good rumen health and adequate time resting, Gomez and Cook (2010) determined cows in free stall barns should spend 11.9 hours lying down, 4.3 hours feeding, 5 hours standing in the alleyway and drinking, 2.7 hours milking, and 2.7 hours standing in the stall in each 24 h period. Barragan et al (2018) determined cows with clinical metritis spent more time lying down and Menichetti et al (2020) determined cows that had a stillborn calf experienced reduced lying time 7 d prior calving. Heifers and cows on 4 dairies (700 – 2800 milking cows) located in PA entered the study 20 – 30 d prior expected calving date and were fitted with a HOBO accelerometer on the rear right leg. Births were monitored for calving

difficulty (no, mild, or severe assistance), calf presentation (forward, backward, breech, large calf), calf limb position (extended or deviated), twin/stillbirth and calf sex. Results: heifers spend less time lying down compared to cows (no stat provided) during 14 d prior calving (12.8 vs. 13.2 h); Heifers and cows that had a female calf also spent more time lying down, had more lying bouts and lying bouts that were shorter in time as compared to heifers and cows that had a male calf (no stat). Severe assisted births noted more lying time pre-calving (no stat) compared to mild or no assistance at calving. Monitoring cow behavior prior calving may predict calving events. n=66 heifers and 70 cows. Penn State U. The Ohio State U. SC169.

Fats and oils nutrition (4 abstracts):

1. *C8:0 (Caprylic) and C10:0 (Capric) fatty acids?* Hypothesis – feeding C8:0-C10:0 to dairy calves will improve their systemic adaptive immune response (abstract 424) and feeding C8:0-C10:0 will improve growth and health (abstract 425). The author reports in vitro data shows C8:0-C10:0 to have antiviral and antibacterial properties (My comment, coconut oil is 0.8% caprylic acid and 6.2% capric acid, while palm kernel oil is 4.1% caprylic acid and 3.6% capric acid and butter fat is 1.4% caprylic acid and 3.1% capric acid; palm oil, lard, and tallow all contain <0.1% of C8:0-C10:0; FA values are from an exhaustive recent review conducted in The Netherlands). Holstein bull calves, 2 – 3 d age, 93.3 lbs. were fed a 24:17 CMR and 18% CP calf starter either with or w/o 0.5% C8:0-C10:0 oil added to the CMR powder and 0.75% C8:0-C10:0 oil added to the starter grain. C8:0-C10:0 inclusion replaced fats or oils so both diets were isonutritious. Calves were fed 6 quarts/d of milk replacer solution wk 1 (3 qts, 2x/d), then 8 quarts/d wks 2 – 6, then 4 qts in a 1x/d strategy week 7 wean. % solids was not reported. BW and dimensions measured weekly. Fecal score (1 – 5) and scouring days were noted as >2 fecal score. Med treatments and BRD treatments were recorded. NEFA, BHBA, Insulin, and glucose from blood samples were taken d 42, 49, and 56 to monitor weaning pre-, during and post-wean. Texturized calf starter was offered ad lib. Vaccine challenge was administered (11 calves/treatment) d 16/17 and d 37/38 via IM injection (1 ml of ovalbumin with 1 mg of aluminum hydroxide adjuvant). Nasal and fecal samples were captured d 16/17 (just prior vaccination), d 37/38 (prior 2nd vaccination), and d 51/52 (2 weeks after booster vaccination) to measure bacterial and viral shedding. Blood samples were drawn d 1 (baseline), d 37/38 (just prior calves were vaccinated a 2nd time in order to determine IgG1 and IgG2 anti-OVA antibody production), and d 51/52 to measure cytokine production (again, to measure anti-OVA antibody production after the booster vaccination, but also to look at IFN-gamma and IL-4 secretions by peripheral blood mononuclear cells upon stimulation in vitro with both ovalbumin, i.e., what the calves were vaccinated with, and also with phytohemagglutinin, a known stimulator of the immune system). Nasal shedding from swabs examined coronavirus, BRSV, BVD, IBR, and PI3. Coronavirus was found in all three time periods nasal swabs were taken and there was NSD in virus shedding between the two groups (as measured by PCR counts, P

value 0.64, 0.76, 0.56 for the three time periods). PI3 was found d 51/52 and NSD (P=0.24) in PCR counts. No other viruses were found. Fecal shedding: PCR counts were made for coronavirus, rotavirus A, E coli K99, crypto, and salmonella. Coronavirus was found in feces collected from all time periods, but PCR counts were NSD (P value 0.62, 0.71, 0.65 for the 3 time periods). Rotavirus A was found in feces collected from all time periods, but PCR counts were NSD (P value 0.78, 0.71, 0.74). Crypto was found in the fecal samples taken prior vaccination and NSD between group. Crypto was not detected in the latter two fecal measures. Salmonella was found in first fecal sample prior vaccination (NSD, P=0.44) and d 37/38 in the fecal sample taken just prior the booster vaccination, and calves fed C8:0-C10:0 noted increased (P=0.04) PCR counts. No other pathogens detected in feces. Blood samples: IgG1 - both groups noted significant increases d 37/38 vs. baseline measure prior vaccination, clearly showing the vaccine worked, but NSD in IgG1 response between groups. Day 51/52 followed suit, showing an increased antibody response, but NSD between calves fed, or not fed C8:0-C10:0. IgG2 - only the control calves (not the C8:0-C10:0 calves) had a significant (P=0.003) improvement in antibody response at d 37/38, however, both had comparable response over baseline, and NSD between the two at d 51/52. Both measures (IgG1 and IgG2) showed the importance of booster vaccines (treatment x time effect P<0.001). IFN-gamma and IL-4 production by blood mononuclear cells, NSD between treatments or in measure methods. NSD in BW (P=0.57) any week except the final measure (d 57) where calves fed C8:0-C10:0 trended (P≤0.1) greater. NSD in ADG any week except week 8 where calves fed C8:0-C10:0 noted increased (P<0.05) ADG, suggesting post-weaning C8:0-C10:0 assisted during the weaning transition. NSD in body condition score, hip width or height, or heart girth measures. NSD in CMR intake, starter intake, total intake, or feed efficiency. NSD in STP (6.03 and 5.81 g/dL; P=0.29). Trend (P=0.08) toward reduction in daily fecal score if fed C8:0-C10:0, but NSD in scouring days, medical days, or BRD treatments. n=22 in vaccine challenge, n=32 in performance data. NEFA was lower d 42 for calves fed C8:0-C10:0, but otherwise no difference in energy balance (BHBA, NEFA, Insulin, Glucose) at any measure (d 42, 49, 56). Author notes C8:0-C10:0 FA's are a quick energy sources because they can be absorbed promptly not needing micelle formation prior absorption. Purdue. Cargill. 424, 425 concurrent oral presentations.

2. *Increased medium chain fatty acids (MCFA)?* Holstein heifer calves were fed 28:18 CMR containing either a.) 3.2% caprylic acid and 2.8% capric acid or b.) 6.7% caprylic acid and 6.4% capric acid from d 2 to 42 in a step up (600 to 1,200 g/d over 10 d), step down (800 g/d wk 5) fashion and weaned d 42. Starter grain and chopped timothy hay were offered ad lib. BW measured weekly to week 13. Total tract digestibility measured wk 13. Plasma concentrations of GH, IGF-1, progesterone, and IL-6 measured every 2 weeks to 41 wks. Rumen LPS activity measured wk 8 and 13. NSD in CMR intake or BW. NSD in BW, ADG, DM digestibility, N retention or rumen VFA concentration at 13 wk. Grain intake was reduced (P<0.05) at wk 7 and 10 in the group fed the increased MCFA

formula. Plasma IGF-1 were higher (P<0.05), plasma IL-6 lower (stat not clear), and Rumen LPS activity lower (stat not provided) for calves fed increased MCFA. Percentage of heifers showing first ovulation (as measured by progesterone) before 41 wks was increased (P<0.05; 19% vs. 61%) for heifers fed increased MCFA in CMR. n=41. ZENRAKUREN. U of Hiroshima. 10 other Japanese research institutions. P268.

3. *Sodium butyrate and increased caprylic and capric fatty acids (medium chain fatty acids)*. Holstein heifer calves fed 28:18 CMR containing either a.) 3.2% caprylic acid and 2.8% capric acid (control), b.) 6.7% caprylic acid and 6.4% capric acid (medium chain fatty acids) with or w/o 0.6% tributyrin on a DM basis in a 2 x 2 factorial from d 8 to 63. CMR fed at 1.32 lbs./d day 8 – 14, 2.9 lbs./d day 15 – 21, 3.1 lbs./d day 22 – 49, 1.54 lbs./d day 50 – 56, 1.32 lbs./d day 57 – 63, weaned d 64. Starter and chopped hay both fed ad lib. Results: NSD in MR, starter, or hay intake during any phase of production pre or post wean (monitored to d 91). Tributyrin improved (P=0.048) body weight during transition and post-weaning. Added medium chain fatty acids improved G:F (P=0.03) d 23 – 49 (0.71, 0.74, 0.71, 0.75 for control, medium chain fatty acids, tributyrin, and combined MCFA and tributyrin, respectively). Blood samples collected day 3 h post MR fdg. Serum BHB and plasma GLP-2 measured. Plasma metabolite and hormone concentrations not affected by MCFA and tributyrin supplementation. n=63. ZEN-RAKU-REN. Hiroshima U. YPTECH Co. Ltd. P348.
4. *Lard, tallow, or vegetable oils?* Holstein heifer calves were fed a Deccox-containing 24:22 CMR composed of either a.) lard, b.) tallow, c.) lard/tallow blend, or d.) vegetable fat (palm oil blend). Holstein heifer calves (2 – 5 d age) were fed a 24:22 CMR at 1.23 lbs./d wk 1 – 2, 1.5 lbs./d wk 3 – 5, and then 0.75 lbs. (1x/d) to 42 d wean. Neomycin/OTC was supplemented d 1 – 14 (22 mg/kg BW/d). NSD in STP, ranging from 5.78 to 5.95 mg/dl. Starter (18% CP, medicated, I assume coccidiostat) offered ad lib. BW measures taken d 1, 14, 28, 42, and 56 and NSD found at any measure (56 d ADG ranged from 1.45 to 1.59 lbs./d). Hip height measures taken d 1 and 56 and NSD found. Fecal scores (1 – 4) determined daily and NSD in fecal score or scouring days. Treatment costs pre-wean trended less (P≤0.10) for calves fed lard- and palm oil blend-CMR vs. calves fed tallow-CMR with the lard/tallow blend intermediary. Feed refusals taken weekly. Starter intake d 56 trended (P≤0.10) greater for calves fed the palm oil blend (103.4 lbs.) vs lard (91.5 lbs.) or the lard/tallow blend (89 lbs.), with tallow intermediary (96.3 lbs., NSD). NSD in starter intake pre-wean, the trends occurred in post-wean starter intakes. NSD in gain:feed. n=106. U of MN. MSG. P343.

Health, respiratory Disease (BRD), enteric disease, and immune function (5 abstracts):

1. *Antibiotic resistance associated with feeding antibiotic contaminated waste milk.* Dairy calves (breed not mentioned) were fed either a.) whole milk w/o antibiotic residue, or b.) whole milk with antibiotic residue. All were fed 6 L/d split evenly 2x/d to d 60 of life. Stool samples were obtained from the rectum d 60 and *E coli* was isolated from each sample and tested for sensitivity to amoxicillin, ampicillin, ceftiofur, cefoperazone,

florfenicol, enroflaxacin, and streptomycin. Calves fed whole milk void of antibiotic residue noted minimal antibiotic resistance (1 of 15 calves to amoxycillin, 2 of 15 to ampicillin, and 1 of 15 to florfenicol were the only *E coli* resistance identified). However, calves fed whole milk with antibiotic residue noted resistance to *E coli* to amoxycillin, ampicillin, ceftiofur, cefoperazone, florfenicol, and enroflaxacin, with only streptomycin not showing any resistance, and this was the least used antibiotic in the herd. Between groups, calves fed whole milk with antibiotic residue showed superior resistance ($P<0.05$) to amoxicillin, ampicillin, ceftiofur, cefoperazone, and enrofloxacin and NSD in resistance for florfenicol and enroflaxacin. Florfenicol was not found in the milk. n=30. U Fed de Minas Gerais Belo Horizonte, Brazil. Embrapa Dairy Cattle Juiz de Fora, Brazil. P331.

2. *Feeding and behavior activities associated with recovery/or lack thereof from BRD?* Calves (breed not identified in abstract) identified with BRD and treated (enrofloxacin 1 mL/kg BW administered d 0) were fitted with an accelerometer (IceRobotics Scotland) and offered 10 L/d CMR and starter via an autofeeder. Accelerometer tracked lying time, step count, lying bouts, for 10 d post treatment and an acceleration activity index was determined. The autofeeder monitored milk intake, drinking speed, visits, and starter intake. Clinically sick was defined as BRD score ≥5 and lung consolidation of ≥3 cm^2 (Wisconsin scoring system) and calf symptoms were recorded daily, and lung ultrasounds conducted 2x/week. Recovery status was evaluated d 10 – 13 post AB treatment, success or failure rates ascertained and feeding and activity behavior during 10 – 13 d period analyzed. Pairing calves by the age treated birthdate and sex was performed. Avg recovery rate was 6 ±2d. Calves that relapsed had more ($P=0.001$) lying time than calves that responded to enrofloxacin treatment to BRD. Calves that relapsed noted a trend ($P=0.07$) towards less change (I assume less increase) in starter intake than those that recovered. Relapse calves also noted less change in the step count and in activity index ($P\leq0.04$) than response calves. n=36. U of KY. U of Guelph. 179.
3. *Can feeding behavior data aid in detection of diarrhea, naval infections, and BRD?* In 2015 16% of Canadian producers reported using an automated milk feeding system. 8 farms with Foerster-Technik autofeeders located near Guelph were visited 1x/ season (4x/year) between Fall, 2015, and summer, 2016. BRD was health scored using the UW Madison scoring systema and scour scores were recorded during these visits. The calf was considered to have BRD if cumulative score met or exceeded 5. Loose or watery feces were classified as scour score 2 or 3 and was considered diseased. Naval infections (enlarged, painful, warm, or had discharge) were also monitored. Age of calf, days on feeder, milk consumption (ml/d), drinking speed (ml/min), total time at the feeder (min/d), % of milk allotment consumed (per d), rewarded visits (per d), and unrewarded visits (per d) were recorded from the autofeeder data. 523 calves were assessed, and 22% had BRD, 25% had diarrhea, 40% had general disease (naval infections). Diseased calves consumed significantly ($P<0.05$) lesser % of their daily milk allotment as compared to “comparative” (a calf not suffering from the same malady, or that was

healthy) calves (down 10 – 11%) and the reduction was similar between diseased calves diagnosed with BRD, scours, and general disease (primarily naval infections). Total milk consumption was reduced in diseased calves suffering from general disease (naval infections) and scours (P<0.05) but did not reach statistical significance in calves suffering from BRD (however, % reductions, on average, were 5.4%, 7%, and 6% for general disease, scours, and BRD, respectively, so quite similar, numerically). NSD in number of rewarded visits and total time at the autofeeder when comparing diseased calves to comparative calves, although, numerically, time at the autofeeder was consistently 5 – 7% less in diseased calves. Milk consumption had the highest sensitivity in detecting disease (55% for scours and 59% for general disease) while unrewarded visits had the least sensitivity (35% for BRD and 43% for general disease). Percent of the allotment consumed and drinking speed were intermediary. Drinking speed had the highest specificity for disease detection and ranged from 47% to 54% for the three disease categories. % of milk allotment consumed had the least specificity (27% to 32%, depending on the disease category). Pat-Horenczyk et al, 2013 was a citation shared in the presentation to help understand parallel testing of sensitivity and specificity of feeding behaviors. Authors noted using a "cut point" of optimal sensitivity and specificity increased BRD sensitivity to 82%, scours to 78%, and general disease to 84% accuracy in using feeding behavior to detect disease. However, specificity was greatly compromised. n=8 farms and 523 calves monitored. U of Guelph. U Agraria de Columbia, Bogota. U of KY, Lexington. 178.

4. *High risk management practices for Johne's disease infection.* Culling based off Johne's testing is not optimal (too many false negatives). A voluntary control program (OJEMAP) was conducted in Ontario with 52% of herds participating (2153/4148) and 1% positive animals detected in 139,893 animals. Whole herds were evaluated using individual cow milk or serum ELISA testing. Farm management to prevent Johne's was assessed. The program also ELISA tested milk bulk tank samples and found 46.8% positivity rate for Johne's in 2013 and 71.4% positivity rate in 2017. 180 farms from these earlier assessments were selected for follow-up Johne's risk assessment in 2019. 97 variables passed thru unconditional models, 25 were significant variables P<0.2. Results: a.) farms reporting to have more than one cow in a calving pen >25% of the time at the time of the OJEMAP risk assessment were 3x more likely to have high bulk tank milk ELISA compared to farms that had only one cow in the maternity pen at a time. b.) farms with more calvings outside the designated maternity area were more likely to have successful Johne's control, c.) herds with more contaminated heifer environments were less likely to achieve control vs. those with cleaner heifers and heifer environments. Author summarizes that crowded maternity barn environment increases fecal/oral transmission; also, keeping wean and bred heifers clean may play an important role in controlling Johne's. U of Guelph. ACER Consulting, Guelph. 293.
5. *Antimicrobial resistance in sick calves in Ontario 2007 to 2020.* According to CIPARS (2018) excluding ionophores and chemical coccidiostats, production animals consume

78% of the antimicrobials in Canada (human pharmacy is 17%). Calves also have a higher risk of excreting resistant bacteria than cows (Springer et al., 2019; Davidson et al., 2018). Details (season, age) of antimicrobial resistance to *E. coli* and *Salmonella* occurring in samples from 0 – 2-month-old calves submitted to Animal Health Laboratory in Guelph, Ontario between 2007 and 2020 were evaluated. Kirby-Bauer disk diffusion results on sample, animal, and bacteria were tabulated from final reports. Samples from embryo, fetus, stillborn, environment and research/herd monitoring purposes were omitted from the analysis. Multivariable logistic regression model by disease and for year, season, and age, was established using Stata 16. Antimicrobial susceptibility testing results were collected from 1,334 calves less than 2 months age from this timeframe (2007 to 2020). Most samples tested were feces/GI tract or lung samples. Most were E coli or salmonella. The odds of AB resistance to *E. coli* increased during the 2007 to 2020 period for Spectinomycin (P<0.05). A marked increase in resistance occurred between 2013 and 2014 and that increased level of resistance maintained mostly until 2020 (approximately doubled from 30% to 60%, just a visual assessment of the graph). Odds of resistance to sulfonamide was stable through 2018 but increased (P<0.05) in 2019. Odds of resistance (again, E coli) to tetracycline was mostly stable with a spike up (P<0.05) in 2019 as compared to 2007 and 2008. Similar was trimethoprim-sulfamethoxazole, as it was stable except when comparing 2019 to 2008. The odds of AB having resistance to E coli increased oftentimes with age. Samples from calves >2 wks age had higher odds (P<0.05) of resistance to E coli for sulfonamide, kanamycin, tetracycline, and trimethoprim-sulfamethoxazole. No effect from season for AB resistance to E coli in this dataset. Regarding *salmonella*, the odds of resistance to ampicillin increased (P<0.05) from 2016. Resistance to ceftiofur remained low but increased in 2019 (P<0.05). Resistance to sulfonamide increased (P<0.05) from 2017. Resistance to tetracycline increased in 2018 compared to 2007. Odds of resistance was greater (P<0.05) in calves >2 weeks age in ampicillin, ceftiofur, sulfonamide, and tetracycline. Seasonal differences in AB resistance to salmonella were only noted in spring (less, P<0.05) for spectinomycin and in fall and winter (more, P<0.05) for trimethoprim-sulfamethoxazole. The author summarized that AB resistance to salmonella and E coli in calves 0 – 2 months age "was stable or increased from 2007 to 2020" and was noted more in "calves greater than 1 week old." n= records from 1334 sick calves. U of Guelph. Atlantic Vet College U of PEI. 180.

Management and housing (38 abstracts) (key topics: housing, heat stress, behavior, transport, surveys of calf raisers, genetics, disbudding and pain management):

1. *Validating an automatic system for monitoring calf body weight and starter intake.* A hutch with a weighing platform that has weight sensors and solar panels on its roof to electrify the scale and that communicates with your smartphone was established and tested using a conventional scale measuring calf body weight 2x/week. Starter was adjusted daily to have 2 kg. Orts were weighed each morning and feed intake calculated.

These manual measures were compared to what the automatic system determined. Accuracy for determining starter intake was $R^2 = 0.92$, and accuracy for determining body weight was $R^2 = 0.71$. The system was deemed worthy for on-farm tracking of calf performance. N=14. U of Sao Paulo. P336.

2. *Does calf birth weight effect dam's milk production?* 11,112 lactation records with no recorded dystocia from 4,350 spring-calved cows on pasture in Ireland, spanning over a decade, were analyzed. Average birth weight 79.8 lbs. The majority were Holstein-Friesian, second was Jersey and a significant portion were native breeds. Calf birth weights >90.4 lbs. from primiparous cows reduced peak (60 d) and total (305 d) milk yield. Also, primiparous cows noted poorer nadir body condition and a longer interval to first service. Conversely, multiparous cows noted +133 lbs. and +417.8 lbs. d 60 and over 305 d, respectively, if having given birth to a >90.4 lbs. birth weight calf. Also, multiparous cows noted better nadir body condition, and improved milk fat and protein with heavier births. NSD in pregnancy rate and increased incidence of mastitis if multiparous cow gave birth to a heavier calf. N=4,350. Innovation Center Cork, Ireland. Munster Tech U Cork. Irish Cattle Breeding Federation. P163.
3. *Individual or pair housing?* At birth Holstein calves were housed either individually or paired through weaning and until 8 weeks of age. All calves were offered 8 L/d of milk replacer via a teat bucket and ad lib access to pelleted grain. Commencing at 6 weeks of life calves were weaned over 10 d. At 8 wks all calves were co-mingled, and group housed (5 ±1 per pen) for one week and then moved to pasture and monitored for body weight weekly for 2 more months. Milk intake did not differ (P=0.22). Duration of scours (tracked first 14 days) did not differ (5.7 individual vs. 3.9 d paired; P=0.16). Paired calves tended to consume more grain pre-wean (P=0.064; 96.1 vs. 62.5 g/d). During weaning paired calves consumed more grain (P=0.05; 2.42 vs. 1.94 lbs./d). No effect on pre-wean ADG (1.3 vs. 1.26 lbs./d; P=0.17) nor in post-wean ADG during grouping (P=0.67), or after 2 months on pasture (P=0.80). n=35 (15 individual, 10 pairs). U of Florida. U of Helsinki. P111.
4. *How does the personality variation in calves effect their social behavior, feeding behavior, and interaction with their environment?* Holstein heifer and bull calves were introduced to groups at 2 weeks age (8 calves/pen: 7.4 x 16 m or 1274 ft^2/calf). Each pen included a rotating brush and a 3-sided shelter. Calves were on an autofeeder and feeding behavior was analyzed d 30 – 36. Behavior was analyzed d 27 – 30 for 10 minutes per calf. Each calf was examined in an open field test (no object), a novel object test (a large green ball 2.5 m away), an unfamiliar calf test (two unfamiliar calves 2.5 meters away), and an unfamiliar human test (2.5 m away). Assessment showed calf avoidance traits correlated with increased shelter use (P=0.10), more lying in the shelter (P=0.07), decreased entering of an occupied shelter (P=0.06) and more milk intake (P=0.10). The human directed factor was only associated with more brush use (P=0.01). The calf's personality is associated with feeding behavior, use of shelters, and use of rotating brushes. n=32. U of FLA. P112.

5. *3 hutches merged group housing in CA.* Calves on a N. CA dairy were sequentially placed in either a group house setting merging 3 polyethylene hutches together with an outside area 1.5 m x 3.6 m or kept with the traditional individual polyethylene hutch with the routine outside area 1.5 m x 1.2 m. Wire panel fencing was used with posts and ties to easily create inexpensive group housing. Calves were reared individually until 7 d age and then the hutches and exterior aprons merged for the group housed calves. Individual calves in both groups were weighed at placement and at weaning at 70 d. STP was not reported, nor was feeding milk/CMR or grain feeding practices except to report calves were fed an accelerated nutrition program peaking at 2 gallons per d at d 42. Health and behavior were monitored daily. The CA bovine respiratory disease (BRD) scoring system was used to track respiratory disease incidence (≥5 score was medically treated). Incidence of BRD was 71.4% and 76.2% for individual and group housed calves, respectively (NSD, P=0.73). Calves were scour scored daily and 100% of the calves noted scour score 2 or 3 triggering medical intervention. No data on scours was reported. Growth to 70 d was 1.47 and 1.36 lbs. per day for group and individually housed calves, respectively (NSD; P=0.32). Height gain was 0.09 and 0.085 inches per d for group and individually housed calves, respectively (NSD; P=0.58). Behavior was reported to be largely reported in a separate report, but highlights were mentioned: much play activity in group housing; much social intervention. Calves were monitored every 10 m for 60 m per day each day of the study. Cross sucking occurred but was reported as not a large problem. Even in hot weather the three grouped calves frequently shared the interior of one hutch to lie down during the day. System was reported as cheap and effective to create group housing. Starter intake was not reported. n=42. UC Davis. Vet Med Teaching Center, Tulare, CA. Cooperative Extension UC Orland, CA. 177.
6. *Group housing vs. individual? Keeping dam and calf together?* Calves are naturally group-living animals. Utilizing nurse cows keeps high SCC milk out of the tank, keeps contagious cows away from un-infected cows, reduces milk being shipped if needed. Johnes is a concern. Surveys taken at the MN State Fair (n=1,773) showed 78% of adults preferred group housing and youth preferred group housing overwhelmingly. Pair housed calves gained more weight during the prewean period and tended to calve earlier (JDS Communications, recent), results: prewean ADG: low milk (4 L/d) individually housed 1.3 lbs./d (b), hi milk (8 L/d) individually housed 1.74 lbs./d (a), lo milk (4 L/d) social housing 1.5 lbs./d P=0.04 (ab), 305 d milk production 1st lactation 23,229, 23,653, 21,841, pounds, respectively, P=0.44. UK study pair housed study showed no effect of housing on ADG, but pair housed calves had more grain intake than individually housed calves (citation: Commercial Dairy Farm Animals, The health and behavioral effects of individual vs. pair housing of calves at different ages on a UK commercial dairy farm). Abstract 108 in this meeting compared U MN Morris 8 L/d vs. ad-lib milk intake on an autofeeder, birth to wean ADG 1.94 vs. 2.5 lbs., respectively, and total milk consumed 406.5 vs. 567.1 L, drinking speed 1,475.7 ml/m vs. 1,105.8 ml/m, milk consumed per calf per d 7.4 L vs. 10.3 L/d, P<0.05 differences across all

measures. Abstract 444 (Heins and Sharpe) compared hutches vs. autofeeders vs. calves on cows either on pasture in summer or in a bedded pack barn in the winter. When calves raised with their mother, the dam was still milked twice daily in a parlor. Group fed (n=15), individually fed (n=16), raised on cows (n=14). Mix of Holstein and crossbreds (Jersey, Normande, Viking Red). STP not different. ADG to 60 d 2.16 vs. 1.07 vs. 2.9 lbs. for group fed, individually fed, and raised on cow, respectively. Cow on calf reared calves were larger in weight and in heart girth at 60 d. Calf reared on cow also relied on suckling colostrum and noted no difference in STP. Calves reared on the cow were the same in growth as calves reared ad libitum out to 12 weeks. Calves reared on cow have more hygiene issues, belly, side, and rear cleanliness, but scour and respiratory scores not different. USDA funded study is ongoing comparing individual, pair-housed, group-housed, and calves raised on cows, results Fall 2020 (preliminary, 2-year study): ADG 2.11, 2.02, 2.21 vs. 2.8 lbs. per d, respectively. Calves suckling cows drink more milk, so they gain more; STP 6.3, 5.4, 5.8, and 6.7, respectively. Number of calves in each group, n=22, 22, 23, and 28, respectively. U of MN, Brad Heins. S134.

7. *How does transport and duration of transport effect lying behavior during travel and for the first days upon arrival?* Calves were hauled in a chopped straw deep-bedded gooseneck trailer from the source dairy for either 6 h, 12 h, or 16 h. Calves were then unloaded into the veal facility. Male and female calves, 5 groups of between 18 to 28 calves, 1 to 22 d of age, were followed in the study. Transport occurred between Oct and April 2021 in S. Ontario from 5 farms of birth to a single grain-fed veal facility. Lying behavior was tracked using HOBO data loggers attached to hind leg of the calves and monitored from 2 days prior to 5 days after transport. Results: calves spent the least amount of time lying on the d of transport (P<0.001) and all three transport times, 6, 12, and 16 h, were affected (reduced from about 20 h to 15 or 17 h per day lying time). Post transport lying time promptly went back to a similar number of hours calves lied down pre-transport. Also, calves transported 16 hours spent less time (P=0.01) lying down during the day of transport as compared to calves transported 6 h. Calves transported for 12 h were intermediary. Finally, calves transported 12 or 16 hours spent more time lying down during the 3 days post transport as compared to those transported 6 h (P<0.001). Calves that were transported longer took more days to recoup from the stress of transport. Lying bouts per d were greater (P<0.001) during d of transport, increasing from 15 bouts/d to 20 to 27 per d depending on the treatment group. Also, calves transported 16 h noted more lying bouts (exceeding 25/d) as compared to those transported 6 or 12. This is likely due to the number of starts and stops during the trip. Calves have lingering effects from transport, particularly longer transport times. n=114. U of Guelph. U of PEI. 172.
8. *Long distance trucking – effect on health of excess calves for the first 2 weeks when reared as grain-fed veal?* In Canada, a new 2020 law requires calves < 8 d age to be transported only once (no assembly center), 12 h max duration of transport until unloaded for a break, also, 12 h max duration off feed and bedding is required. Calves

were enrolled at birth on 5 dairy farms in Ontario and monitored daily via health exams. Calves 2 – 22 d of age were randomly assigned to 6, 12, or 16 h of transport in a gooseneck trailer, and daily health exams (enteric and respiratory) were performed for 14 d after arrival at a veal facility. Calf age and weight were not different between transport stress groups. Poisson regression models were built to assess calf health. Calves transported 16 h had higher incidence (1.3x; P=0.02) of abnormal fecal scores compared to 6 h transport with 12 h transport intermediary and NSD (P=0.24) (oral presentation presented stats on the rate of abnormal fecal scores while the abstract reported Relative Proportion Ratio, which reports the same disparities, just in a somewhat different statistical perspective). "As age increased, the proportion of days with an abnormal fecal score decreased (P=0.001)." NSD in number of days with abnormal respiratory score across treatment groups. "Compared with calves less than 41 kg (90.4 lbs.) at arrival, calves weighing 41 to 47 kg (90.4 to 103.6 lbs.) were less likely to have abnormal respiratory scores" (P=0.04), "but there was no difference for calves 47 to 52 kg (103.6 to 114.6 lbs.). Seasonally, there were differences. Calves transported in the winter noted an increased days of abnormal respiratory scores compared to calves transported in the fall (P=0.01) or in the spring (P<0.001). Calves with good colostrum status (STP 5.8 – 6.1 g/dL) noted lesser proportion (38% as many days, P<0.001) of days with an abnormal respiratory score compared to those with poor colostrum status (<5.1 g/dL); excellent colostrum status was intermediary (75% as likely as poor colostrum status calves; P=0.13) between good colostrum status and poor. Fair colostrum status (STP 5.1 – 5.7 g/dL was NSD (P=0.78) compared to poor. Author noted Boulton et al (2020) reported odds ratio for young calf mortality increased by 1.5 for each hour calves were transported, and that transport duration increased morbidity and mortality (adding Mormede et al, 1982 to this health citation), and that "winter was associated with the highest post transport mortality rates in Canada" (Windsor et al 2016; Renaud et al 2017). n=119. U of Guelph. U of KY, Lexington. 186.

9. *Survey of Ontario dairy farmers on male calf care.* Survey of all (3,367) Ontario dairy producers. 248 responses, and of the 38 calf questions noted 170 – 183 responses depending on the specific question. 78% of respondents were owners, 8% managers. Respondents 68% male, 30% female. Equal age distribution. Amount of colostrum fed was similar between male and female calf averaging around 3.5 L (9% offered less than 3 liters). Male calves were offered less milk/d in weeks 2 (app. 7+ liters; P<0.001) and 3 (app. 8 liters; P=0.007). Male calves received more raw waste milk (P=0.06). Raw waste milk was reported fed by app. 12 – 16% of survey respondents. NSD in male calves being fed CMR (35 – 45% of all respondents), pasteurized milk (low single digits), or raw milk from bulk tank (app. 40% of all respondents) when compared to how female calves were fed on farm. Male calves were mostly sold at less than 14 d age, most 7 – 10 d. 27% respondents identified male calves being picked up and taken to an auction as the means male calves are sold, while 60% reported them being picked up and taken to a calf raiser. Only 8% remained on farm. Most farmers had a positive attitude towards

caring properly for male calves (multiple questions), even when their selling price is very low. However, survey questions showed price incentives may motivate a higher level of care. Feedback from calf buyers might be influential on calf care on the dairy, according to survey responses. U of Guelph. Atlantic Veterinary College, PEI. ACER Consulting, Guelph. 185.

10. *Scoping review of the literature about transporting young dairy calves.* 47 research articles were identified of the initial search of 6,862 articles in 8 databases. Criterion to select included investigating transport of calves of any sex, calves younger than 60 d age or weighing less than 220 lbs., and/or research that discussed stress, morbidity, or mortality of transported calves. Most (26) were experimental in study design, with 15 using a cohort design and 5 a cross-sectional design. Most common risk factor studied were time to transit; distance traveled, feeding, and age were also leading risk factors studied. Blood parameters, health assessment, weight and behavior were leading ways to evaluate transport. "A diverse range of risk factors and outcomes were evaluated in the studies included in this scoping review, making it difficult to compare findings." U of Guelph. P152.
11. *Growth and carcass traits in beef x dairy crossbreds.* As compared to traditional US beef genetics, data shows dairy beef (Holstein) calves typically have higher average USDA quality grades and less subQ fat, however, data also shows they have lower ADG & lower carcass yield, lighter muscling, smaller ribeye area and undesirable elongated shape of loin, and either lighter or heavier weight carcass (not ideal carcass weight for slaughterhouse). In aggregate, these facts lead to severe discounts. The author reports current selective bull criteria for mating to low-genetic dairy cows with are black hides, cheap semen, and ability to generate a pregnancy according to a 2019 survey conducted by UW Madison animal scientists. Beef x dairy are still experiencing discounts due to light muscling, small ribeye areas and large frame size. The study: pedigree and growth records collected by International Genetic Solutions (www.internationalgeneticsolutions.com) on calves born between 1970 and 1990; purebred data removed; final observations on 81,039 animals composed of six crosses – Simmental bull on either Brown Swiss, Holstein, or Jersey cow, or a Limousin bull on either a Brown Swiss, Holstein, or Jersey cow. 205 d adjusted weaning weight (n=43,566 data points), 160 d adjusted weaning weight, and 365 d yearling weight (n=5,815) were analyzed. For each 1% increase of Simmental in a calf's pedigree, it's 205 d weight increased (P<0.001) +0.65 lbs. and it's 160-d adjusted weight increased (P<0.07) +0.31 lbs. For each 1% increase of Limousin its 205-d weight increased +0.07 lbs., for Brown Swiss it decreased -0.19 lbs., for Holstein it decreased -0.41 lbs., for Jersey it decreased --1.23 lbs. For 365 d yearling weight, each 1% increase of Simmental genetics in a calf's pedigree found that it's 365 d yearling weight increased +0.97 lbs., for Limousin +0.46 lbs., for Brown Swiss +0.43 lbs., for Holstein +0.24 lbs., there were inadequate Jersey numbers to tally. Author cautions that Bergen et al 2005 noted hip height positively correlated with carcass weight in bulls and Simmentals recorded the largest hip height

in this 2005 study. Crossing Holstein on Simmental may create a calf with too large frame size for beef processors. Observations for carcass traits were analyzed on 73,183 animals (4 crosses) from records on calves born between 2015 and 2020 (again, International Genetic Solutions data). 40% were F_1 crosses and the balance were non-F_1. Crosses included Limousin bulls on either Holstein or Jersey cows, and LimFlex (Limousin x Angus hybrid) bull on either Holstein or Jersey cows. Carcass weight (lbs.), Rib Eye area (in^2), back fat (inches), and marbling score (USDA) data were analyzed. F_1 cross Holstein calves noted increased carcass weight regardless of beef bull used when compared to non-$F_{1,}$ conversely, F_1 cross Jersey calves noted lesser carcass weight when F_1 as compared to non-F_1. For ribeye area, F_1 cross calves noted increased (particularly Holstein on Limousin +4.3%) REA if Holstein or if Limousin bull on Jersey cow. Backfat was greater (P<0.0001) on calves from either Holstein or Jersey crossed on LimFlex (Limousin x Angus), particularly if non-F_1 cross, and the author attributed this to Angus genetics. Similarly, USDA marbling scores were improved (P<0.0001) on the LimFlex genetic animals when compared with their respective Limousin crosses. ISU. Tom Genomics. 298.

12. *Which calf management practices and health events affect cow longevity?* An OMAFRA (Ontario government) study reported 15% of calves die before reproductive maturity and that 31% had FPT. A cohort study was performed on 225 calves from 8 herds in the province of New Brunswick. Prewean records on calf mngt., disease events, colostrum management, passive immunity status and genotype were recorded from 2014 and 2015 and the same calves were tracked as adult cows by monitoring milk, protein and fat yield and Estimated Breeding Values (EBV). Linear regression models were used to analyze calf effects and adjusted EBV. The linear regression model for calf effects noted a sig correlation as the adjusted R^2=0.60. *Calf effects*: as weaning weight increased milk production increased 58 lbs. (P=0.008) (I think for each kg BW, however, the author wasn't clear). Interestingly, if the time after birth colostrum was fed ranged between 1.25 and 2 hours, future milk production increased 1,398 lbs. (P=0.009). The author attributed this to giving the calf a chance to recover from the trauma of birth. Also, if time after birth colostrum was fed was 2+ hours, then no correlation (P=0.295) to milk yield was found. If a calf was treated with antibiotics milk production decreased -2,453 lbs. (P=0.003), conversely, if a calf suffering from FPT was treated with antibiotics, milk yield increased 2,601 lbs. (P=0.055). Age at calving (P=0.726) and failure of passive transfer (P=0.746) were not correlated to a change in milk yield. The 2nd model with estimated breeding values (EBV) added in, noted an even greater correlation with an adjusted R^2=0.81. Weaning weight correlated with +33.3 lbs. milk yield (P=0.03). If time after birth fed colostrum was fed was between 1.25 and 2.0 hours, milk yield increased +952.7 lbs. (P=0.011). Treatments with antibiotics reduced milk yield 1,138.9 lbs. (P=0.018). No correlation was found with incidence of FPT (P=0.161) or age at calving (P=0.537). n=225. U of Prince Edward Island, Atlantic Vet College. U of Guelph, Center of Genetic Improvement. U of Bern, Switzerland. 301.

13. *Survey of Ontario dairy farmers on calf health practices.* From November 2020 to March 2021 172 farmers responded to a 45-minute calf health survey sent to 3,367 producers identified thru the provincial dairy association. 78% of respondents were farm owners. Mean herd size was 86 cows, and 305 d milk production was 23,534 lbs. Veterinarians visited farms every 2 weeks (50% of respondents) or monthly (30%). Mean colostrum intake was 3.6 liters most frequently delivered via a bottle (68%) or an esophageal tube (23%). 85% of colostrum feedings came from the calf's dam and 96% targeted feeding colostrum between 1 and 6 h after birth. In the 1st week of life calves received a mean of 6.3 L/d of milk as either milk replacer (38% of respondents), from the bulk tank (37%), or as waste milk (13%). Week 2 43% of female and 48% of male were fed <8 L/d, and week 3, 26% of both sexes were fed <8 L/d. 41% reported the herd veterinarian's opinion on calf care practices was considered "very important." The opinion of the public on calf care practices was considered very important by only 7% of respondents and approximately 40% noted it as "unimportant." The opinion of other dairy farmers on calf care issues was also considered very important by just 7% of respondents. Code of practice, calf buyer and milk board opinions on calf care practices were intermediary in importance. Half of producers used employee labor for calf care and half of this base considered it challenging to train employees. n=172. U of Guelph. The Ohio State U. Atlantic Vet College, PEI. ACER Consulting, Guelph. 184.
14. *What factors are associated with calf body weight upon arrival to veal facility?* Prior research shows lighter calves upon arrival note increased risk of mortality (Renaud et al, 2018; Winder et al, 2016; Santman-Berends, et al, 2018), respiratory disease (Brscic et al, 2012) and diarrhea (Wilson et al, 2020). Surplus calves (males and females) from 5 dairies were enrolled at birth and followed daily for the 2 to 22 d period until arrival at a grain-fed veal facility in Ontario. Mean birth weight was 102 lbs. (±15.2 lbs.) and mean body weight upon arrival to the veal facility was 103.3 lbs. (±12.3 lbs.). On d prior transport calves were randomly assigned to either 6 h, 12 h or 16 h of continuous transportation by road. 7 groups of calves 1 – 21 d of age were transported between October 2020 and June 2021. Mixed linear regression model examined risk factors associated with arrival weight including birth weight, calving difficulty, incidence of FPT, proportion of days with diarrhea, BRV, or naval infection, BW immediately before transport, and transport duration. Birth weight (P<0.001; every +1 kg of BW correlated to +0.86 kg increase in arrival weight) noted sig effect on arrival weight. Age upon arrival also noted an effect on arrival weight. Calves 5 – 9 d age were +5.4 lbs. (P=0.007) upon arrival, calves 10 – 12 d were +13.1 lbs. (P=0.001), and calves ≥13 d were +13.1 lbs. (P=0.001) heavier. Other aforementioned factors including health status or duration of transport were not correlated to arrival weight. n=195. U of Guelph. P151.
15. *Survey of WI calf raisers on social housing pre-wean.* 201 producers responded to a survey distributed either online or at extension events in Fall, 2019. 81% reported rearing heifer calves individually and 19% housed at least some calves socially. Among those socially housing calves 32% housed in pairs, 29% in groups of 2 – 8, and 39% in

groups of more than 8. If individually housed, 6% kept heifers with no visual contact, 70% reared heifers with visual contact but no tactile (touch) contact of other calves, and 24% reared heifers with both visual and tactile contact. Farms offering social housing to calves pre-wean averaged 400 milking cows, while those rearing calves individually averaged 200 milking cows (P=0.04). 4-week-old calves individually housed were fed less frequently (P<0.001) each day as compared to calves socially reared. 74% of farms housing calves socially offered milk via a nipple (26% via buckets; P<0.001), conversely, if housed individually it was opposite (77% fed via bucket, 23% via nipple). 4-week-old calves reared socially averaged 8 quarts of milk offered daily while individually calves were offered numerically slightly less (NSD, P=0.40). n=201 producers surveyed. UW-Madison. U of Guelph. P101.

16. *Economics of using beef semen in dairy herds.* A hypothetical model 1000 cow dairy was established assuming, a.) 55% conception rate for first breeding heifers and 20% 21-d pregnancy rate for cows using conventional semen, and b.) 35% turnover rate. 5 strategies of beef semen used on adult cows (either 0, 25, 50, 75, or 100%) were combined with 6 strategies of sexed semen used, either 1.) no sexed semen, 2.) sexed semen used on first breeding heifers, 3.) sexed semen used on "2 first breeding heifers" (unclear what this means, no poster and no video associated with this abstract), 4.) sexed semen used on "2 first breeding heifers + 20% top genetic cows," 5.) sexed semen used on "2 first breeding heifers + first breeding primiparous cows, and 6.) sexed semen used on "First breeding primiparous cow + second lactation cows." All females not bred to either sexed or beef semen were bred to conventional semen. Assuming beef calf value was 4x dairy calf value and assuming the price of sexed semen was 2.3x either conventional or beef semen, the optimal strategy to maximize income over semen costs (+$2,001) was 100% beef semen after imposing sexed semen on the first breeding of second lactation cows. "This strategy was consistently the best option under several feasible market conditions, but not when reproductive performance changed dramatically." UW-Madison. S150.
17. *Does late gestation heat stress effect the calf's gut morphology in utero?* During the summer and fall of 2020 in Florida, late gestation (app. 60 d prior calving) heat stressed multiparous Holstein cows were either a.) only allowed the shade of the barn, or b.) allowed both the shade of the barn and fans over stalls and access to water soakers. At birth calves were provided a gallon of high-quality colostrum within 2 h and AEA of IgG was determined measuring IgG in fed colostrum and serum IgG at 24h. 16 calves (8/treatment) were randomly euthanized at birth and 16 more (8/trt) at d 63 (one week after complete weaning). GIT samples were taken from the duodenum, ilium, and jejunum. Gut morphology was measured. IgG concentration in both maternal colostrum (P=0.32) and in serum IgG at 24 h was not different (P=0.32) between groups. However, after accounting for calf birthweight AEA was shown to be decreased (P=0.004) in calves heat-stressed in utero. At birth, there was NSD between calves from heat-stressed and cooled dams regarding duodenum or jejunum morphology, however, there was a lesser

crypt depth in the ilium of heat-stressed calves. On d 63, NSD in gut morphology between calves from heat stressed or cooled dams in their duodenum or ilium, however, the length of the jejunum was decreased ($P<0.05$) in cooled calves. n=41. U-W Madison. U of Guelph. U of Fla, Gainesville. SC143.

18. *Effect of heat stress on placenta development and fetal growth?* Aug – Oct 2020 on a large commercial herd in NC Florida multiparous Holstein cows bred with sexed-semen 54 ±5 d prior targeted parturition date (enrolled 1st d of dry period) were provided either a.) access to the shade of the barn + forced ventilation via fans + water soakers over feed lines, or b.) only provided access to the shade of the barn and natural ventilation. Cows were blocked by parity, mature equivalent milk production, and sire. Complete placentas were collected from 6 cows/treatment group within 4 h of calving. All placentas were from heifer calf births. Placenta total weight, cotyledon number, weight and surface area were measured within 1 h of placental expulsion and total surface are of cotyledons was measured using ImageJ software. Gestation length was reduced in heat stressed dams ($P<0.001$) by 3 d (275 vs. 278.3 ±0.7 d). Heifer calf BW was reduced by 8.8 lbs. ($P<0.001$) in heat stressed dams (76.7 vs. 85.8 lbs.). Placenta tended to have lower weight (P=0.10; 9 vs. 11.5 lbs.) and cotyledon number was decreased (P=0.006; 48.2 vs. 94, ±12.5) in heat stressed dams. Total cotyledon surface area was also lower (P=0.01) in heat stressed dams. NSD in individual cotyledon area (P=0.80) or cotyledon weight (P=0.60). Researcher showed images of cotyledons from a placenta from a heat stressed cow and a cooled cow: there were two full trays of placentas in the cooled cow, vs. just one tray in the heat stressed cow. Dramatic visual. n=41. U W-Madison. U of Fla, Gainesville. Laval U, Quebec City. 333.
19. *Does heat stress in utero impact heifer calf hair length and skin properties?* THI (temp humidity index) above 68 is shown to stress mature lactating cows and recent research notes negative carryover effects of late gestation hyperthermia on the postnatal calf (Zimbelman et al 2009; Tao et al 2012; Dado-Senn et al 2020). “Hair color, hair follicle density, and skin color proportions may play a role in thermoregulatory abilities.” Thermoregulation in cows comes from either evaporative heat loss (sweating) or via panting. Slick haired cattle are better at thermoregulating. (Frinch, 1986; Han, 1999; West, 2003; Maia et al 2005a, 2005b; Bernabucci 2010). Holstein multiparous dams were provided either a.) access to the shade of the barn + forced ventilation via fans + water soakers over feed lines, or b.) access to the shade of the barn and natural ventilation only (no fans/no soakers). Hair sample and skin biopsy (5 mm punch) from neck and rump locations were taken from randomly selected calves (8/treatment) at birth. The same process was repeated (again, from randomly selected calves) d 63. Weekly (d 7, 14, 21, etc.) thermoregulatory measures were taken including respiratory rate, rectal temp, skin temp, and sweating rate (neck and rump locations). Several days post-wean (weaned d 56) skin temps, rectal temps, and sweating rate were monitored every 4 h for 36 h to monitor how these responses change during the day. Epidermis thickness and dermis thickness were measured. Sweat gland depth, sebaceous glands,

and sweat glands (number area and avg. gland size) were measured. ImagJ was used to measure hair length. Results: hair length at birth NSD. Hair length d 63 reported NSD in rump area, however, hair length differed in the neck reporting shorter short hair and longer long hair in the calves from heat stressed dams (pretty sure stat was P<0.05, but perhaps tighter p value). At birth, calves from heat stressed dams note smaller sebaceous gland size (P=0.03) and lesser epidermis area (P=0.0003) in the neck and more sebaceous glands (P=0.05), lesser average sebaceous gland size (P=0.007) in the rump. D 63 sebaceous gland number in the neck was less (P=0.04), sweat gland area less (P=0.01) and a trend towards number of sweat glands being less (P=0.10) in the calves from heat stressed dams. D 63 NSD in any parameter in the rump sample except distance from sweat gland to skin surface area being greater (P=0.05) in calves from heat stressed dams. Weekly measure of respiration rates reports NSD between groups. In utero heat stressed calves tended (P=0.07) increased sweating rate in both the neck and rump as compared to their cooled peers. Weekly rectal temps were greater (P=0.004) in calves from heat stressed dams. Weekly skin temps in neck NSD, but variability in skin temp differences (several points going both ways) in the rump. Sweating rate as measured in the rump was greater (P=0.02) early and later in the day in the post-wean 36 h measures in the calves from heat stressed dams. NSD in skin temp of rump or rectal temps during this 36-h measure period. n=82. UW-Madison. U of Fla, Gainesville. 334.

20. *Cooling preweaned calves with forced ventilation in SE Georgia July - Sept: effect on health and growth.* Upper critical temp for pre-weaned calves is 78.8 F (Spain and Spiers, 1996) and in the SE USA this threshold is super passed app. 4 months of the year. Female calves were housed in structures with a high roof and no walls and bedded on sand and housed in individual pens with hog fencing (frame wire 7' x 5', 2' apart from each other) either with or w/o fans (3 alternating sections within the barn). Author reported fans operating at 80% of capacity. Weekly body weight and rump height measures were taken, and bi-weekly health score measured. Milk consumption and starter intake were monitored daily. Air velocity, air temp, rectal temp, and respiratory frequency were monitored every 3.5 d at both 10 am and 4 pm to d 68. Fans increased air velocity in both morning and afternoon measures (P<0.01) from app. 0.3 - 0.5 to 1.2 - 1.6 meters/second. Fans decreased air temp in the AM (P=0.02) but not in the PM (P=0.08). Fans reduced rectal temp in the AM (P=0.02) but not in the PM (P=0.37). Respiratory frequency was not affected (p=0.16 in AM, P=0.18 in PM). No effect on G:F (P=0.71), ADG (P=0.21; ranged from 1.29 to 1.33 lbs./d), or rump height (P=0.73). NSD in % of calves that doubled birth weight by weaning (59.9% and 56.9%, P=0.71). BW at 146 d NSD (P=0.61; app. 365 lbs. interpreted off graph). Probability of fever NSD (P=0.55; 47.2% vs. 42.5%, no fan vs. +fan), NSD in total health score (UW Madison scoring system, P=0.48), NSD in mortality 4.8 vs. 4.0%. Trend towards fans reducing incidence of hyperthermia (66.4% vs. 49.5%, P=0.08). n=125. U of Florida, Gainesville. P245.

21. *Heat stress effect on calf microbiome? Mitigated by organic acids and plant botanicals?* In attempts to improve heat loss, the blood flow is redirected from visceral organs to body periphery. This causes reduced oxygen to the intestines resulting in local gut inflammation and recruitment of acute phase proteins that initiate an immune response and a reduction in tight juncture proteins thus allowing compounds like LPS to leak into the blood causing systemic inflammation (Bouchama and Knochel, 2002, New Eng J Med 346). Poultry research shows heat stress effects gut microbiome (Zhu 2019. Appl. Microbial Biotechnol). Heat stress causes damage to ruminal mucosa in growing bulls (Yazdi 2016 J An Sci). AviPlus R (25% citric acid, 16.7% sorbic acid, 1.7% thymol, 1.0% vanillin) organic acid and plant botanical was tested. Weaned bull and heifer calves were offered starter grain and reared in either thermoneutral conditions (68 F, relative humidity app. 35% to 45%, THI 63) or in heat stress conditions (96 F, Relative humidity app 70%, 82.5 THI) for 3 days prior to being either supplemented AviPlus R (Vetagro Inc.) at low dose (75 mg/kg BW) or high dose (150 mg/kg BW) or not supplemented, and, furthermore, unsupplemented calves in thermoneutral conditions were either fed ad lib or pair-fed to heat stressed unsupplemented control calves. AviPlus R was dosed via gel caps twice daily. Control calves received triglyceride flakes via the same gel caps twice daily. These triglyceride flakes mimic the fat coating around AviPlus R that provides rumen bypass protection. Ruminal fluid was collected 3 days prior to introducing heat stress and again d 19 post commencing the heat stress and was tested for VFA determination using HPLC chromatography. Fecal swabs were collected every 3 d and intestinal collection occurred d 19 of the study when calves were sacrificed. Microbiome 16s rDNA sequencing (extraction) was conducted. All calves had been on their respective AviPlus (or AviPlus void) starter grain in the pre-wean period commencing d 5 of age onward. 10 d post wean all calves were transported to a new facility and exposed to thermoneutral (68 F) conditions for 7 days prior to imposing the heat stress (96 F, high humidity). Post this acclimation period calves were either kept on the thermoneutral conditions or then exposed to heat stress, depending on the treatment group. Calves put into heat stress noted increased rectal temp ($P<0.0001$) and increased respiration rate ($P<0.0001$) relative to those in non-heat stressed environs throughout the 19-day heat stress period. VFA analysis: acetate, propionate, butyrate, valerate, isovalerate, and formate were not affected by heat stress or supplementation of additive (NSD between any group). However, isobutyrate was increased ($P=0.0002$), as was lactate ($P=0.004$) in the pair fed thermoneutral group (no additive) vs. all other groups (about 2 – 3x more). The author speculates this may be due to less demand for fermented carbs (in the case of isobutyrate) and loss of saliva from panting and drooling (in the case of lactate). Also, no major changes in the dominant ruminal phyla due to heat stress. “Heat stress did not result in major changes in the rumen microbiome.” However, intestinal phyla were affected. Fibrobacteres tended ($P=0.06$) less in the duodenum in heat stressed calves. In jejunum heat stressed calves had 2x

Euryarchaeotan phylum (P=0.06). AviPlus had no effect on microbiome profile. n=62. Cornell. U of Bologna, Italy. Vetagro, Chicago. 434.

22. *Are infrared thermometers accurate for measuring calf body temp?* Daily (0700 h) rectal and infrared temperatures were taken on calves housed in straw bedded individual hutches d 4 – 24 of age between July and December at the U of Illinois. Infrared measures were taken on neck, rump, and forehead from 12 inches distance from the calf's skin. Heart rate, respiratory rate, and health parameters were measured daily. Hourly measures of temperature and relative humidity were taken using on-site data loggers. Incidence of fever or sickness were reported as minimal. Rectal temperature showed a relationship (P=0.0010) to max environmental temperature and to max hutch temperature (P=0.0026). Infrared measures taken at all anatomical sites (neck, rump, and forehead) showed correlation (P<0.05) with rectal temp, environmental temp, and hutch temp. However, infrared temperatures were much lower than rectal temperatures and thus more poorly correlated to actual rectal temperature as season changed to fall (Sept/Oct) and winter (Nov/Dec) indicating Infrared is not a useful tool during colder seasons and not a useful tool for on-farm use. As outside temperature gets colder data showed so does skin temperature. Also, as hutch gets cooler, so does skin temperature. "Respiration rate showed a relationship (P=0.0049) to maximum hutch temperature." No correlation between heart rate and hutch temp. n=25. U of Illinois. P120.
23. *7% iodine tincture based umbilical dip disinfectant as preventative?* Naval infection is the third most common disease in dairy calves with prevalence varying from 1.3% to 34%. 5 dairy farms in S. Ontario were visited bi-weekly from 9/2020 to 3/2021. Holstein calves were randomly assigned to receive either a 7% Iodine tincture based umbilical dip (one dose) or no treatment. Data on dam, birth, colostrum administration, sex, were collected from producer. Health scores (naval, fecal, and respiratory) were measured bi-weekly until 30 d age. "Umbilical infections were defined as an enlarged naval with pain, heat or malodorous discharge." STP was monitored. ADG measured close to birth, app. 30 d, and app. 60 d. NSD in STP (serum total protein) or BW. ADG and scour and respiratory health measure results not reported. 22% (31 of 140) and 20% (29/144) of the Iodine-treated and the control calves, respectively, noted naval infections (P=0.70). Calves born in a dirtier calving pen noted tendency (P=0.06) towards increased odds of umbilical infections. Farm had sig effect on the risk of umbilical infection (ICC=0.09). n=284. U of Guelph. P146.
24. *Plane of nutrition effect recovery from disbudding? NSAID effect?* Hot iron disbudding use rate is 86% and 70% in Canada and the USA, respectively (Winder et al 2018; USDA, 2014). Studies show 3 weeks to heal (Huebner et al, 2017) and 9 – 13 weeks to heal (Adcock & Tucker, 2018; fed 3 – 5 L/d of milk). Randomized controlled study 10/2019 to 11/2020 in Ontario implemented a 2 x 2 factorial study comparing 15 L/d or 6 L/d of milk and with and w/o an extra NSAID administered 3 d after disbudding with hot iron. Heifers were disbudded by removal of the horn bud with a hot iron at 18 – 25 d of age.

All calves received a lidocaine cornual nerve block + meloxicam (NSAID) 15 m before disbudding. Photos of the wound were taken 2x/week until 56 – 59 d after disbudding. Wound scoring system measured healing. Also, wound pressure sensitivity (using pressure force algometer) and standing and lying behavior were monitored (using accelerometers). 70% of calves achieved full healing by d 56 – 59 post disbudding. Time for re-epithelization (healing) ranged from 28 to 59 d in those that healed prior ending the study. Wounds from disbudding healed more quickly (P=0.005) when fed 15 L/d vs. 6 L/d. Calves given an extra NSAID healed more slowly (P=0.008). Calves fed 6 L/d of milk and calves fed the extra dose of NSAID were both less sensitive to the wound pressure sensitivity test. Calves fed 15 L/d were more active than those fed 6 L/d (less time lying during the day, fewer lying bouts, but more time lying down when they did). The week post disbudding calves that received the extra NSAID were more active. n=80. UC Davis. UW Madison. U of Guelph. 168.

25. *White willow bark extract for pain?* White willow bark (*Salix alba)* is a known analgesic (reduce pain) for humans. Could it reduce pain associated with disbudding? 3 white willow bark extracts were tested for salicin concentrations, "Dull it" (Dr. Paul's Lab, Mazomanie, WI; 17.6 microgram/g concentration), WWB tincture (Mountain Rose Herbs, Eugene, OR; 143 microgram/g), and WWB powder (Mountain Rose Herbs, Eugene; 2,171 microgram/g). Also, effects of IV flunixin meglumine and 3 oral doses of white willow bark extract (WWB powder was used) on inflammation and salicilic acid plasma concentrations in dairy calves was tested. 25 pre-weaned and crossbred dairy bull calves were used. Calves were orally administered either low (57.6 mg/kg) dose white willow bark, medium dose (115.1 mg/kg) white willow bark, high dose (230.3 mg/kg) white willow bark, or Flunixin meglumine (Banamine; Merk Animal Health) IV, or no treatment. Blood taken immediately before treatment, and 1, 2, and 4 h post treatment. Salicylic acid and Prostaglandin E2 were determined at Iowa State U lab. Prostaglandin E2 concentration (best known lipid mediator that contributes to inflammatory pain, according to Pubmed) was reduced post treatment in calves provided Flunixin meglumine (P<0.01), while there was NSD in concentrations between any other treatment. The maximum salicylic acid concentration was 23.4, 21.5, and 23.3 ng/mL for low, med, and high dosage (NSD) of white willow bark extract. Banamine reduced inflammation (P<0.001) compared to all other treatment groups. No effect from white willow bark. Researchers estimate 528 to 1450 mg/kg of BW might be needed to affect the calf and they reported being concerned with gastrointestinal upset. n=25. U of MN West Central Research and Outreach, Morris, MN. 101.
26. *Neuropathy with splayed forelimbs (aka JNS), a birth defect in Jerseys.* Calves affected with JNS cannot stand on splayed forelimbs, exhibit extensor rigidity and/or excessive lateral abduction at birth. Calves are known to be alert but spastic in the head and neck and convulsive. Dislocated shoulders, congenital craniofacial anomalies and degenerative myelopathy are all associated with the malady. All cases (16 reported across the country) are traced to a common ancestor born in 1995. 6% of Jerseys are

carriers of the haplotype associated with the haplotype. The author estimates 300 affected calves per year will result from the nation's 370,000 Jersey cows in DHI. USDA ARS Animal Genomics and Imp. Lab, Beltsville, MD. American Jersey Cattle Ass. 199.

27. *Individual vs. pair-housed calves, post-weaning behavioral differences.* Video footage of 5 calves were monitored for 78 h post entry into group pens at weaning. Prewean, 2 were housed as paired and 3 individually. Calves were housed post-wean with their treatment group. "Lying, standing, or walking by self; and social lying, standing or walking" were monitored. "self-groom, self-explore, self-locomotor play, cross-suck, social explore, kick, mock fight, mount, allogroom (groom another calf), social sniff, ad social locomotor play," were monitored. "In general, scans did not reveal substantive differences in recorded behavior categories, with the following exception: previously paired calves were more frequently observed to lay near a companion compared with previously individually housed calves." Individually housed calves spent more time engaged in self and in social locomotor play and mock fighting and less time grooming and exploring socially. Only paired calves groomed another pen mate. No statistics reported in the abstract. n=5. U of MN. 394.
28. *Rearing calves on a nurse cow?* Holstein and crossbred calves were reared either on the cow in a compost bedded pack barn and on pasture, or, individually in a Calf Tel hutch, or grouped in an indoor-outdoor barn on an autofeeder. Calves reared on individual cows were allowed to bond as pairs for 3 d prior grouping all cow/calf pairs together. Individual and auto-feeder calves were introduced to the respective treatment group d4 and fed 8 L/d. All were weaned d 90 and weighed weekly and scored for health and behavior. Calves suckling dam were heavier at 90 d (303.4, 264.6, 283.1 lbs. BW for calves suckling, individually housed, and auto-feeder fed, respectively, $P<0.05$) and had greater ADG (2.47, 2.05, and 2.22 lbs./d, suckling, individual, and auto-fed, respectively, $P<0.05$). NSD between individual and auto-fed calves (90 d BW or ADG). 120 d ADG not different between the three groups. Auto-feeder fed calves noted higher fecal score ($P<0.05$) and calves reared on cow were dirtier ($P<0.05$; dirtier bellies and sides). n=45. U of MN Morris. 444.
29. *Behavior of paired housed calves during first days of pairing.* Newborn Holstein heifer calves were monitored in summer 2020 on a rearing facility in N. Colorado. Milk was offered 3x/d (6:30 am, 12:30 pm, 7:30 pm) and calves were housed in pairs sharing 2 polyethylene hutches and a sand bed in front (48.4 square feet) enclosed with galvanized welded wire fence. Video was monitored for 10 d and behavior monitored for 1 h pre- and post-milk feeding. THI (temp/humidity index) inside hutch was monitored. THI ranged from 59.3 to 61.2 in AM, 80.5 to 81.6 at noon, and 69.4 to 72.2 in pm. On d 2 calves rested more in AM and noon vs. PM fdg ($P<0.05$) and, conversely, were more active at PM feeding vs. AM or noon ($P<0.05$). Calves also spent more time outside together during PM feeding period (19.2%; $P<0.05$) and more time as a pair inside the hutch at noon (41.3%; $P<0.05$). Day 5 calves spent more time resting at noon (88.2%; $P<0.05$) and more time active during AM (27.8%) and PM (32.9%) vs. noon

(11.8%) (P<0.05). Calves also spent more time paired outside in the PM (P<0.05) feeding and no differences in amount of time paired inside the hutch. Day 9 calves spent more time resting at noon (83.4%) vs. AM (75.3%) and both noon and AM vs. PM (65.4%) (P<0.05). Calves spent less time active at noon (16.6% for noon vs. 24.7% for AM and 34.6% for PM) (P<0.05). Calves were paired outside more in PM (18.6%) vs. noon (2.4%) (P<0.05) and paired outside less in PM (17.3%) vs. noon (54.8%) or AM (45.5%) (P<0.05). There was NSD in time spent alone between any time (AM, Noon, or PM, during any measure period, i.e., day 2, 5, or 9). n=15 pairs (30 calves). CSU. P105.

30. *Cow-calf contact*. *Benefits?* Cows either had a.) no contact with their calf (removed at birth), or b.) partial contact (no suckling, housed in adjacent pen allowing physical contact), or c.) full contact including suckling (housed together in freestall barn). Calves were weighed weekly and monitored daily for 48 d using health score (scours, respiratory, pyrexia, naval inflammation). Total health score did not differ between groups. Antibiotic treatments were needed on 5 of the 18 partial-contact calves, on 6 of the 20 full-contact calves, and on 0 of 10 of the no-contact calves, however, P>0.05 using a Fisher's exact test, i.e. NSD in use of AB therapy. Full-contact calves had greater (P=0.001) ADG (mean of 2.14 lbs./d) vs. either no-contact (1.61 lbs./d) or partial-contact (1.56 lbs./d) calves. n=48.Wageningen U, the Netherlands. 421.
31. *Pain control for disbudding*. *Opinions of Ontario producers.* Pain control for disbudding in Canada is mandatory. "Phone interviews were conducted with 29 Ontario dairy producers from September 2020 to January 2021." Cautery disbudding was identified as their primary method of disbudding with analgesic or local anesthetic. Meloxxicam, lidocaine, and a sedative were used by 93%, 86%, and 57% of participants, respectively. Most common time to disbud was 4 – 8 weeks age (43%) and next was 1 – 4 weeks age (36%). "Overall, producers reported a positive view of pain control for disbudding, stating that it was necessary and provided a better disbudding experience for both the calf and the producer." Participants also noted pain control made disbudding easier. Cost, and time to perform the procedure were cited as barriers. n=14 completed interviews. UW-Madison. OMAFRA. U of Guelph.
32. *USA producers' perceptions of male calves*. 14 producers in OH and IN were interviewed on neonatal calf care, producer decision making regarding care, and perceptions of male calves. All reported dipping navels on male calves, some reported providing poorer quality or less colostrum to male vs. female calves. A majority reported rarely administering preventative health supplements to male calves. Cost of care relative to value of bull calf was reported as the barrier. As was marketing route. Calves sold to auctions received poorer nutrition and care as compared to those sold to neighbors or reared at home. Slaughter withholding periods, accountability for calf health and purchaser paying for additional supplementation are reasons given for lesser investments. n=14. U of Guelph. OSU, Columbus. U of PEI, Canada. 171.
33. *Environmental enrichment*? Lit review on interactive objects for grooming and social partners. Available literature reports calves prefer mechanical brushes over stationary

ones because they offer grooming in hard-to-reach places. Lit also reports calves spend more time engaging brushes around meals. VA Tech. SC159.

34. *Human/calf interaction*. At birth calves were assigned to either a.) individual housing, or b.) pair housing. Test of human approaching and extending their hand to the calf occurred week 3 in the home pen and week 4 in a test arena. Latency to contact human, frequency of human-directed oral behavior, latency to lie down following testing, and a human approach score were ascertained. Latency to contact humans was greater in the arena than in the home pen. 59% of calves directed nonnutritive oral behavior to the human. No effect of housing on any behavior. More social calves tended to lie down more quickly following testing. n=12. U of Florida, Gainesville. P110.
35. *Long non-coding RNA and how they are expressed pre- and post-wean.* Tissues taken from 6 Bos taurus calf rumens pre- and post-wean. Over 21 million reads per sample, filtering identified 2,026 and 2,074 transcripts pre- and post-wean, respectively. 2,025 were shared in both tissue conditions, 30 found only in pre-wean tissues, 78 found only in post-wean tissues, and 336 were differently expressed between tissue conditions. U of Maryland College Park. Animal Genomics and Imp. Lab, Beltsville, MD. P165.
36. *Survey determining calf health recording protocols in Ontario*. 13 producers responded to a survey on health recording protocols. 12 utilized computer and written (combined) records, one was written only. During a scouring event, rectal temps were recorded in 3 of 13, calf alertness in 13 of 13, and fecal score in 10 of 13. For cases of pneumonia rectal temps were recorded in 10 of 13, coughing 13 of 13, and nasal discharge in 11 of 13. n=13 surveys. U of Guelph. U of Bern, Switzerland. 300.
37. *Foster cow rearing of calves, perception of it by UK farmers*. Phone interview of 6 cow/calf rearers and 5 conventional was conducted. Author listed anecdotal comments of both parties. No organized assessment or analysis. Reads like an editorial in a newspaper. Harper Adams U Newport, Shropshire, UK. 345.
38. *Western Canadian producers' attitudes towards calf rearing*. Interviews of owners (n=15) or primary calf caretakers (n=3) were conducted July and September 2020. 4 major themes identified, 1.) reliance on calf-based factors (health, growth & behavior), 2.) personal beliefs and vested interests, (ease, consistency, and habit) 3.) perceived environmental influences (facilities, environment, and equipment), and 4.) characterization of weaning success. U of BC, Vancouver. P306.

Physiology (particularly gut microbiome) (1 abstracts)

1. *Fecal microbiota transplant?* Healthy newborn Holstein calves were fed non-medicated CMR either with or w/o a 1x/d inoculation of 25 g of fecal donor material from age 8 to 12 d. Blood samples were collected weekly for cytokine measures. Fecal samples were collected d 7, 14, and 35. Donor and calf fecal material were analyzed for microbiome contents. A trend (P=0.06) for greater body weight (P=0.06; 134.9 vs. 127.2 lbs.) at d 35 for the fecal transplant calves was noted. Also, lower IL-1 beta and IL-6 were noted in fecal transplant calves (P≤0.05) during weaning d 42 – 49. Firmicutes, Bacteroidetes, and

Proteobacteria were the most highly represented phyla in the donor fecal material (95.8% of sequences). Odoribacteraceae abundance was greater (no stat provided) in control calves early in life whereas Succinivibrionaceae was greater (no stat) in fecal transplant calves at 14 d. At 35 d Enterobacteriaceae was lower in fecal transplant calves. Author notes an abnormal increase of Enterobacteriaceae has been shown to trigger calf scours. Author reported no diarrhea incidence occurred prior weaning in fecal transplanted calf (but no context vs. control was reported). In oral Q & A author reported she would have preferred inoculating the calves at a younger age. Screened based on health of the cow, no clinical disorder, high milk production, and screened for salmonella and crypto. n=16. SDSU. U of Arkansas Medical Sciences, Department of Pediatrics. U Cattolica del Sacro Cuore, Italy. 176.

Starter grain & forage feeding (8 abstracts)

1. *Effect of an Alltech blend of organic TM's, Biomos and essential oil in pelleted grain, and with added energy either from roasted beans or dextrose.* Holstein heifer calves were fed 20:20 CMR at 1.23 lbs./d to d 35 and then 1x/d (0.61 lbs.) until d 42 wean and Deccox containing pelleted starter composed of either a.) no Alltech additives and no additional energy source (3.13% fat, 1.39% sugar), or b.) with Alltech additives including Bioplex, Sel-Plex, Biomos, and an essential oil (3.12% fat, 1.39% sugar), or, c.) same Alltech additives but increasing fat to 5.73% by using roasted beans (same 1.395% sugar), or d.) same Alltech additives and increasing sugar to 5.98% using dextrose (same 2.98% fat). Inclusion of roasted soy or dextrose, i.e. both instances of added energy, noted reduced ($P<0.05$) 28 d ADG, and also reduced ADG d 56 and d 84 (both $P<0.05$) as compared to calves fed the non-additive, non-added energy source, control diet. Control diet with Alltech additives was intermediary and NSD. Post-wean hip-height gain was also greater ($P<0.05$) in control calves (no additives, no added energy) vs. calves fed starter with Alltech additives and inclusive of roasted beans; d 1 – 56 starter intake corresponded to ADG (126.6, 117.4, 100.5, and 118.4 lbs. for pelleted grain with no additives and no added energy, pelleted feed with additives and no added energy, pelleted grain with additives and roasted beans as added energy, or pelleted grain with additives and dextrose as added energy, respectively. No difference in G:F or in health costs were noted. Fecal scores d 1 - 56 improved ($P\leq0.05$) if Alltech additives were fed, but the advantage was negated if roasted beans or dextrose were added. n=109, Hubbard Feeds & U of MN Waseca. P342.
2. *Low rumen pH in calves, problem or opportunity?* Low rumen pH is common in the young calf. pH is highly variable between calves and strategies and performance can be quite good at low rumen pH. Low rumen pH in the calf is associated with VFA production. Low rumen pH is also associated with increased acidification of the cell and intracellular acidification allows the epithelium cells to remodel the size and density of the developing rumen and it may increase passive diffusion as tight junctures dissolve. Low rumen pH is responsive to hay intake but not generally starter intake, it may be a

factor in rumen development, and physiological activity of absorption site for nutrients may be linked to rumen pH. Butyrate is bioactive and is effective around diet transitions. Research particularly shows it to be important in the first week of life (but not during colostrum feeding as it speeds up gut closure) and during weaning transition. A Laarman, U of Alberta. S133.

3. *Whey based starter? With different CMR feeding rates?* Holstein heifer calves individually housed within 2 h of birth and within 1 of 4 rooms at U of Guelph Dairy Research Center and trained onto auto-feeding calf rail on d 2 were gradually weaned d 43 – 63 and were monitored post-wean to d 77. Milk offered via rail 5x/d (5 am, 9 am, 1 pm, 5 pm and 9 pm). Respective starter offered ad lib starting d 5. GFV Bioforce acidified CMR was fed at 15% solids (5.39 pH, 26% CP, 18% fat). 2 x 2 factorial study design implemented with either high or low CMR treatment and either whey-based or grain-based dry feed. Calves were offered either 15 L/d in 3 L meals, 5x/d or 6 L/d in 1.2 L meals, 5x/d in the high milk or low milk groups, respectively. Calves were also offered either a grain-based ration, composed of 95% pellet (20% CP, Bionic Calf Grower Pellet) and 5% chopped wheat straw (0.8 inch), or a "whey-based pellet fed at 150 g/d until the entire 150g/d was consumed 2 out of 3 consecutive days, then 150 g/d was top-dressed onto the grain-based ration to allow for ad lib intake until weaning, when all calves only received the grain-based ration (d 64 – 77)." Starter grain diet details (including whey content) were not disclosed. Body weight and body dimension measures taken individually 2x/wk; feed, milk, and water intake monitored daily; rumen fluid drawn (measured pH and VFA's), fecal starch and blood BHB (indicator of rumen development) measures determined d 36, 57, 70, and 77. Calves fed high milk quantities noted greater (P=0.03) milk intake during the earliest wean transition period as milk intake was declining (in the chart it looks like d 42 – 47) when offered the grain-based ration vs. the whey-based pellet. No differences (P=0.71) in milk intake noted in calves limit fed milk, regardless of which grain was offered. Calves offered whey-based pellet tended greater (+14.3%; P=0.06) solid feed intake prewean as compared to calves fed the grain-based ration, however, NSD during transition (P=0.87) or post-wean (P=0.62). Calves fed whey-based pellet had increased (+32.5%; P<0.001) prewean free water (pail fed) intake and also tended (P=0.10) greater (+8.3%) free water intake during transition, but NSD (P=0.55) in water intake post-wean. ADG similar (NSD) between treatments (started wk 2 at app. 600 g/d and increased to about 1.0 kg/d (P=0.42 between treatments), maintained around 900 g/d during transition (P=0.72) and increased to around 1400 g/d post wean (P=0.76)). NSD in body dimension measures except heart girth tended greater for calves fed whey-based pellet vs. grain-based ration when calves were also fed low milk quantities. Both total VFA in rumen fluid, rumen pH (P=0.53), blood BHB (P=0.30), and fecal starch (P=0.45) did not differ between treatments, however, the proportion of acetic acid was greater for calves fed high milk quantities in tandem with whey-based pellet as compared to calves fed low milk quantities and either dry feed. Also, isovaleric acid was greater if calves received grain-based starter vs. whey-based

pellet, conversely, valeric acid was greater d 36 & 57 if calves were fed whey-based vs. grain-based starter. n=240. U of Guelph. 423.

4. *Steam-flaked corn or extruded corn?* Individually penned Holstein heifer calves 2 to 5 d of age and averaging 85.3 lbs. were fed 1.23 lbs./d 20:20 CMR to d 35 then half rate to 42 d wean and offered 18% CP, Deccox-containing texturized starter (ad lib) composed of either a.) formulated with low inclusion of steam flaked corn (ADF 10.3%, aNDF 16.8%, starch 29%), b.) formulated with high inclusion of steam flaked corn (ADF 8.43%; aNDF 16.8%, starch 33%), c.) formulated with steam flaked corn and extruded corn at a 1:0.75 ratio, respectively, (ADF 8.15%, aNDF 14.2%, starch 32%) or d.) formulated with steam flaked corn and extruded corn at a 1:2.5 ratio, respectively (ADF 7.2%, aNDF 12.1%, starch 40%). Further details on starter formulas not provided. BW measures at d 1, 14, 28, 42, 56, and 84; hip height taken d 1, 56, and 84; health measures and fecal scores determined daily. Starter intake monitored. NSD in d 1 – 56 ADG (1.52, 1.45, 1.48, 1.45 lbs./d for diets a, b, c, and d, respectively), nor in ADG d 1 – 84 (1.67, 1.67, 1.65, and 1.65). Calves fed starter composed of low-inclusion of steam-flaked corn or the combo of steam flaked corn with high ratio of extruded corn (1:2.5 ratio) noted increased hip height gain (P=0.05) vs. calves fed steam flaked corn at low ratio to extruded corn (1:0.75 ratio). Post-wean starter intake tended (P=0.10; 69.4 lbs.) greater for calves fed starter with low inclusion of steam flaked corn as compared to the other three treatments (63.9, 62.8, and 62.4 lbs.). NSD in overall DM intake or G:F (0.57, 0.58, 0.58, and 0.59). NSD in health measures or STP (serum total protein). n=107. Hubbard Feeds. U of MN, Waseca. P340.
5. *Barley straw or alfalfa hay as forage?* Male Holstein calves (98.1 lbs., 3 d age) were individually penned with sawdust bedding and fed either a.) barley straw before and after weaning, b.) barley straw before and alfalfa hay after weaning, or c.) alfalfa hay before and after weaning. The study was conducted at IRTA in Spain. Calves were offered respective forage treatment in a separate bucket at 7.5% of the previous days concentrate feed intake pre-wean and at 15% of the previous days concentrate feed intake post-wean commencing d 4 – 56 (pre-wean) and d 57 – 91 (post-wean), respectively. All calves were offered concentrate (starter grain) ad lib (details of grain not provided) and CMR at 6 L/d (3 L, 2x/d), 15% solids (details of CMR not provided) until d 57 wean. Feed intake was measured daily, and body weight measured weekly. Ruminal microbiota samples were taken weeks 7, 9, and 13, and ruminal epithelium biopsy by endoscope week 13. Pre-wean NSD in concentrate intake (mean 1.01 lbs./d, ±0.1 lbs./d), forage intake (27 g/d) or ADG (1.76, 1.76, and 1.67 lbs./d for calves offered barley straw, mixture, or alfalfa straw, respectively). Post-wean concentrate intake increased (P=0.02) in calves offered solely barley straw (avg 7.7 lbs./d) as compared to calves fed either the mixture of barley straw and alfalfa hay (pre- and post-wean, respectively, avg. 6.55 lbs./d) or solely alfalfa hay (pre- and post-wean, avg. 6.55 lbs./d). Post-wean ADG was greater (P=0.03; 2.78 lbs./d) for calves fed barley straw pre- and post-wean as compared to those fed the mixture (2.38 lbs./d), with those fed alfalfa hay

pre- and post-wean intermediary (NSD, 2.51 lbs./d). Rumen microbiota was not different between treatments, however, abundance of *Acidaminococcus* and *Selenomas* genera increased (P<0.05), while *Alloprevotella*, *Bifidobaterium*, *Olsenella*, and *Succiclasticm* genera deceased (P<0.05). with calf age. The only difference in ruminal epithelium was in gene expression of MCT1 (Monocarboxylate transporter 1) noting increased expression in calves fed solely barley straw (P=0.02) as compared to those fed either the mixture, or solely alfalfa hay. NSD in MCT4 (P=0.49), sodium/proton exchanger 1 (P=0.24) or 3 (P=0.29), Occludin (P=0.41), Claudin-4 (P=0.84), transforming growth factor-beta (P=0.17), or interleukin 6 (P=0.40. n=45. U de la Republica San Jose, Uruguay, IRTA Aaldes de Monitubui, Spain, Marlex Sant Cugat de Lailes, Spain, Zabol U, Iran. P347.

6. *Forage introduction at 30 d age.* Holstein heifer calves were introduced to either 75 g/d of alfalfa hay or 75 g/d of oat hay at 30 d age or kept on only CMR and grain (no forage). Feed and milk replacer intakes were measured on 4 continuous days ever week. Growth, rumen fluid and blood samples were measured or collected every 2 wks. Health checked daily. Calves offered alfalfa hay noted greater forage intake but lesser grain intake vs. those offered oat hay (P<0.01). NSD in milk, solid, or total DM intake across treatments. Calves fed either forage noted greater (P=0.04) rumen pH and proportion of acetate (P=0.01) but lower total VFA concentration (P<0.01) and lower proportions of propionate (P<0.01) and valerate (P<0.01) than calves fed no forage. NSD in health or growth or G:F. Calves fed alfalfa noted greater blood beta-hydroxybutyrate concentrations (P=0.06) vs. those fed no forage. Forage fed calves noted lesser incidence of loose stools week 3 and at weaning. n=54. Northwest A & F U Yangling, Shaanxi, China. P349.
7. *Corn silage prewean? Fresh-cow TMR prewean?* Holstein heifer calves were offered from birth to a 9-week wean pasteurized milk (quantity not disclosed) and either a.) calf starter (20.3% CP, 34.1% starch, 4.5% ether extract), or a mixture of 75% calf starter and 15% DM corn silage (18.8% CP, 34.5% starch, and 4.3% ether extract), or 100% early lactation cow's TMR (16.6% C.P., 26% starch, and 5.5% ether extract). Feed and milk intake measured daily. Body weight and dimensions and blood samples measured or collected every 2 weeks. Rumen fluid collected d 40 and d 60. NSD in feed intake or growth. NSD in blood glucose, total protein, IgG or in insulin concentrations except blood albumin tended greater (P=0.07) in the starter grain/silage blend. Similar ruminal fermentation parameters except the blend of starter grain and silage noted lower (P<0.01) pH than the TMR on d 40. Bacterial community of rumen was determined and *Acetitomaculum* was enriched in the calves fed only starter grain. TMR reduced feed costs. Authors assess cow TMR can be fed pre-wean w/o negative effects on health or growth. No details on growth rate or morbidity provided in abstract, missed seeing video. n=45. China Ag U, Beijing. Northwest A&F U Yangling, Shaanxi, China. P353.
8. *Immune cell genotypes.* "Immune cells in a newborn calf could be produced by the calf, maternally derived, or absorbed from colostrum." Genotype was analyzed in calf hair

sample, dam hair sample, and colostrum from multiple cows prior feeding. 665 no concordant T-cell genotypes indicated 82 matched the dam, 147 matched colostrum, and 105 matched both. Of the 322 that matched neither, 70 had no colostrum genotype. "For the remaining 252, 241 were instances where the T-cell genotype was heterozygous, and the dam and colostrum genotypes were homozygous for opposite SNP (acronym not defined)." "Dam and colostrum derived cells contribute to building passive immunity, and T-cell genotypes suggested some degree of DNA contamination with elevated non-call rate, heterozygosity, and mismatches with the true genotype. Nevertheless, immune cells isolated from a newborn calf's blood provided largely accurate genotypes." Penn State U. New Ya'ar Research Center, Yishay, Israel. The Hebrew U of Jerusalem Israel. P158.

Weaning (2 abstracts)

1. *Wean at 6 or 8 wks? Abrupt or gradual?* Holstein male and female calves blocked by sex and BW at birth and housed individually in covered hutches were randomly assigned to be weaned either early (42 d) or late (56 d) and weaned either abruptly (weaned over 3 days and 4 meal step-downs) or gradually (weaned over 14 days with 7 meal step downs). Calves were increased to 1200 g/d CMR (26:17) by d 7 and maintained at high intake until weaning started. Calves were also offered ad lib grain (18% CP, 3% fat) and alfalfa hay (18% CP, 29% fiber). Rumen pH was measured every 2 m via a bolus logger for the last 3 d of the weaning transition. Milk, grain, forage intake measured daily; body weights taken weekly; body temp, heartrate, respiration, fecal scores taken weekly. Calves weaned later (56 d) noted increased (P=0.01) change in grain intake during weaning as compared to calves weaned early (42 d). Also, calves weaned gradually (over 14 d), whether weaned early (at 42 d) or late (at 56 d) noted an increased (P<0.01) change in grain intake during weaning as compared to calves abruptly weaned. Forage intake at weaning tended to change at an increased rate (P=0.07) if calves were gradually weaned vs. abruptly weaned. ADG at wean transition was greater (P=0.01) in late (d 56) wean than early (d 42). Early/abrupt group noted reduced (P=0.01) ADG during wean transition as compared to the late/abrupt wean group. Gradually weaned groups noted increased (P=0.05) mean rumen pH vs. abruptly weaned groups. The late/gradual group tended (P=0.07) greater pH overall. Early wean groups tended (P=0.08) to have a higher minimum rumen pH. Calves weaned late tended (P=0.10) increased daily duration of subacute ruminal acidosis (any time below pH 5.8). NSD in fecal scores. NSD in body temperature. Abruptly weaned groups noted increased (P=0.01) calf heartrate (BPM) as compared to gradually weaned groups and groups weaned later tended (P=0.07) increased respiration rate (BPM). n=40. U of Idaho. U of Alberta, Edmonton. SC120.
2. *Using technology to develop an individual calf weaning strategy?* Feeding behavior and activity behavior were monitored with an auto-feeder (Forster-Technik) and accelerometers (IceQube, Scotland) on healthy dairy calves until d 87 (2 wks post-wean).

Calves were weighed by scale at birth, twice weekly, and d 87. Milk was offered at 10 L/d until d 50 and then reduced slowly (50% cut until d 64, then reduced 20%/d until wean d 70). Autofeeder monitored milk intake, drink speed, rewarded and unrewarded visits, and grain intake (offered ad lib). Accelerometer measured lying time, bouts, step counts and acceleration activity index (author notes as proven algorithm monitoring playing behavior). Each parameter was monitored for the first 30 d and entered into principal component analysis and linear regressions examined associations between each factor and grain intake and ADG. 70% of the variance in the feeding and activity behaviors was explained by 3 variables: 1.) if they had a high drinking speed and high starter intake, i.e., "feed motivated," (high correlation to increased starter intake, P=0.02, and to increased ADG, P<0.01), 2.) "Milk-driven" i.e., high rewarded visits and high unrewarded visits, (high correlation with *reduced* starter intake, P=0.03, and no association with ADG, P=0.45), and 3.) being "active," i.e., high step counts, high lying bouts and low lying times (no association with starter intake, P=0.34, or with ADG, P=0.20). Bottom line: data from auto-feeders in the first 30 days may be useful to determine future weaning success. Starter intake and milk drinking speed, and milk motivation (many rewarded and unrewarded visits), but not activity level, are useful measures to identify calves that could struggle at weaning. Author notes establishing an index of these correlated factors may aid with weaning. n=42. U of KY, Lexington. AgResearch Ltd, Hamilton, NZ. P118.