

INTERPRETIVE SUMMARIES, SEPTEMBER 2021

Invited review: The welfare of dairy cattle housed in tiestalls compared to less-restrictive housing types: A systematic review. *By Beaver et al., page 9383.* Many dairy cattle worldwide are housed in tiestalls (i.e., tethered to individual stalls within a barn). We conducted a systematic review of the literature to evaluate the welfare of tied dairy cattle through comparison with less-restrictive housing systems. We found some trade-offs in cattle health between the systems, but the expression of certain behavioral patterns was impaired when cattle were restricted to tiestalls. Few papers have examined affective state, but research to date suggests that this too may be improved in loose housing.

<https://doi.org/10.3168/jds.2020-19609>.

Invited review: Mechanisms of hypophagia during disease. *By Brown and Bradford, page 9418.* Livestock experience a decline in feed intake during diseases, such as metritis, mastitis, or diarrhea. The mechanisms of hypophagia in these instances are likely tied to immune responses, as cytokines such as interleukin-1 β and tumor necrosis factor- α signal peripherally and centrally. Both cytokines have potent action in the hypothalamus, known as the feed intake center of the brain. Additionally, acute-phase proteins, leptin, and calcium may play a role during an initial disease event. Understanding these mechanisms may prove useful in early diagnosis of disease in transition dairy cows, neonatal illness, and mastitis before clinical observation.

<https://doi.org/10.3168/jds.2021-20217>.

Screening of a *Bacillus subtilis* strain producing both nattokinase and milk-clotting enzyme and its application in fermented milk with thrombolytic activity. *By Zhang et al., page 9437.* A new *Bacillus subtilis* strain found in natto could be an excellent starter for thrombolytic-active fermented milk, which would be a novel functional food for the prevention of thrombosis-related cardiovascular diseases.

<https://doi.org/10.3168/jds.2020-19756>.

Mechanisms of structure formation underlying the creaming reaction in a processed cheese model system as revealed by light and transmission electron microscopy. *By Vollmer et al., page 9505.* Although the “creaming reaction,” a thickening of the cheese mass during and after cooking, is widely known in the processed cheese industry, its underlying mechanisms are poorly understood. An in-depth analysis of the developing structure during this reaction using light microscopy and transmission electron microscopy revealed several key elements that are related to the characteristic change in viscosity. New scientific insights gained from this study could be applied to the

design of cheese manufacturing lines to better control and standardize the processing conditions during and after the cooking step, leading to reduced product variability.

<https://doi.org/10.3168/jds.2020-20080>.

Effects of tolC on tolerance to bile salts and biofilm formation in *Cronobacter malonaticus*.

By Wang et al., page 9521. *Cronobacter* infections have been associated with the consumption of contaminated powdered infant formula, and *Cronobacter* spp. have shown strong tolerance to bile salts. The effects of tolC on growth, cell morphology, motility, and biofilm formation ability in *Cronobacter malonaticus* have been investigated under bile salt stress. Our results lead to a better understanding of bile salt tolerance in developing strategies to control and prevent *C. malonaticus* infections in powdered infant formula.

<https://doi.org/10.3168/jds.2021-20128>.

Cheese quality from cows given a tannin extract in 2 different grazing seasons. *By Menci et al., page 9543.*

Dietary tannin extracts are used in cattle farming as health and performance promoters. However, little is known about their effect on cheese quality or about their behavior in different grazing seasons. The findings of this study suggest that dietary tannins have no detrimental effects on cheesemaking at a supplementation dose of about 1% of dry matter intake. Moderate improvement in cheese quality was observed during Mediterranean dry grazing season. This could have practical implications as agroindustrial by-products and forages (especially those from dry areas) often contain tannins.

<https://doi.org/10.3168/jds.2021-20292>.

Detection of bovine milk adulteration in caprine milk with *N*-acetyl carbohydrate biomarkers by using ¹H nuclear magnetic resonance spectroscopy. *By Rysova et al., page 9583.*

In recent years, caprine milk has regained a significant portion of the dairy market, which makes it the object of adulteration with cheaper milk, especially bovine milk. The aim of this study was to develop a robust and rapid method that would be useful to inspection authorities for the detection of bovine milk in caprine milk. Proton nuclear magnetic resonance spectroscopy identified reliable *N*-acetyl carbohydrate biomarkers for the detection of adulteration and appears to be promising for routine analysis of caprine milk authenticity.

<https://doi.org/10.3168/jds.2020-20077>.

Effect of fumaric acid on the growth of *Lactobacillus delbrueckii* ssp. *bulgaricus* during yogurt fermentation. *By Yamamoto et al., page 9617.* *Streptococcus thermophilus* and *Lactobacillus*

delbrueckii ssp. *bulgaricus* are well-known lactic acid bacteria for fermenting yogurt. They protooperate with each other by exchanging metabolites, resulting in shorter fermentation time. Identifying metabolites that influence this symbiosis is important for optimizing fermentation conditions, which can increase the efficiency of industrial manufacture of yogurt. In this study, we found that the addition of fumaric acid promoted the growth of 75% of *L. bulgaricus* strains tested and that fumaric acid produced by *S. thermophilus* is one of the important symbiotic substances in yogurt fermentation. <https://doi.org/10.3168/jds.2021-20173>.

Diet supplementation with canola meal improves milk production, reduces enteric methane emissions, and shifts nitrogen excretion from urine to feces in dairy cows. *By Benchaar et al., page 9645.* This study investigated the effect of using canola meal (7.9, 15.8, or 23.7% of the dietary dry matter) at the expense of soybean meal as a protein source on enteric methane emissions, nitrogen excretion, and milk production of dairy cows. Including canola meal in the diet increased dry matter intake and milk production, whereas it decreased enteric CH₄ production (g/d) and intensity of emissions (g of CH₄/kg of milk). Replacing soybean meal with canola meal in the diet shifted the route of nitrogen excretion from urine to feces, suggesting reduced potential N volatilization from manure. Results from this study show that canola meal can successfully replace soybean meal as a protein source in the diet to improve efficiency and sustainability of dairy production. <https://doi.org/10.3168/jds.2020-20053>.

Effect of *Lactobacillus hilgardii*, *Lactobacillus buchneri*, or their combination on the fermentation and nutritive value of sorghum silage and corn silage. *By Arriola et al., page 9664.* This study examined the effect of 2 bacterial inoculants on the fermentation and aerobic stability of sorghum [27% dry matter (DM)] and corn silage harvested at normal (34% DM) or late (43.8% DM) maturity after 30 or 90 d of ensiling. Inoculation increased aerobic stability of sorghum ensiled for 90 d and increased or tended to increase that of normal corn regardless of the ensiling duration; however, inoculation did not affect aerobic stability of late-harvested corn. <https://doi.org/10.3168/jds.2020-19512>.

Evaluation of Molly model predictions of ruminal fermentation, nutrient digestion, and performance by dairy cows consuming ryegrass-based diets. *By Morales et al., page 9676.* This study evaluated the versatility of the Molly cow model for predicting the digestive processes and subsequent animal performance of cows fed pasture-based diets using a data set compiled from the literature. Although

Molly has been developed using mainly US data from Holstein dairy cows consuming mixed rations, our findings demonstrate its potential applicability to represent cows consuming pasture-based diets given some model modifications and reparameterization. Some potential differences in physiological processes of grass diet digestion compared with mixed rations were identified, and future model improvements areas are also discussed in this work. <https://doi.org/10.3168/jds.2020-19740>.

Effect of a calcium-energy supplement drink at calving on lactation performance: Milk yield and composition, odds to reach a next lactation, and calving interval. *By Daniel et al., page 9703.* Calving is a challenge to calcium homeostasis. Administration of a Ca supplement at calving is a common practice that has been proven to sustain blood Ca within the first 24 h after administration. This experiment was a prospective randomized study that evaluated the effects of a Ca-energy supplement drink on lactation performance in commercial dairy farms in the presence of a blinded placebo. We observed that the Ca-energy supplement drink did not increase the odds of reaching a next lactation, but primiparous cows had increased milk and components yields, decreased risk of subclinical ketosis, and increased calving interval. <https://doi.org/10.3168/jds.2020-19742>.

Effects of rumen-protected choline supplementation in Holstein dairy cows during electric heat blanket-induced heat stress. *By Holdorf and White, page 9715.* Heat-stressed dairy cows exhibit reduced feed intake and milk production, which may be partially explained by an inflammatory response. Nutritional interventions may mitigate negative effects on performance and health. Rumen-protected choline has been demonstrated to mitigate immune responses in transition dairy cows and could be a beneficial nutritional strategy in heat-stressed dairy cows. Rumen-protected choline partially mitigated the effect of heat stress in mid-lactation cows. Further exploration into rumen-protected choline as a potential nutritional strategy to mitigate the negative effects of heat stress on health and production is warranted. <https://doi.org/10.3168/jds.2020-19794>.

Derivation of the maintenance energy requirements and efficiency of metabolizable energy utilization for dry and lactating Jersey cows. *By Morris and Kononoff, page 9726.* Maintenance energy requirements of Jersey cows during lactation, maintenance feeding, or when fasted were derived. Energy balance was quantified via total collection and indirect calorimetry. Metabolizable energy for maintenance was 0.146 ± 0.0087 Mcal per unit of metabolic body weight (MBW). Net energy for maintenance as deter-

mined via fasting heat production was 0.102 ± 0.0071 Mcal/MBW. Net energy for maintenance estimated via regression was not different between lactating and dry cows; however, the efficiency of converting metabolizable energy into net energy was greater for dry compared with lactating cows (0.714 vs. 0.685) when evaluated with a fixed intercept.
<https://doi.org/10.3168/jds.2020-20056>.

Daily alternation of the dietary starch level in Holstein dairy cows. *By Hernández-Castellano et al., page 9735.* Feeding high amounts of starch to sustain high milk yield increases the risk for decreased rumen pH, causing either ruminal acidosis or subacute ruminal acidosis. Although several studies have investigated the effect of different starch levels in dairy cows, limited information regarding the effect of daily alternation of the dietary starch level on dairy cows is available in the literature. The present study showed that repeated daily alternation of the dietary starch level from 21 to 42% of feed dry matter affected the proportions of volatile fatty acids, although no effects were observed in blood, urine, or milk.
<https://doi.org/10.3168/jds.2020-19989>.

Effects of calcium salts of palm fatty acids on nutrient digestibility and production responses of lactating dairy cows: A meta-analysis and meta-regression. *By dos Santos Neto et al., page 9752.* Our objective was to perform a meta-analysis and meta-regression to evaluate the effects of calcium salts of palm fatty acids on nutrient digestibility and production responses of lactating dairy cows. Also, we aimed to evaluate whether experimental design affects production responses to supplementation with calcium salts of palm fatty acids. Our results indicate no reason for the restrictive use of changeover designs in supplementation studies and meta-analysis with calcium salts of palm fatty acids. Feeding calcium salts of palm fatty acids reduced dry matter intake and increased the yields of milk and milk fat.
<https://doi.org/10.3168/jds.2020-19936>.

Effects of mixed tocopherols added to milk replacer and calf starter on intake, growth, and indices of stress. *By Quigley et al., page 9769.* Vitamin E comprises several isoforms of tocopherols and tocotrienols, although α -tocopherol is the main isoform supplemented in calf diets. Adding γ - and δ -tocopherols to milk and calf starter improved growth, feed efficiency, and several biological responses. Our data suggest that tocopherols may improve an animal's oxidative status, directing more nutrients toward growth and improving animal efficiency. Further consideration should be given to the effects of these isoforms in diets of ruminants.
<https://doi.org/10.3168/jds.2020-19929>.

Dietary starch level and rumen-protected methionine, lysine, and histidine: Effects on milk yield, nitrogen, and energy utilization in dairy cows fed diets low in metabolizable protein. *By Zang et al., page 9784.* We aimed to assess whether replacing beet pulp and soyhulls with ground corn supplemented or not with rumen-protected amino acids would improve production and nutrient utilization in dairy cows fed low metabolizable protein diets. Although feed intake decreased, yields of milk and milk protein increased with feeding ground corn versus beet pulp and soyhulls. Feeding ground corn also reduced urinary urea nitrogen excretion and tended to improve milk energy output. Rumen-protected amino acids did not change milk production or nutrient utilization.
<https://doi.org/10.3168/jds.2020-20094>.

Effect of protein concentrate mixtures and dietary addition of exogenous phytase on major milk minerals and proteins, including casein phosphorylation. *By Poulsen et al., page 9801.* Increasing demand for sustainable production of feed protein, genetically modified organism (GMO)-free milk production, and optimized phosphorus utilization are main drivers for changes in protein supplementation for dairy production. Through a controlled feeding experiment, the effect of concentrate mixture based on fava beans, rapeseed meal, or soybean meal as main phosphorus and protein sources on milk composition was examined under typical Danish management conditions. The study identified changes in milk mineral and protein compositions including casein phosphorylations in relation to used concentrate mixture, which may affect milk functionality. No effect of addition of dietary exogenous phytase on milk composition or functionality was detected.
<https://doi.org/10.3168/jds.2020-20075>.

Milk from cows fed clover-rich silage are higher in n-3 fatty acids compared with that from grass silage-fed cows. *By Lashkari et al., page 9813.* The diet fed to lactating cows has great effect on milk fatty acid profile. The present experiment showed that both white and red clover silage gave higher proportion of polyunsaturated fatty acids such as n-3 and n-6 in milk than feeding grass silage of perennial ryegrass, festulolium, and tall fescue. Feeding tall fescue silage resulted in highest milk proportion of *cis*-9,*trans*-11 and *trans*-10,*cis*-12 conjugated linoleic acid. The α -tocopherol content was highest in milk from grass silage-fed cows.
<https://doi.org/10.3168/jds.2021-20407>.

Lactational performance, rumen fermentation, and enteric methane emission of dairy cows fed an amylase-enabled corn silage. *By Cueva et al., page 9827.* Inclusion of an amylase-enabled (Enogen, Syngenta Seeds LLC) corn silage (ECS) at 40% of di-

etary dry matter increased milk, milk protein yields, and feed efficiency, and tended to increase energy-corrected milk feed efficiency, compared with an isogenic corn silage. Enteric methane emission intensity was decreased by ECS. Data suggest that ECS can be used as an alternative to conventional corn silage, and it may increase feed efficiency and decrease the intensity of enteric methane emission in dairy cows.

<https://doi.org/10.3168/jds.2021-20251>.

Partial replacement of corn silage with whole-plant soybean and black oat silages for dairy cows. *By Silva et al., page 9842.* This study evaluated the partial replacement of corn silage with soybean silage or black oat silage in diets of dairy cows. The inclusion of oat silage reduced nutrient intake, milk production, and feed efficiency, whereas soybean silage sustained the performance of cows. Soybean silage can partially replace corn silage with no adverse effects on productivity.

<https://doi.org/10.3168/jds.2021-20200>.

Conditions stimulating neutral detergent fiber degradation by dosing branched-chain volatile fatty acids. II: Relation with solid passage rate and pH on neutral detergent fiber degradation and microbial function in continuous culture.

By Roman-Garcia et al., page 9853. Addition of exogenous branched-chain volatile fatty acids (BCVFA) was studied in continuous cultures that had 2 particulate passage rates and maintained at high and low pH. Diets contained a forage-to-concentrate ratio of 50:50 and had 15.4% crude protein. Addition of BCVFA increased neutral detergent fiber degradability without interacting with other factors. Decreasing pH shifted volatile fatty acid stoichiometry away from acetate and methanogenesis. Effluent flow and efficiency of microbial protein synthesis were not affected. Results support provision of BCVFA to improve fiber degradability or to reduce rumen-degraded protein in dairy cattle diets.

<https://doi.org/10.3168/jds.2021-20335>.

Conditions stimulating neutral detergent fiber degradation by dosing branched-chain volatile fatty acids. III: Relation with solid passage rate and pH on prokaryotic fatty acid profile and community in continuous culture.

By Roman-Garcia et al., page 9868. Addition of exogenous branched-chain fatty acids (BCVFA) was studied in continuous cultures that had 2 particulate passage rates and were maintained at high and low pH. Diets had a forage-to-concentrate ratio of 50:50 and contained 15.4% crude protein. Addition of BCVFA increased the relative abundance of *Fibrobacter* and *Treponema*, 2 bacterial genera known to cooperate to degrade fiber and to require BCVFA. Low pH shifted branched-chain fatty

acids in bacteria while simultaneously changing the bacterial community. The addition of BCVFA might stimulate fibrolytic bacteria even when pH is decreased and passage rate is high, as occurs in high-producing dairy cattle.

<https://doi.org/10.3168/jds.2021-20336>.

Effects of prepartum dietary protein level and feed intake on postpartum lactation performance and feeding behavior of multiparous Holstein dairy cows.

By Akhtar et al., page 9886. This study aimed to test the effects of prepartum ad libitum and restricted intake of low and high protein diets on postpartum dry matter intake, milk production, body condition, and feeding behavior of dairy cows. The results revealed that high dietary protein supplies increased milk yield and tended to increase postpartum dry matter intake, whereas controlled intake decreased postpartum body condition loss and serum β -hydroxybutyrate over the 9 weeks of lactation. Our results indicate that feeding a prepartum high-protein diet combined with restricted intake can provide benefits of both strategies than relying independently on increased dietary protein or restricted intake.

<https://doi.org/10.3168/jds.2021-20218>.

Histidine dose-response effects on lactational performance and plasma amino acid concentrations in lactating dairy cows: 1. Metabolizable protein-adequate diet.

By Räsänen et al., page 9902. This experiment investigated production responses to incremental levels of digestible histidine in lactating dairy cows fed metabolizable protein-adequate basal diets. Diet 1 was low in histidine and included feather meal only, whereas diet 2 included blood meal in addition to feather meal and was top-dressed with rumen-protected histidine to provide 2 additional histidine doses. Digestible histidine supplemented at 69 g/d resulted in the greatest milk fat and energy-corrected milk yields, whereas milk protein concentration and yield were not affected by histidine supply.

<https://doi.org/10.3168/jds.2021-20188>.

Histidine dose-response effects on lactational performance and plasma amino acid concentrations in lactating dairy cows: 2. Metabolizable protein-deficient diet.

By Räsänen et al., page 9917. The objective of this experiment was to investigate production responses to incremental levels of digestible histidine (45–74 g/d) in lactating dairy cows fed a metabolizable protein-deficient diet. Milk yield increased up to digestible histidine supply of 63 g/d, whereas feed efficiency, energy-corrected milk, and milk true protein yield increased linearly up to digestible histidine supply of 74 g/d. Overall, midlactation dairy cows fed a diet providing 85 to 90% of NRC (2001) recommendations

for metabolizable protein had increased lactational performance at digestible histidine supply of 74 g/d. <https://doi.org/10.3168/jds.2021-20189>.

Effects of varying extracellular amino acid concentrations on bidirectional amino acid transport and intracellular fluxes in mammary epithelial cells. *By Yoder et al., page 9931.* Intracellular amino acid supplies regulate milk protein synthesis; hence, an understanding of regulation of amino acid uptake and its effect on intracellular concentrations as supplies are varied is needed to predict milk protein. Amino acid uptake exhibited linear kinetics for 11 amino acids when supplies were varied below and above typical in vivo concentrations using an in vitro technique and mammary epithelial cells. Arginine, valine, and proline exhibited saturation kinetics within the in vivo range. <https://doi.org/10.3168/jds.2021-20187>.

Intravenous trimethylamine N-oxide infusion does not modify circulating markers of liver health, glucose tolerance, and milk production in early-lactation cows. *By Myers et al., page 9948.* The gut bacteria-derived metabolite trimethylamine N-oxide (TMAO) has been implicated in the development of metabolic disease in nonruminants. In ruminants, dietary choline supplementation increases circulating TMAO concentrations; however, the effects of TMAO on energy metabolism have not been previously investigated in dairy cattle. We evaluated the effects of intravenous TMAO infusion on circulating measures of liver health, glucose tolerance, and milk production in early-lactation cows. Our results suggest that TMAO does not modify energy metabolism or liver health in dairy cattle. <https://doi.org/10.3168/jds.2021-20169>.

Replacing stearic acid with oleic acid in supplemental fat blends improves fatty acid digestibility of lactating dairy cows. *By Prom and Lock, page 9956.* The objective of our study was to determine the effect of altering the ratio of stearic and oleic acids in a dietary fat supplement on fatty acid digestibility and production responses of lactating dairy cows. We observed that increasing oleic acid increased digestibility and absorption of total, 16-carbon, and 18-carbon fatty acids. Supplemental fat increased milk yield, milk fat yield, and energy-corrected milk, but there was no difference between the fatty acid-supplemented treatments. Overall, supplementation with fatty acids increased milk yield and energy-corrected milk regardless of the ratio of stearic to oleic acid. Increasing oleic acid in a dietary fat supplement increased fatty acid digestibility and preformed milk fatty acid yield without negatively affecting dry matter intake. <https://doi.org/10.3168/jds.2020-19985>.

Exploring farmers' attitudes and determinants of dairy calf welfare in an expanding dairy sector. *By Osawe et al., page 9967.* The Irish dairy industry expanded rapidly following European Union milk quota abolition in 2015, resulting in increased herd sizes and changed breeding strategies. In this article, we used survey data of 441 Irish dairy farmers to assess farmers' attitudes toward the welfare of farmed animals and dairy calves. We also explored how expansion, breeding, and calf management characteristics relate to calf welfare outcomes. Our analyses revealed that expansion, breeding, and calf management factors were significantly associated with calf welfare. We conclude with suggested strategies worth promoting to improve dairy calf welfare, such as beef trait-focused breeding leading to greater dairy-beef integration. <https://doi.org/10.3168/jds.2020-19550>.

Economic and environmental effects of revised metabolizable protein and amino acid recommendations on Canadian dairy farms. *By Binggeli et al., page 9981.* Whole-farm mathematical simulations were used to compare the effect of balancing dairy rations based on amino acids, using a variable efficiency with the current formulation based on a fixed efficiency of utilization of metabolizable protein. Assuming constant milk production, the former has the potential to reduce pollution while enhancing net income when compared to the latter. Indeed, the amino acid approach, in 3 Canadian environmental and crop contexts, increased estimated net income by 4.2%, with a reduction of 6.3% of manure N excretion by lactating cows, resulting in 3.8% reduction of whole-farm N balance. Nitrous oxide and ammonia emissions from manure could also be reduced by 1.7%. <https://doi.org/10.3168/jds.2020-19893>.

A survey of dairy goat kid-rearing practices on Canadian farms and their associations with self-reported farm performance. *By Bélanger-Naud et al., page 9999.* Based on self-reported data, our study identified common goat kid-rearing practices, from birth to weaning inclusively, on Canadian dairy goat farms and analyzed the associations between these practices and 6 farm performance indicators. Several practices, mainly around colostrum and milk feeding management, were identified as being associated with good farm performance. Rearing practices associated with higher farm performance could be targeted by field advisors to help improve management practices on Canadian dairy goat farms. <https://doi.org/10.3168/jds.2020-18663>.

Genetic parameters of semen quality traits and genetic correlations with service sire nonreturn rate in Nordic Holstein bulls. *By Gebreyesus et al., page 10010.* The quality of semen is shown to be a

significant factor for reproductive success in artificially inseminated dairy cows. Nonetheless, the literature on the genetic variability in semen quality between bulls used in artificial insemination is scarce. Additionally, no study so far has estimated the genetic correlation between semen quality traits and service sire nonreturn rate. In this study, we report low to moderate heritability for semen quality traits, presenting an opportunity for selective breeding to improve service sire semen quality. In addition, some of the semen quality traits were shown to have moderate to high genetic and phenotypic correlation with nonreturn rate, indicating the predictive value of these traits for service sire nonreturn rate.

<https://doi.org/10.3168/jds.2021-20403>.

Genetic analysis of semen characteristic traits in Norwegian Red bulls at the artificial insemination center. *By Olsen et al., page 10020.* Knowledge on the genetics of semen quality in bulls is limited. Our aim was to estimate heritability of and genetic correlations among semen characteristic traits. The heritability of semen weight, concentration, and number of straws made were moderate, whereas motility (the sperm's swimming ability) had low heritability. Traits measured in the andrology test at the performance test station showed strong genetic correlations with corresponding traits for bulls in semen production at the artificial insemination center. The andrology test performed on young bulls is therefore a resource to identify the genetically best bulls for artificial insemination.

<https://doi.org/10.3168/jds.2020-19294>.

Genotype by heat stress interactions for production and functional traits in dairy cows from an across-generation perspective. *By Kipp et al., page 10029.* The effects of direct heat stress on genetic parameter estimates for cow traits have been shown in a variety of previous studies. In this study, we focused on the dry cow period and analyzed the effects of in utero heat stress on genetic parameter estimates for traits recorded in the offspring generation. For nonreturn rates and diseases, genetic variances and heritabilities increased due to prenatal heat stress, but for milk yield, opposite effects were observed. Genetic correlations smaller than 0.80 for nonreturn rates and diseases at a temperature-humidity index (THI) of 65 with corresponding traits at remaining THI indicated time-lagged genotype by environment interactions.

<https://doi.org/10.3168/jds.2021-20241>.

Bayesian inference of the inbreeding load variance in fertility traits in Brown Swiss cattle. *By Martinez-Castillero et al., page 10040.* Inbreeding depression reduces the phenotypic performance of fitness-related traits (e.g., fertility). In this study, we

investigated the effects of inbreeding load on fertility in dairy cattle. The results confirmed that inbreeding depression affects fertility (e.g., by reducing or increasing the number of days in an interval fertility trait), supporting the opportunity to include inbreeding loads in selection and breeding strategies.

<https://doi.org/10.3168/jds.2020-20087>.

Practical implementation of genetic groups in single-step genomic evaluations with Woodbury matrix identity-based genomic relationship inverse. *By Koivula et al., page 10049.* Genomic selection has become a standard in dairy cattle breeding. A proper way to account genetic groups through unknown parent groups (UPG) after so-called QP transformation is one key factor in a single-step model. When the UPG effects are incompletely accounted for, the iterative solving method may have convergence problems. In this study, we investigated computational and predictive performance of single-step genomic BLUP based on the **T** matrix (GTBLUP) with residual polygenic (RPG) effect and UPG. The results show that UPG can be easily implemented in single-step GTBLUP having RPG. Furthermore, for good convergence of the preconditioned conjugate gradient method, a complete QP transformation was necessary.

<https://doi.org/10.3168/jds.2020-19821>.

Effect of diet and nonesterified fatty acid levels on global transcriptomic profiles in circulating peripheral blood mononuclear cells in early lactation dairy cows. *By Cheng et al., page 10059.* Excessive production of nonesterified fatty acids (NEFA) was previously identified as a major risk for postpartum immunosuppression. Our results demonstrated that increased circulating NEFA concentration altered various aspects of immune system process in peripheral blood mononuclear cells in early lactation cows. When the NEFA concentration exceeded 750 μ M, their cell-to-cell adhesion was inhibited, which would reduce the efficiency of diapedesis. This would contribute to decreased body defense or immunity and predispose animals to infection.

<https://doi.org/10.3168/jds.2021-20136>.

Genome-wide association study and functional analyses for clinical and subclinical ketosis in Holstein cattle. *By Soares et al., page 10076.* Ketosis is a metabolic disease that directly interferes with the peak of milk production. In this study, we carried out an investigation to first detect regions of the Holstein cattle genome associated with clinical and subclinical ketosis in first and later lactations. Then, the genes in these regions were identified, and further analysis showed that their gene ontology terms were mostly involved in fatty acid metabolism, lipid metabolism, and inflammatory response. An additional study of the as-

sociation among these genes provided very informative gene networks, which help to define their shared biological processes. Overall, these results help to enhance the genetic understanding of clinical and subclinical ketosis in dairy cows, which could improve selection decisions in the future.
<https://doi.org/10.3168/jds.2020-20101>.

Effects of early social contact on dairy calf response to initial social grouping and regrouping. *By Lindner et al., page 10090.* We examined the effects of early social contact, with calves housed individually or in pairs for the first 2 wk of life, on early life behavior and performance and response to initial introduction to group-housing with an autfeeder and subsequent regrouping. Housing treatment did not affect calf health, performance, ability to learn to use the teat in the first 2 wk, or use of an autfeeder after grouping. Following initial grouping and regrouping, previously pair-housed calves spent more time lying socially, but previous social contact did not affect interaction with novel pen resources or locomotor activities.
<https://doi.org/10.3168/jds.2021-20435>.

The effect of pegbovigrastim on early-lactation disease, production, and reproduction in dairy cows. *By Van Schyndel et al., page 10100.* A randomized, double blind, placebo-controlled trial was conducted on 6 commercial dairy herds in Canada to assess the effects of pegbovigrastim, an immune modulator, on health and performance of dairy cows. We found no differences between treated and control cows in the incidence of reproductive tract diseases, mastitis, displaced abomasum, culling in early lactation, or in reproductive performance. Cows that received pegbovigrastim produced approximately 1 kg/d less milk in early lactation.
<https://doi.org/10.3168/jds.2021-20266>.

Evaluation of test characteristics of 2 ELISA tests applied to bulk tank milk and claw-trimming records for herd-level diagnosis of bovine digital dermatitis using latent class analysis. *By Holmøy et al., page 10111.* The traditional diagnostic method used to detect bovine digital dermatitis is assessment at claw trimming, which is time consuming and expensive, and requires trained personnel. Laboratory tests to diagnose digital dermatitis at the herd level are desirable. This Norwegian study estimated characteristics of 2 ELISA research tests on bulk tank milk and trimming records for herd-level diagnosis of digital dermatitis. Neither of the 2 ELISA tests yielded satisfactory sensitivity without compromising specificity. Currently, inspection at trimming in a chute is necessary for surveillance of digital dermatitis in Norway,

although these ELISA tests of bulk tank milk might be a useful supplement.
<https://doi.org/10.3168/jds.2020-19804>.

Homogeneity density scores of quarter milk in automatic milking systems. *By Hallén Sandgren et al., page 10121.* Homogeneity changes in milk, such as clots, are indicators of mastitis and poor milk quality. The occurrence and dynamics of clots in cows milked in automatic milking systems is poorly known. A method to score clot density of quarter milk was developed and validated. Elevated scores were found in a limited group of cows. The risk for a cow having clots in milk increased with clots present in previous milking, longer milking interval, and lactation number, and decreased during lactation. Validated methods for assessing clots in individual udder quarters are essential for setting industrial standards and to develop technologies for detection.
<https://doi.org/10.3168/jds.2021-20439>.

Associations between the metabolic status of the cow and colostrum quality as determined by Brix refractometry. *By Immler et al., page 10131.* Calf health is a relevant animal welfare issue in dairy herds. Producing high-quality colostrum is essential to prevent failure of passive transfer of immunoglobulins in newborn calves. This field study focused on the influence of the prepartum cow's health status on colostrum quality with special emphasis on metabolic health. Our results provide parameters to assess cow health during the close-up period and demonstrate the importance of cow-level health monitoring to ensure calf health by good quality colostrum.
<https://doi.org/10.3168/jds.2020-19812>.

Modifiable management practices to improve udder health in dairy cattle during the dry period and early lactation: A scoping review. *By McMullen et al., page 10143.* Modifiable management practices used during the dry period to affect udder health were characterized in this scoping review. Management strategies including vaccines, nonantimicrobial products, nutrition, dry period length, housing, and milking frequency prior to dry-off were reported in 229 articles. These strategies need to be assessed for their efficacy in preventing intramammary infections and clinical mastitis postcalving to aid in mastitis control, either with or replacing antimicrobial dry cow therapy.
<https://doi.org/10.3168/jds.2020-19873>.

Perspectives of Western Canadian dairy farmers on providing outdoor access for dairy cows. *By Smid et al., page 10158.* Our aim was to investigate the perspectives of Western Canadian dairy farmers on outdoor access for dairy cows. We conducted 11 focus

group discussions with a total of 50 Western Canadian dairy farmers and 6 semi-structured individual interviews with dairy farmers of Hutterite colonies. Using template analysis, reasons to provide and not to provide pasture or alternative types of outdoor access fell into 5 themes: climate conditions, cow welfare, economics, farm infrastructure, and management. In conclusion, the decision to provide outdoor access involved the weighing of a multitude of farm-specific factors, interlaced with the farmer's beliefs and values.
<https://doi.org/10.3168/jds.2021-20342>.

Selenomethionine activates selenoprotein S, suppresses Fas/FasL and the mitochondrial pathway, and reduces *Escherichia coli*-induced apoptosis of bovine mammary epithelial cells. *By Zhuang et al., page 10171.* *Escherichia coli* is a major environmental pathogen causing bovine mastitis. Selenium, an essential trace element, protects against mastitis by preventing apoptosis. Bovine mammary epithelial cells were evaluated to determine the protective mechanism of selenomethionine on *E. coli*-induced apoptosis. We concluded that selenomethionine attenuated *E. coli*-induced apoptosis of bovine mammary epithelial cells by activating selenoprotein S, associated with both the Fas/FasL and mitochondrial pathways. This study provides new knowledge regarding pathogenesis of *E. coli*-induced bovine mastitis.
<https://doi.org/10.3168/jds.2020-20034>.

Associations between feeding behaviors collected from an automated milk feeder and disease in group-housed dairy calves in Ontario: A cross-sectional study. *By Conboy et al., page 10183.* The objective of this study was to determine if the automated milk feeder can be used to detect disease in calves at a single time point. It was found that total milk consumption, the percentage of milk allotment consumed, drinking speed, and the number of unrewarded visits were all significantly associated with 2 or more of bovine respiratory disease, neonatal calf diarrhea, or general disease. However, the sensitivity of disease detection was low; thus, to increase it, parallel interpretation was completed. With parallel interpretation, the use of an automated milk feeder can be a useful preliminary tool in disease detection.
<https://doi.org/10.3168/jds.2021-20137>.

A study on the use of thermal imaging as a diagnostic tool for the detection of digital dermatitis in dairy cattle. *By Anagnostopoulos et al., page 10194.* We investigated the association between bovine digital dermatitis lesions and the interdigital skin temperature measured by infrared thermography. All clinical stages of digital dermatitis were associated with increased foot skin temperature. Feet with active

lesions were recorded having higher mean interdigital skin temperature compared with feet with chronic, inactive digital dermatitis lesions and nonaffected feet. This finding led to the development and validation of predictive models that use interdigital skin temperature readings, among other variables, as input to distinguish between feet affected with active digital dermatitis and nonaffected feet or feet bearing chronic digital dermatitis lesions.
<https://doi.org/10.3168/jds.2021-20178>.

Assessing effects of dietary and milking frequency changes and injection of cabergoline during dry-off on hunger in dairy cows using 2 feed-thwarting tests. *By Franchi et al., page 10203.* We investigated the effects of dietary and milking frequency changes during a week before dry-off, as well as injection of cabergoline (dopamine agonist) after the last milking, on the feeding motivation in dairy cows using 2 feed-thwarting test paradigms. Reducing feeding level, either before or on the dry-off day, resulted in behavioral changes indicative of hunger, though no clear effect of reduced milking frequency was found. The effects of cabergoline on feeding motivation were unclear and deserve further investigation. The current study contributes to the understanding of how dry-off management can affect the behavior and welfare of cows.
<https://doi.org/10.3168/jds.2020-20046>.

The effect of new bovine viral diarrhea virus introduction on somatic cell count, calving interval, culling, and calf mortality of dairy herds in the Dutch bovine viral diarrhea virus-free program. *By Yue et al., page 10217.* The effect of new bovine viral diarrhea virus (BVDV) infection on herd performance (somatic cell count, calving interval, culling risk, and calf mortality rate) in the Dutch BVDV-free program was assessed on a unique combination of herd-level surveillance data and herd performance information from 2007 to 2016. Within the control program, BVDV-free herds had a lower somatic cell count, culling risk, and calf mortality rate, and shorter calving interval than BVDV breakdown herds. New introduction of BVDV had a negative but, on average, relatively small effect on herd performance in BVDV breakdown herds.
<https://doi.org/10.3168/jds.2021-20216>.

Detecting intramammary infection at the end of lactation in dairy cows. *By McDougall et al., page 10232.* Due to increasing concerns about antibiotic use, the practice of treating every cow with antibiotics at the end of lactation is under scrutiny. The alternative, use of antibiotics only in cows likely to be infected, requires tests such as milk somatic cell count (SCC) to

define the cow's status. Recently, it has been suggested that cow and herd factors could alter the SCC cut-point that defines infection. This study demonstrated that addition of age, milk yield, herd prevalence of infection, and bulk tank SCC did not improve ability to predict presence of infection above that provided by SCC alone.

<https://doi.org/10.3168/jds.2020-20036>.

Antimicrobial resistance and virulence characteristics in 3 collections of staphylococci from bovine milk samples. *By Fergestad et al., page 10250.*

The aim of this study was to identify and characterize 3 collections of staphylococcal isolates from bovine milk samples regarding antimicrobial resistance and their carriage of virulence genes typically displayed by *Staphylococcus aureus*. A total of 272 staphylococcal isolates were included. Antimicrobial resistance was common in *Staphylococcus epidermidis* and *Staphylococcus haemolyticus*, with resistance to trimethoprim-sulfonamide often observed, while virulence genes occurred frequently in *S. aureus*. Our results contribute to the continuous need for knowledge regarding staphylococci from food-producing animals as a basis for better understanding of occurrence of resistance and virulence traits in these bacteria

<https://doi.org/10.3168/jds.2020-19988>.

The effect of pair housing on dairy calf health, performance, and behavior. *By Bučková et al., page 10282.*

This study focused on welfare and performance of dairy calves. Dairy calves are kept individually during the milk-feeding period, but there is increasing interest among farmers in adopting alternative housing of calves such as pair housing. Pair housing combines welfare benefits with practicality, but differences in the health and performance of individually and pair-housed calves remains unresolved. We recorded calf diarrhea and respiratory problems, feed intake, and weight gain between wk 2 and wk 8 and found no difference between individually and pair-housed calves. However, individually housed calves were more play-deprived at 2 wk of age.

<https://doi.org/10.3168/jds.2020-19968>.

Effect of treatment of pneumonia and otitis media with tildipirosin or florfenicol + flunixin meglumine on health and upper respiratory tract microbiota of preweaned Holstein dairy heifers. *By Bringhamti et al., page 10291.*

Pneumonia and otitis media are within the main causes of economic losses, mortality, and morbidity in dairy calves. In this study, we compared the effects of 2 drugs, tildipirosin and florfenicol + flunixin meglumine, used to treat pneumonia and otitis on the disease recurrence risk, average daily gain, health parameters, and upper respiratory tract

microbiota of Holstein calves. No difference between drugs was observed in the recurrence risk of pneumonia and otitis or in average daily gain. Although both drugs had similar effects on reducing rectal temperature and leukocyte counts, florfenicol + flunixin meglumine had a greater reduction on rectal temperature within 4 d after treatment. Both drugs were effective in reducing the mean relative abundance of important bacterial genera present in the upper respiratory tract (*Mannheimia*, *Moraxella*, and *Pasteurella*), and no reduction was observed for the genus *Mycoplasma*.

<https://doi.org/10.3168/jds.2020-19945>.

Hepatic effects of rumen-protected branched-chain amino acid with or without propylene glycol supplementation in dairy cows during early lactation. *By Leal Yepes et al., page 10324.*

Nutritional requirements increase drastically in all dairy cows at calving, but voluntary dry matter intake is insufficient to supply the nutrients needed to support lactation. The essential branched-chain amino acids (BCAA) are in deficit in early-postpartum dairy cows. We tested the hepatic effects of early-postpartum rumen-protected BCAA and propylene glycol supplementation in dairy cows. The degree of hepatic lipidosis improved, certain liver enzymes were lower, and serum concentrations of insulin and certain essential amino acids were greater in rumen-protected BCAA combined with propylene glycol supplementation. Supplementation with rumen-protected BCAA and propylene glycol may help improve early-lactation liver metabolism.

<https://doi.org/10.3168/jds.2021-20265>.

Longitudinal changes in fatty acid metabolism and in the mitochondrial protein import system in over- and normal-conditioned cows: A transcriptional study using microfluidic quantitative PCR. *By Ghaffari et al., page 10338.*

Using metabolomics profiling in serum samples, we reported previously that over-conditioning around calving may contribute to mitochondrial overload and impairment of β -oxidation in early lactation. Herein, we extended our investigation into the effect of over-conditioning at calving on the liver, testing the hepatic mRNA abundance of genes related to fatty acid metabolism and to the mitochondrial protein import system in the previously established animal model. Our results further support that mitochondrial fatty acid overload and ketogenesis are elevated in over-conditioned compared with normal-conditioned cows.

<https://doi.org/10.3168/jds.2021-20237>.

Effect of monensin on milk fatty acid profile in dairy cows and on the use of fatty acids for early diagnosis of elevated blood plasma concentrations of nonesterified fatty acids and

hyperketonemia. *By Henno et al., page 10355.* The use of monensin to reduce health disorders associated with negative energy balance in transition cows is widely used. Warning biomarkers for these disorders are elevated blood nonesterified fatty acids (NEFAH) and elevated β -hydroxybutyrate (i.e., hyperketonemia, HYK) concentrations. Thresholds of certain milk fatty acids (FA) have been proposed as routinely detectable markers for the identification of NEFAH and HYK cows. Precalving continuous-release monensin capsule administration affected postcalving milk FA profile and the identification accuracy of most estimated FA for NEFAH cows and some FA for HYK cows. The specific FA thresholds for identification of NEFAH and HYK cows are applicable only within similar feeding conditions and rumen environment.
<https://doi.org/10.3168/jds.2020-20041>.

Effects of colostrum feeding on the mRNA abundance of genes related to toll-like receptors, key antimicrobial defense molecules, and tight junctions in the small intestine of neonatal dairy calves. *By Ghaffari et al., page 10363.* The objective was to elucidate the effect of feeding colostrum or milk-based formula ($n = 7/\text{group}$) on mRNA abundance of genes related to toll-like receptors, key antimicrobial defense molecules, and tight junctions in the small intestine. Observed differences in mRNA abundance of genes related to mucosal innate immune responses and barrier functions in the calves fed with colostrum versus formula suggest that feeding colostrum may improve immune responsiveness and epithelial barrier function in neonatal calves.
<https://doi.org/10.3168/jds.2021-20386>.

Effect of temporary cessation of milking on the innate immune components in goat milk. *By Purba et al., page 10374.* Temporary cessation of milking is widely used during the dry period of dairy cows to stop milk removal from the mammary gland. However, in Japan, the combination of this practice with antibiotic administration is used to treat mastitis. This study aimed to elucidate the role of the innate immune system during and near temporary cessation of milking by investigating the concentration of several innate immune components in goat milk. The results suggest that temporary cessation of milking increase somatic cell count and the concentration of several innate immune components in milk without infection, which may contribute to mastitis treatment.
<https://doi.org/10.3168/jds.2021-20564>.

Positive genetic merit for fertility traits is associated with superior reproductive performance in pasture-based dairy cows with seasonal calving. *By Meier et al., page 10382.* Pasture-based, seasonal-calving systems require dairy cows to become pregnant within approximately 80 d of calving to support a 365-d lactation cycle coincident with feed supply. A superior genetic merit for fertility was associated with a shorter calving to ovulation interval, improved uterine health, and superior reproductive performance.
<https://doi.org/10.3168/jds.2021-20195>.

Effects of 2 liquid feeding rates over the first 3 months of life on whole-body energy metabolism and energy use efficiency of dairy calves up to 5 months. *By Tümmler et al., page 10399.* Milk replacer feeding intensity in calves is suggested to affect milk production in later life. The underlying mechanisms of this nutritional long-term effect are not fully understood. To test whether milk replacer feeding intensity affects energy use efficiency of calves, we investigated the effect of 10% versus 20% milk replacer allowance of body weight on parameters of energy metabolism. During the milk feeding period, calves fed the lower level of milk replacer used dietary energy less efficiently, but this effect did not occur after weaning, suggesting that energy use efficiency does not persist through later stages in life.
<https://doi.org/10.3168/jds.2021-20278>.

Graduate Student Literature Review: Mitochondrial adaptations across lactation and their molecular regulation in dairy cattle. *By Favorit et al., page 10415.* Lactation requires numerous physiological changes to meet the elevated demand for energy and nutrients. These physiological changes occur in the mammary gland and other major metabolic organs, such as liver, skeletal muscle, and adipose tissue. Metabolism changes according to cellular energy need and is regulated, in part, by mitochondria. Biochemical reactions within mitochondria generate most of the body's energy and provide substrates (e.g., malate, acetyl coenzyme A) that are used in the synthesis of milk components. This review covers the functional changes (e.g., respiration, biogenesis) occurring in mitochondria throughout lactation and the molecular pathways that regulate those changes.
<https://doi.org/10.3168/jds.2021-20138>.