

**HH-01****Controlled trial of the effect of negative dietary cation-anion difference on postpartum health and culling of dairy cows**

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**Objective:** Negative Dietary Cation-Anion Difference (DCAD) diets fed during the prepartum period enhance calcium metabolism. Hypocalcemia influences neutrophil function and both are risk factors for clinical disease in the transition period of dairy cows.

The objective of this study was to assess the effects of a negative dietary cation-anion difference (DCAD) dry cow diet on postpartum health and culling.

**Material and Methods:** Cows from 4 commercial dairy farms in Ontario, Canada were enrolled in a randomized controlled trial from November 2017 to April 2019. Close-up pens (1 per farm) with cows 3 wk before expected calving were randomly assigned to a negative DCAD (TRT; -100 mEq/kg DM; target urine pH 6.0–6.5) or a control diet (CON; +95 mEq/kg DM with a placebo supplement). Each pen was fed TRT or CON for 3 months (one period) then switched to the other treatment for the next period, with 4 periods per farm. Body condition score (BCS) was measured at enrollment and urine pH was measured weekly until calving. Data from 1086 animals (TRT: n = 681; CON: n = 405) that received the assigned diet for > 2 wk were included. The incidence of milk fever (MF), retained placenta (RP), metritis, ketosis (blood BHB > 1.2 mmol/L, measured weekly in wk 1 and 2), clinical mastitis < 30 DIM (CM), displaced abomasum (DA), purulent vaginal discharge (PVD, assessed once at wk 5), ≥ 1 disease (DIS) or culling by 35 DIM were analyzed with logistic regression models with treatment, parity, BCS, and their interactions, accounting for pen-level randomization and clustering of animals within farm with random effects. There were no interactions of treatment with parity or BCS for any outcome. There were only 43 cases of MF, allowing only univariable analysis.

In a subset of 38 multiparous cows, blood was collected at -1wk, day 1 and 4 for assessment of: neutrophil phagocytosis (P) and oxidative burst (OB); ionized calcium (VetStat) and total calcium. Median fluorescence intensity for P and OB, and the shift of percentage of cells active for P and OB were measured with flow cytometry. Values represent stimulated cells minus unstimulated aliquot of the same sample.

**Results:** The incidence of MF was 5 ± 3% in CON and 1 ± 1% in TRT ( $P = 0.18$ ). There were no treatment effects (CON vs TRT, LSM ± SE) on RP (7 ± 3%; 6 ± 2%;  $P = 0.71$ ), metritis (11 vs 12%; SE = 4;  $P = 0.83$ ), ketosis (21 vs 23%; SE = 4;  $P = 0.59$ ), PVD (13 vs 12%; SE = 3;  $P = 0.51$ ), or DIS (44 vs 41%; SE = 7;  $P = 0.41$ ). Cows fed TRT had lesser incidence of CM (4 vs 2%; SE = 1,  $P = 0.09$ ) and DA (3 vs 1%; SE = 1,  $P = 0.05$ ). Culling < 35 DIM tended to be greater in CON (7 ± 2%) than TRT (5 ± 1%,  $P = 0.11$ ).

There were no differences between treatment groups in the 4 neutrophil function outcomes ( $P > 0.25$ ). Correlations of

iCa or tCa with each of the PMN function outcomes were weak ( $r < |0.3|$ ).

**Conclusion:** Contrary to our hypothesis, feeding a negative DCAD diet for 3 wk before calving did not improve neutrophil phagocytosis or oxidative burst activity. However, under commercial herd conditions, a negative DCAD fed 3 wk before parturition improved some but not all health outcomes assessed.

**Keywords:** Transition cow, nutrition, diseases, neutrophil function.

**HH-02****An outbreak of acute respiratory disease in an adult dairy herd due to dust inhalation**

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**Objectives:** This clinical study describes an outbreak of respiratory disease in an adult dairy herd comprising 850 milking cows. The affected animals responded poorly to treatment and so the focus was to identify the cause and prevent new cases.

**Materials and Methods:** 28 adult dairy cows were severely affected with respiratory disease over a period of six months. Those that were clinically affected had a poor prognosis. Many others in the herd had intermittent mild signs of respiratory distress. Clinical signs included an afebrile pneumonia, with severe dyspnoea and respiratory distress in the worst affected cases. The response to treatment with antibiotics, non-steroidal anti-inflammatory drugs, and corticosteroids was poor. Most affected animals either died or had to be euthanized. Those that survived had poor productivity with chronic respiratory signs and were culled.

Four animals that had died soon after first clinical signs, or were sacrificed, were examined post mortem, with blood samples taken from five other affected animals to investigate the involvement of respiratory pathogens.

**Results:** Post mortem examinations and clinical pathology did not identify any involvement of bovine herpes virus, respiratory syncytial virus, mycoplasma bovis, or any other common respiratory pathogens that are considered potential causes of respiratory disease in adult cattle. The post mortem examinations and histopathology suggested an allergic or hypersensitivity reaction to an environmental exposure to an allergenic or irritable substance. Investigations at the farm discovered the use of a fine dust derived from Medium Density Fibre Board (MDF) as a bedding material, spread by a mechanical spreader each day in the cow housing. This dust was inevitably inhaled by some cattle present in the shed at the time of spreading.

**Conclusions:** The use of fine wood dust as a bedding material in a poorly ventilated environment can predispose to acute respiratory disease due to the inhalation of the dust and a hypersensitivity reaction in the respiratory tract. Recovered



cases become affected by chronic obstructive pulmonary disease and have markedly reduced productivity. The use of such bedding materials should be with extreme care.

**Keywords:** Pneumonia, respiratory disease, dyspnoea.

### HH-03

#### The association of cough and other clinical signs with ultrasonographic lung consolidation: differences between dairy, veal and beef calves

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**Background:** Bovine respiratory disease (BRD) remains a leading cause of economic losses, hampered animal welfare and intensive antimicrobial use in the cattle sector. The latter contributes to public concerns and awareness about the development of antimicrobial resistance. To reduce antimicrobial use without risking economic losses or compromising animal welfare, it appears rational to limit antimicrobial treatment to calves with pneumonia, while withholding this treatment for just an upper respiratory tract infection at first instance. A true gamechanger in recent years is the use of thoracic ultrasonography (TUS) on farm, which was evidenced to be the most accurate diagnostic test for pneumonia in calves. Despite that rapid ultrasound techniques have been developed to better meet practitioners demands, continuously scanning all animals is practically and economically impossible. Therefore, the need for the development of early warning systems based on clinical signs, to timely detect animals with pneumonia is ever growing. However, a wide variety of definitions, based on clinical signs, to identify cattle with respiratory disease requiring antimicrobial treatment have been used in science and practice. Also, current scoring systems can be quite time consuming, whereas it is not known whether it is necessary to score all signs. Available scoring systems were developed and tested almost exclusively in pre-weaned dairy calves. Therefore, the question arises which clinical signs are associated with ultrasound confirmed pneumonia and whether the same clinical signs can be used postweaning or in other breeds or different production systems.

**Objectives:** To identify which clinical signs are associated with ultrasonographic lung consolidation ( $\geq 1$  cm) in different breeds, production types (dairy, beef and dairy-mixed), and pre- and post- weaning. To identify how well individual clinical signs performed in the detection of ultrasound confirmed pneumonia compared to BRD clinical scoring cards in a new dataset.

**Material and Methods:** A cross-sectional study was conducted in the northern part of Belgium (Flanders) between 2016-2019. 956 untreated calves (70% Holstein-Friesian dairy and 30% Belgian Blue) from 84 herds were conveniently selected. At enrollment, all calves were clinically examined

using 24 parameters, scored using the Wisconsin and Davis BRD clinical scoring card and subjected to TUS. Associations between clinical signs and pneumonia were determined using a generalized linear mixed model. Herd was added as random factor to take clustering of calves within a herd into account.

**Results:** Cough, both spontaneous and/or induced cough, was the only and best performing clinical sign, significantly associated with lung consolidation in all production types. Fever ( $\geq 39.4^\circ\text{C}$ ) was the second most promising factor, being significant in beef and veal calves, but not in dairy calves. At last, respiratory rate ( $\geq 43$  bpm), eye and nasal discharge were only of significance in veal calves. However, across the complete dataset spontaneous cough (Acc (Accuracy): 65.1%), induced cough (Tracheal reflex Acc: 61.1%, Larynx reflex Acc: 58.1%), rectal temperature (Acc: 61%), breathing rate (Acc: 61.3%) and eye discharge (Acc: 59.1%) were significantly associated. Postweaning, none of the clinical signs studied were associated with pneumonia, with the exception of cough in dairy calves. Further, cough as a single clinical sign outperformed any combination of clinical signs, including the Wisconsin (Acc: 62.8%) and Davis (Acc: 61.5%) respiratory disease scoring systems, but sensitivity remained low.

**Conclusion:** Cough outperformed existing scoring systems based on multiple parameters, but still had too low accuracy to be useful for decision making regarding antimicrobial treatment. Based on the present study, cough is best regarded as a group level warning that the respiratory tract reacts on pathogens, environmental factors or their combination. Rather than using clinical signs, TUS remains absolutely necessary to responsibly use antimicrobials, avoiding treatment of animals with only an upper respiratory tract infection. Next to cough, rectal temperature and breathing rate are the most promising clinical signs for further exploring in continuous monitoring systems for pneumonia detection in calves. Given that the association of clinical signs with ultrasonographic pneumonia differed between production systems, breeds, and weaning status, validation of a scoring system in each breed, age category and housing system is recommended.

**Keywords:** Bovine respiratory disease, pneumonia, score-cards, predictive monitoring, thoracic ultrasound.

### HH-04

#### Follow up of persistent pneumonia in a dairy cattle herd using quick thoracic ultrasound (qTUS) and non-endoscopic bronchoalveolar lavage (nBAL)

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**Objective:** Every calf experiences respiratory tract infections. Generally, this will not severely affect the young animal unless the infection develops into a pneumonia. Pneumonia affects growth, production, mortality, welfare, antimicrobial use and fertility, making it one of the most important economic

diseases in cattle farming. Despite years of research and substantial efforts, still many herds face unsatisfactory results of preventative and therapeutic approaches.

The objective of this study was to describe an approach of individualized antimicrobial treatment using quick thoracic ultrasonography (qTUS) and diagnostics on non-endoscopic broncho-alveolar lavage (nBAL) samples in combination with targeted biosecurity measures in a large dairy herd with persistent pneumonia.

**Materials and method:** A 700 head dairy farm, with around 150 female calves aged under 4-5 months requested a herd visit for reasons of persistent cough and calf mortality since 2016. The herd relied on metaphylactic antimicrobial therapy with tulathromycin at first grouping for years. Vaccination against bovine parainfluenza type 3, bovine respiratory syncytial virus and bovine herpesvirus 1 was conducted. The planned approach consisted of a problem herd analysis investigation, followed by a series of follow-up visits. qTUS was performed with a linear 7.5 MHz probe, using 70% isopropyl alcohol solution as transducer agent. Calves with consolidations <1 cm were classified as healthy, between 1 cm and <3 cm were classified as mild pneumonia and consolidations ≥3 cm as severe pneumonia. Failure of passive transfer was assessed through total protein refractometry in calves less than one week old. Also, during the first and two other follow-up visits, five bronchoalveolar lavages (BAL) were taken from pneumonic animals. BAL fluid was cultured on blood agar and modified pleuropneumonia-like organism (PPLO) agar. Whole genome sequencing (WGS) with nanopore sequencing was performed on a pooled sample to identify all pathogens related to BRD. A *Mycoplasma bovis* PCR was done on a bulk tank milk sample.

**Results:** During the first visit, 56% of the calves were diagnosed with severe pneumonia and 10% with mild pneumonia. On aerobic culture *Trueperella pyogenes* was isolated and four PPLO agars tested positive for *Mycoplasma bovis*. WGS identified *M. bovis* and Bovine adenovirus. The genome of *M. bovis* was fully sequenced for known mutations previously associated with antimicrobial resistance and strain typing. Resistance against the macrolide tilmicosin was identified and the strain belonged to the Belgian genomic cluster V. Eight calves were evaluated for FPT and all had adequate antibody levels. Bulk tank milk PCR for *M. bovis* was negative.

Pneumonic animals were based on their age, either treated with oxytetracycline (age <6 weeks) or florfenicol (age ≥6 weeks). Treatments were carried out by the owner after thoroughly discussing the treatment plan after every visit with the veterinarian. To what considers biosecurity, individual housing pens and group pens were adjusted to avoid contact between pens. Calves were only grouped after a negative lung ultrasonography. Calves with unresponsive pneumonia were not commingled with healthy groups.

A total of 8 visits was needed, and at the end of the intervention 17% (22) and 18% (23) of the present calves remained with mild and severe pneumonia. A total of 71 new cases occurred in the follow-up period. Cure rate of the initial pneumonia cases was 15% while new cases cure rate was 57%. A year after the first follow-up, the average age at first calving, reduced from 24.7 months before the intervention to 23.5 months in the qTUS monitored group.

**Conclusion:** Severity of the pneumonia was greatly underestimated in this farm, partly because of the subclinical manifestation. The pathogen oriented approach, in this case based on the primary pathogen *Mycoplasma bovis*, consisted of both targeted biosecurity as tailored individual treatment based on susceptibility testing. The presented approach, using nBAL diagnostics to target treatment and prevention, and qTUS to personalize treatment and follow-up resulted in a significant decline in pneumonia prevalence in the calves. Cure rates were fair in animals, early detected by qTUS, whereas they remained disappointing in chronically affected animals. Hence, continuous qTUS follow-up remains necessary in *M. bovis* infected herds to assure early detection and effective treatment, given the predominance of subclinical pneumonia.

**Keywords:** *Mycoplasma bovis*, pathogen oriented approach, individualized treatment, biosecurity.

## HH-05

### Evaluation of umbilical involution in Holstein-Friesian calves after different treatments post natum

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**Objectives:** An infection of the umbilical region, together with neonatal diarrhea and pneumonia, is one of the most common diseases in preweaning calves. The prevalence varies between 2% to 30% (Hathaway et al., 1993; Svensson et al., 2003). Disinfection of the umbilicus immediately after birth can decrease the risk of umbilical infections. Besides the approved and established disinfection solutions such as iodine, new products are being used hoping that they will lower infection rates. The aim of this study was to compare umbilical involution after the umbilicus treatment with iodine (J: Vet-Sept 10%; aniMedica GmbH, 48308 Senden-Bösensell, Germany) or Engemycin-Spray (E; active ingredient: Oxytetracyclinchloride 25mg/ml; Intervet Productions S.r.l., Aprilia (LT), Italy) to an untreated group (U) of calves.

**Materials and Methods:** The study was done in 127 calves (n = 70 female; n = 57 male) at the Educational and Research Centre for Animal Husbandry, Hofgut Neumuehle, Münchweiler an der Alsenz, Germany. Animals were randomized to one of three groups by draw and were treated within one hour after birth. The assessment (including the degree of drying) and measurements of the umbilical structures (including circumference of the skin umbilicus and length of the umbilical cord) were done immediately after birth (<1h) and on day 1, 3 and 7 after birth. After day 7 the assessments were done once per week up to 10 weeks (n = 70 female; n = 33 male; n = 27 males were sold 14 days after birth). The calves were kept in single hutches for the first 14 days and in groups of 10 animals afterwards.



**Results:** The circumference of the skin umbilicus immediately after birth was unrelated to gender in all three groups: J:  $n = 43$ ;  $10.8 \pm 2.0$  cm; E:  $n = 42$ ;  $10.9 \pm 2.1$  cm; U:  $n = 42$ ;  $10.3 \pm 2.0$  cm. Subsequently there was a significant reduction in circumference in all three groups ( $p < 0.0001$ ), but there was no difference between groups (J:  $n = 19$ ;  $8.8 \pm 0.6$  cm; E:  $n = 17$ ;  $9.9 \pm 0.7$  cm; U:  $n = 24$ ;  $9.1 \pm 1.4$  cm). The umbilical cord dried up during the first day after birth in 11 animals in group J, 7 in group E, and 8 in group U. By day 7 this number increased to 38 (88.4%), 32 (76.2%), and 39 (92.9%), respectively. The umbilical cord fell off after  $3.0 \pm 1.9$  weeks (Group J),  $3.3 \pm 1.5$  weeks (Group E), and  $3.3 \pm 1.7$  weeks (Group U). None of the animals showed any sign of umbilical infection at any point in time.

**Conclusions:** This study did not show a difference between the two treatments compared to an untreated group. Based on this, it seems that other factors such as housing system or dryness of bedding have a higher impact on infection rates. The use of antimicrobial agents for treatment of the umbilicus immediately after birth also needs to be seen critically in the light of antibiotic minimization goals and therefore should be avoided.

**Keywords:** Umbilical infection, disinfection, Iodine, Engemycin-Spray.

## HH-06

### A high plane of nutrition is a protective factor against neonatal calf diarrhea on Bavarian dairy farms

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**Objectives:** Calf mortality and morbidity is still unacceptably high worldwide. Neonatal calf diarrhea is the most important cause of calf losses in the first weeks of life. Therefore, risk factors for calf diarrhea as a herd health problem were investigated in a case-control study on Bavarian dairy farm.

**Materials and methods:** A total of 59 dairy farms were investigated by veterinarians of the Bavarian Animal Health Service due to problems with neonatal calf diarrhea (group P). The control group consisted of 18 farms out of the customer base of the Bavarian Animal Health Service that reported no veterinary treatments for calf diarrhea (group C). Management factors were assessed using a questionnaire during a face-to-face interview. Serum samples were collected from up to 10 healthy calves from 2 to 10 days of age for the examination of the quality of passive transfer using total protein analysis. Up to 10 colostrum samples were assessed for immunological and hygienic quality. Data were analysed using IBM SPSS Statistics 24.0.0.1. The association between the appearance of diarrhea on farm and the evaluated factors was analysed by univariable regression tests for binary or categorical variables, the Mann-Whitney U-test was used for continuous variables. Variables with a p-value  $\leq 0.2$  were entered into a multivariate

regression model with calculation of odds ratios (OR) and associated 95% confidence intervals (95% CI) using a stepwise backward procedure with a Wald  $P < 0.05$  as selection criterion and using presence of diarrhea problems on farm as a binary outcome variable. If two variables were closely correlated to each other ( $r_s > 0.60$ ), only that variable was entered into the model which had the lowest P-value in the univariable analysis in order to minimize the effects of collinearity. The fit of the final logistic regression model was evaluated by means of the Hosmer-Lemeshow Goodness-of-Fit test.

**Results:** Herd size was the same (Median = 75 dairy cows) between groups. There was no difference in quality of passive transfer as assessed by serum total protein between problem herds and control herds. Also, no difference was found with regards to the immunological and hygienic quality of colostrum samples. Variables entered into the multivariate regression model were: Cleaning of calving pen after each calving ( $p=0.141$ ); calf left longer than 3 hours with the mother ( $p=0.071$ ); 3 litres of colostrum at first feeding ( $p=0.079$ ); 3 litres or more at second feeding ( $p=0.012$ ); ad-libitum feeding in first week of life ( $p=0.004$ ); own feeding bucket for each calf in first week of life ( $p=0.032$ ); calves housed near cows ( $p=0.042$ ); administration of an iron containing preparation after birth ( $p=0.172$ ).

Variables remaining in the final model were 3 litres or more at second feeding (OR: 0.209, 95% CI: 0.049 – 0.892,  $p=0.035$ ); ad-libitum feeding during the first week of life (OR: 0.059, 95% CI: 0.006 – 0.599,  $p=0.017$ ); and administration of an iron containing preparation after birth (OR: 10.935, 95% CI: 1.251 – 95.624,  $p=0.031$ ). Hosmer-Lemeshow Goodness-of-Fit test: Chi-square: 0.721, df: 3,  $p=0.868$ .

**Conclusions:** Neonatal calf diarrhea is a multifactorial disease with numerous infectious and non-infectious factors determining if calves fall sick or stay healthy. In this study, two of the three variables in the final model gave evidence for a higher plain of nutrition being a protective factor against calf diarrhea on Bavarian dairy farms. In the past decades evidence is accumulating, that early life nutrition has an important impact on calf growth, development, health and well-being. Biologically normal feeding is recommended for the first three to four weeks of life, which means providing unrestricted amounts of milk or milk replacer as opposed to the traditionally practiced feeding of restricted amounts of milk, e.g. 10 or 15% of body weight. Ad-libitum or enhanced milk feeding results in elevated body growth and organ growth, e.g. of the small intestine, the mammary gland, thymus and endocrine pancreas. It either enhances or has no impairment on ruminal development postweaning. An adequate nutrient supply is important for the development of a stable intestinal microbiota and a successful intestinal immune response against pathogens. Therefore, results of this study are in line to previous findings and support the establishment of ad-libitum feeding programs in dairy calf rearing.

**Keywords:** Calf diarrhea, ad-libitum feeding.

## HH-07

**Motivations and barriers perceived by veterinarians when implementing herd health fertility management on UK dairy farms**

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**Objectives:** Vets can play a vital role in fertility herd health management. However, there is evidence to suggest that this is an area in which vets are not as involved as they could be, and sometimes not at all. By not proactively getting involved in fertility herd health management, vets are at risk of losing the role of consultant to other paraprofessionals. Furthermore, in a recent farmer satisfaction questionnaire, farmers rated proactivity as the number one rated attribute they look for in a vet (Jefferson-Loveday 2018). Why then as a profession are we not more involved in this area with farmers? We should be acting as the driving force for farm efficiency and profitability while keeping animal welfare at the forefront. The main aim of this study was to investigate the motivators and barriers that vets perceive when trying to implement herd health fertility programmes on UK dairy farms.

**Methods:** Face-to-face semi-structured interviews were conducted with 20, purposively sampled vets working in private practice in the north of England and southern Scotland, UK. All participants spent a minimum of 30% of their time working with dairy cattle and conducted routine fertility visits themselves. Interviews lasted between 20-60 minutes and were audio recorded and transcribed verbatim. The data was analysed inductively using qualitative NVivo software and followed the six-phase process of thematic analysis as described by Braun and Clarke (2006). Coding and theme generation was led by JB, with refinement through consultation with HMH, EF and RS.

**Results:** Gender was split 13 men and 7 women. Mean number of years qualified was 12.5 (range 3 to 31). There were 8 assistants and 12 senior partners/directors. Of the 20 participants, 10 were working in mixed practice, 10 were in farm-only practice and 4 had post-graduate cattle-related qualifications. The size of the veterinary practice they worked in varied from 3 to 28 farm vets, with a mean of 8.6.

The analysis generated four themes which together encapsulate the various barriers that the vets perceive to engaging with farmers in fertility health management, their approaches to engaging and their motivations for doing so. The first theme, "clinical baggage" explored past experiences that vets have had and how they shape, and in some cases seriously hinder, future attempts to engage with farmers. The second theme, "stuck in the comfort zone" highlighted, amongst other things, that if vets lack familiarity with data handling or have gaps in their knowledge this can contribute to a lack of confidence to engage on the subject of herd health fertility management. The third theme, "money matters" explores the financial motivations vets have for themselves but to a greater extent for the farmers they are engaging with. The fourth theme, "relationship with the farmer" included factors such as the importance of forging a positive relationship and trust with a farmer and

how this is crucial for effective engagement. This was distinct from 'friendly relationships' that can impede vets attempts at making positive change.

**Conclusions:** Vets recognise the value of fertility herd health management, but are often unsuccessful in engaging with farmers for a variety of reasons. The themes identified in this study provide useful insight into the challenges they face and also provide key areas that could be targeted in future interventions to improve the uptake of fertility health management on dairy farms. Our suggests for future interventions will be presented at the conference.

**Keywords:** Engaging with farmers, Proactive, Preventative, Facilitating behaviour change.

## HH-08

**Effects of postpartum NSAID treatment on milking performance, reproductive performance and survival of cows and calves experiencing both assisted and unassisted parturition**

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**Objectives:** Parturition assistance in cattle is common and has been shown to adversely affect reproductive performance, milk yield and culling risk. Effects of assisted birth on future productivity of calves have been less well studied although one study suggests that assisted birth may negatively affect future milk production. The underlying mechanisms for such adverse effects are not understood; however, multiple factors are likely to be involved, potentially including pain and inflammation. Although non-steroidal anti-inflammatory drug (NSAID) analgesia is commonly provided following veterinary-assisted parturition, it is uncertain whether any positive NSAID effects extend to production parameters. It is also difficult to draw conclusions from available data as few studies compare assisted and unassisted parturition, and both NSAID treatment and production outcomes differ between studies. Additionally, longer-term effects of administering NSAID treatment to calves at birth on their future production have not been reported. The objective of this study was to investigate the effects of both farmer-provided assistance and postpartum NSAID analgesia on subsequent production of cows as well as future production of calves. A factorial design allowed us to study not just the separate effects of assistance and NSAID treatment, but also the effects of interactions between assistance and treatment status.

**Materials and methods:** The study was performed on a commercial UK dairy farm; the cows are housed and calve all year round. Forty-seven cows and 47 calves experiencing farmer-assisted parturition and 42 cows and 44 calves experiencing unassisted parturition were recruited and randomly assigned to either an NSAID treatment group (45 cows and 46 calves) or a placebo group (44 cows and 45 calves). Ketopro-



fen or saline was administered within 3h of parturition to animals in the treatment or placebo groups respectively. Production data were obtained (with permission) from farm records for statistical analysis and animals were followed until either the end of their subsequent lactation (cows) or 1st lactation (calves), or until they left the herd.

### Results:

#### Milking performance

Irrespective of assistance status, NSAID-treated cows had a mean 305-d mature equivalent yield (305ME) 664kg higher than placebo-treated cows ( $p = 0.011$ ). Additionally, NSAID-treated unassisted cows had a tendency towards a mean 305ME approximately 1500kg higher than cows in the other three interaction groups ( $p = 0.073$ ).

#### Reproductive performance

The median calving to conception interval of NSAID-treated cows tended to be 22d shorter than placebo-treated cows, irrespective of assistance status ( $p = 0.056$ ). Additionally, NSAID-treated cows tended to be more likely to conceive overall (compared to placebo-treated cows) ( $p = 0.056$ ) and a greater proportion of cows in the NSAID treatment group were inseminated to observed oestrus than in the placebo group (72% vs. 57%), although this was not statistically significant. Irrespective of treatment status, parturition assistance was associated with poorer reproductive performance with affected cows being less likely to conceive overall (OR 0.02; 95% CI 0.002-0.32;  $p = 0.005$ ) and by 150 and 200 DIM (both  $p < 0.05$ ).

First lactation reproductive performance of calves was negatively affected by assisted birth: assisted calves were bred more times before conceiving ( $p = 0.001$ ) and had a longer calving to conception interval ( $p = 0.027$ ) than unassisted calves.

#### Survival

Thirty-one cows (34.8%) left the herd before completing the subsequent lactation; assisted parturition was associated with an increased risk of leaving the herd early (OR 4.53; 95% CI 1.53 – 13.5;  $p = 0.004$ ). Although treatment status did not affect the overall risk of leaving the herd early, median survival time of culled NSAID-treated assisted cows was 268DIM, compared to 169DIM for culled placebo-treated assisted cows, although this was not statistically significant.

Calves experiencing birth assistance were eight times more likely to not complete their first lactation than unassisted calves (OR 7.95; 95% CI 1.31-48.4;  $p = 0.024$ ).

**Conclusions:** This study supports previously demonstrated adverse effects of assisted parturition on cows' reproductive performance and survival in the subsequent lactation. Only 305ME was positively affected by postpartum NSAID treatment, but this is an important finding due to the potential economic benefits provided by increasing milk yield. Results from this study also indicate that the effects of assisted birth may be long lasting and affect calves into their first lactation, although long lasting effects of ketoprofen treatment were not identified in calves.

**Keywords:** Parturition, NSAID, productivity, cow, calf.

### HH-09

#### Characterisation of reticuloruminal contractions using a reticuloruminal accelerometer bolus, neck collar accelerometer and clinical examination (ultrasound and auscultation)

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**Objectives:** Physical activity and reticuloruminal contraction rate (RRCR) have been used as indicators of health status in cows. The three objectives of this study were to (1) determine whether a reticuloruminal tri-axial accelerometer bolus (smaXtec Classic Bolus) could provide observations that are consistent with RRCR as determined by clinical examination using auscultation and ultrasound; (2) describe the relationship between two commercial devices that indicate rumination rate (Afimilk Silent Herdsman neck-mounted tri-axis accelerometer collar; smaXtec Classic Bolus); (3) describe the diurnal pattern of RRCR using motility indices derived from boluses (smaXtec Classic Bolus).

**Materials and methods:** Six rumen-fistulated Jersey cows at the University of Glasgow were studied over two weeks in June 2021. Cows were fitted with collars (Afimilk Silent Herdsman neck-mounted tri-axial accelerometer collar) and boluses (smaXtec Classic Bolus) several weeks before the study. Cows were housed together in a single straw-bedded pen and fed *ad libitum* hay, replenished daily at 7.30-8.00 and 15.45-16.00. On Mon, Wed, Fri of the first week each cow was examined between 09.00-10.30h and at 16:30-18:00h. RRCR was determined over a 10 minutes period by ultrasound (US) with a convex 3.5 MHz probe placed on the ventral paramedian area of the abdomen, to the left of the caudal part of the xiphoid and simultaneously a second operator recorded reticuloruminal contractions by auscultation (AUSC) of the left paralumbar fossa. In the second week, no clinical examination was performed to avoid any interactions with the animals that might perturb the normal diurnal pattern of reticuloruminal contraction. Data were obtained from commercial web-platforms for both devices (collars: hourly summarised rumination, eating and activity indices; boluses: 10 minutes summarised temperature, rumination, activity indices) and boluses (smaXtec Classic Bolus) supplied inter-contraction interval (ICI) and contraction duration (CD) information summarised every 30-60s from their commercially protected algorithms, derived from raw accelerometer data. Time-series data were filtered to two datasets: 1) hourly bolus and collar data for the entire study period, 2) bolus data every ~30-60s during the 10-min periods of the clinical examinations. Distributions were checked. 10-min data were summarised to the hour for the main dataset. Pearson's correlation coefficients and Bland-Altman plots were used to compare clinical examination (US and AUSC) with bolus contraction intervals and to assess the relationship between the rumination and activity indices from neck mounted collars and boluses. A cyclic Generalised Additive Model (GAM) with cow as fixed effect and smoothed time was used to describe the effects of hour of day (diurnal pattern).

**Results:** During the 10-min examination periods, mean

ICI ( $\pm$ SD) derived from US, AUSC and bolus were  $40.1 \pm 3.96$ s,  $38.5 \pm 3.33$ s,  $40.4 \pm 4.75$ s respectively. The Pearson correlation coefficients for estimated inter-contraction interval between US and AUSC with boluses, and between AUSC and US for the period of clinical observation were 0.55, 0.40 and 0.69 respectively (all  $p < 0.05$ ). Pairwise Bland-Altman plots indicated similar performance of methods across all mean values, with small biases: Bolus-US = 0.27s, US-AUSC = 1.7s. The Pearson correlation coefficient for rumination index derived from neck mounted collars and indwelling boluses was 0.72, and for activity index it was 0.53 (both  $p < 0.001$ ). The GAM showed a strong diurnal pattern for all cows. The ICI was consistently high for all cows from 23:00 until 05:00h, falling then and increasing to a second peak which varied among cows between 10:00 and 14:00h, again falling after ~16:00h until ~20:00h. The effect of time and cow were highly significant ( $p < 0.0001$ ), and the model explained 15% of the deviance. By examining the relationship between ICI and the CD, it was possible to identify two apparent types of contraction: one centred around a CD of ~10 s and an ICI of ~50s, the other at CD ~ 8.5s with ICI ~ 37s.

**Conclusions:** There was a robust relationship between clinical observation and the boluses for estimation of ICI, and between the bolus and collar for estimation of rumination index, indicating that the bolus provides useful clinical information about changes in rumination pattern. We are conducting further studies to assess the value of changes in ICI and CD for the early detection of disorders of the rumen and systemic disease states.

**Keywords:** Reticuloruminal contractions, diurnal pattern, ultrasound, 3-axis accelerometer, Precision Livestock Farming.

## HH-10

### Use of an automated monitoring system to assess rumination time and activity patterns in cows with metritis

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**Objectives:** Postpartum uterine conditions such as metritis are common in dairy cows and represent a significant threat to animals' health and wellbeing, and frequently lead to a decreased reproductive performance in the subsequent breeding season. Changes in feed intake, rumination, and activity pattern in the periparturient period have been reported in cows that develop metritis in early postpartum period (Cocco et al., 2021). With an increased number of dairy farms equipped with automated monitoring systems, the use of health insights generated by such systems opens an opportunity for farmers and their vets to identify cows with higher risk of metritis.

The objectives of this study were to evaluate the efficiency of an automated monitoring system (SenseHub™ Dairy, Allflex® Livestock Intelligence™) to detect changes in rumination

time and activity in dairy cows with post-partum metritis.

**Materials & methods:** The study was conducted throughout November 2019 to October 2020 with 493 Holstein cows (n=493) aged 2 to 6 years, on a commercial dairy farm, located in the Southern region of Minas Gerais state, Brazil. All animal procedures were following the recommendations of the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 1999). During the experimental period, cows were housed in a free stall. Cows were fed ad libitum a TMR based feed with corn silage as forage, and concentrates composed of corn and soybean meal, and added minerals and vitamins, which was balanced to meet or exceed the nutritional requirements of lactating dairy cows (NRC, 2001). Rumination time and activity pattern were monitored continuously in all cows using an automated monitoring system (SenseHub™ Dairy, Allflex® Livestock Intelligence™), from 30 days prepartum to 120 days postpartum. The cows were also monitored daily for signs of metritis. Cows between 5 and 15 days postpartum who exhibited signs of behavioral changes, depression, as well as the presence of abnormal uterine discharge and impaired uterine involution, were treated with antibiotics for three consecutive days (Conventional Treatment). After this period, treated cows in which no clinical resolution was observed, were treated with antibiotics for another 5 days (Extended treatment). Both treatment groups were compared to healthy cows with no signs of metritis (Healthy) from the same herd. The rumination time (minutes per day) and activity trend (provided by the system) were compared between groups using the SAS Glimix procedure (SAS Software, v9.4).

**Results:** Metritis was observed in 15.2% (75/493) of cows, out of which 66.7% (50/75) required extended antibiotic treatment for another 5 days. The average rumination time was  $523.7 \pm 1.3^a$ ;  $515.6 \pm 3.1^b$  and  $507.7 \pm 2.7^c$  minutes (mean  $\pm$  std error) for the Healthy (n=418), Conventional Treatment (n=25) and Extended Treatment groups (n=50), respectively. The results revealed that cows affected by metritis had lower average rumination time ( $P < 0.022$ ) compared to the Healthy control group. The persistence of clinical signs and the need for extended treatment, which indicated a more severe process, were associated with a further reduced overall rumination time compared to the cows in which clinical cure was achieved after conventional treatment ( $P = 0.05$ ). The average activity trend generated by the system was  $357.6 \pm 0.9^a$ ;  $351.6 \pm 2.2^b$  and  $332.0 \pm 1.6^c$  (mean  $\pm$  std error) for the Healthy, Conventional Treatment and Extended Treatment groups, respectively. The presence of metritis and severity of the condition (as indicated by the requirement for extended therapy) clearly affected the overall activity of the cows ( $P = 0.017$  and  $P < 0.0001$ , respectively).

**Conclusions:** The results of the study confirmed that cows that go on to develop early postpartum metritis exhibit lower rumination time and decreased activity pattern than cows with no uterine conditions. Moreover, it also revealed that animals, in which the short antibiotic treatment did not lead to a clinical improvement, showed more pronounced deviation in the monitored variables.

These results open a significant opportunity to manage one of the biggest challenges in the postpartum period, identify in advance animals in high risk of metritis.



**Keywords:** Monitoring system, rumination, activity, metritis, pospartum.

## HH-11

### Effect of Formic Acid Treatment on Colostrum Quality and on Absorption and Function of Immunoglobulins: A Randomized Controlled Trial in Holstein Dairy Calves

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**Objectives:** Good quality colostrum is characterized by high immunoglobulin levels and low pathogen load. Techniques to decrease pathogens can damage immunoglobulins, potentially reducing both absorption and function. Objectives were to determine the effect of formic acid treatment on colostrum bacterial and immunoglobulin (IgG) levels before feeding, and serum immunoglobulin levels and neutralizing capabilities after feeding of either untreated or acidified colostrum.

**Materials and Methods:** Fifteen female Holstein calf pairs born < 12 h apart from different dams were randomly assigned to receive four liters of either untreated pooled (both dams) colostrum or the same pooled colostrum acidified to pH 4.0-4.5 with 10% formic acid. Colostrum characteristics including pH, bacterial load, immunoglobulin concentration and neutralizing capability were evaluated in both untreated and acidified samples. Blood samples were collected from each heifer pair on day 1 pre-colostrum followed by day 3 post-colostrum and then monthly for 6 months. Blood was analyzed for immunoglobulin G (IgG) concentrations and neutralizing capabilities against viral Infectious Bovine Rhinotracheitis (IBR), Bovine Viral Diarrhea Virus (BVDV) Type-1 and Type-2 and five serovars of bacterial *Leptospira*. Data were analyzed using STATA 17 (Stata Corp, College Station, TX, United States). A parametric t-test or non-parametric Kruskal Wallis test (which makes no assumptions about data distributions) were used to examine associations between feeding of untreated or acidified colostrum and outcome variables. Because many outcomes were below the detection limit of various assays, tobit regression was also used to censor those values and evaluate significance. A value of  $P < 0.05$  was considered statistically significant.

**Results:** Birth weights among calf pairs were not significantly different. Compared to untreated colostrum (mean = 6.7, standard deviation [SD] 0.4, median 6.8, range 6.0-7.3) acidification significantly reduced colostrum pH (mean = 4.3, SD 0.3, median 4.3, range 4.0-4.5)  $P < 0.001$ . Total coliform count was also significantly reduced (untreated mean cfu/ml = 149, SD 444, range, median 1, range 0-1,700; acidified mean cfu/ml = 8, SD 31, median 0, range 0-120;  $P = 0.02$ ). Colostrum IgG levels were not significantly different between untreated (mean 93.3 g/L, SD 39.7; median 92.80, range 36.7-164.4) and post-acidified colostrum (mean 101.9 g/L, SD 36.7; median 108.3, range 33.8-164.4;  $P = 0.54$ ). There were no significant differences between untreated and acidified colostrum

neutralizing titers for IBR, BVDV1, or BVDV2. Except for one calf in the untreated group, IgG levels on day 1 pre-colostrum were all less than 10 mg/dL. At 3 days of age, total protein levels in calves fed untreated colostrum (mean = 6.5 mg/dL, SD 0.4, range 5.4-7.0) and those receiving acidified colostrum (mean = 6.3 mg/dL, SD 0.7, range 5.2-7.6) were not significantly different,  $P = 0.38$ . Peak IgG levels occurred on day 3 (untreated mean = 26.1 g/L, SD 34.9, median 169.2, range 8.3-151.0; acidified mean = 30.2 g/L, SD 48.7, median 188.8, range 3.1-204.4;  $P = 0.77$ ). Apparent efficiency of IgG absorption was not different between groups (untreated mean 24.3%, SD 11.4, median 25.3, range 8.6-51.3; acidified mean 22.6%, SD 21.7, median 21.6, range 4.1-58.9;  $P = 0.65$ ). Thereafter, IgG levels slowly declined over the subsequent 6 months, but they were never significantly different between groups. Over the same period, maternal antibody titers against IBR, BVDV1, BVDV2, and *Leptospira canicola*, *L. hardjo*, and *L. pomona* were not different. Titers against *L. grippityphosa* and *L. icterohaemorrhagiae* were unmeasurable in the majority of calves and the data were not analyzed.

**Conclusions:** Colostrum acidification significantly decreased bacterial load fed to newborn calves without affecting IgG concentration or virus neutralization. Nor did acid treatment impact serum IgG levels in calves or activity against common pathogens.

**Keywords:** Randomized Controlled Trial, Acidified Colostrum, Pathogen Load, Immunoactivity.

## HH-12

### Comparison of diagnostic testing strategies for failure of passive transfer (FPT) in Scottish dairy calves

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In dairy calves, failure of passive transfer (FPT) results in an increased risk of calthood morbidity and mortality (Tyler *et al.* 1999; Pardon *et al.* 2015). Furthermore, calves with FPT have reduced liveweight gains following weaning (Furman-Fratczak *et al.* 2011) and reduced first milking lactation yields (Denise *et al.* 1989).

**Background:** Serum IgG levels of  $\geq 10$ g/L are indicative of adequate passive transfer (Tyler *et al.* 1999; Virtala *et al.* 1999). The reference test for measuring IgG in serum is radial immunodiffusion (RID) which directly measures the IgG in a sample (Cuttance *et al.* 2017). In Scotland, this test is prohibitively expensive so indirect measures such as total protein (TP) tests are often substituted. Zinc sulphate turbidity (ZST) testing is another indirect measurement of IgG in serum (Hogan *et al.* 2015) and is commonly used in Scotland by clinicians and disease investigation centres to diagnose FPT in calves; despite a growing body of evidence to suggest its inferiority to other tests (Hogan *et al.* 2015), in particular its poor specificity. Brix refractometry has been used as an inexpensive and convenient calf side measure of FPT, which can also

be used to measure colostrum quality (Quigley *et al.* 2013).

#### Objectives:

- To explore the performance of various diagnostic testing strategies for FPT in Scottish dairy calves.
- To redefine optimal cutpoints for indirect testing strategies, including Brix refractometry, total protein (TP) and zinc sulphate turbidity (ZST).
- To challenge the *status quo* of indirect measures of FPT offered in commercial laboratories and disease investigation centres in Scotland.

**Materials and methods:** Serum samples were collected from 370 calves between 24 hours and 7 days old from 38 dairy farms in Lanarkshire, Stirlingshire and Dumfries and Galloway. Calves were excluded if they exhibited signs of ill health; in particular, dehydration. Samples were tested using ZST, Brix refractometry, TP and RID.

Receiver operating characteristic (ROC) curve analysis was used to determine the optimal cutpoints for correctly predicting FPT using concentrations of TP, percentage Brix and ZST. The optimal cut-point for each test was calculated using the Youden's index, where the sum of sensitivity plus specificity is maximised and equal weight is given to false positive and false negative results.

**Results:** False positive rates were high using indirect testing, particularly when ZST was used. FPT prevalence was 29.5%, 30.8% and 46.4% for TP, Brix and ZST respectively, compared with 14.1% for direct measurement of IgG concentration using RID. The results from this work confirm the poor test specificity of the ZST test and recommend a lowered cut-point to improve test performance, in line with other published, international work. Existing cutpoints (from international literature) for indirect FPT tests were redefined using ROC (receiver operating curve) analysis and the accuracy of each test improved.

**Conclusions:** Despite over-estimation of the prevalence of FPT in this population of calves, it is still useful to monitor FPT using indirect tests due to their convenience and cost effectiveness; however, it is recommended that test cutpoints are lowered for all indirect measures, particularly ZST to improve performance.

It is recommended that clinicians take at minimum of 12 serum samples from a cohort of 1-7 day old calves at regular intervals to monitor the effects of any interventions to reduce the prevalence of FPT on a farm. Over-interpretation of indirect testing at one time point is a risk, especially if low numbers of calves are sampled.

**Keywords:** Calf, failure of passive transfer, diagnostics.

#### HH-13

#### A parallel evaluation of five cost-effective indirect methods for assessing failure of passive immune transfer in neonatal calves

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**Objectives:** The aim of this study was to evaluate the diagnostic accuracy of five indirect methods that may be used in veterinary practices to assess the success of maternal immunoglobulins (Ig) transfer in neonatal calves. These methods include the assessment of STP by biochemistry analyzer in veterinary practice or by optical refractometry, digital Brix refractometry, calculated serum globulin concentration, and serum  $\gamma$ -glutamyl transferase (GGT) activity level.

**Materials and methods:** Blood samples were collected from 245 2 to 6-d-old calves. Serum IgG concentration were determined by radial immunodiffusion (RID). Serum total protein (STP\_BA) and albumin concentrations and  $\gamma$ -glutamyl transferase activity (GGT) were determined by veterinary practitioners using their own biochemistry analyzer. Globulin concentration (GLOB) was calculated. Veterinary practitioners were also asked to assess STP using a digital Brix refractometer (%Brix) and an optical refractometer (g/L, STP\_OP). Test sensitivity (Se) and specificity (Sp) were calculated using RID as the reference standard with failure of passive immune transfer (FTPI) defined as IgG < 10.0 g/L. Receiver operating characteristics curves were created and optimal cut-offs values for each of the five indirect measurement methods were selected based on the maximization of the Youden's *J* statistic.

**Results:** In this study, GLOB yielded the highest accuracy to identify FTPI (Se = 89.4%; Sp = 89.3% at 34 g/L). For %Brix, the optimal combination of Se and Sp was at 8.4% Brix (Se = 86.5% and Sp = 83.8%). The use of STP\_OP was associated with the lowest diagnostic accuracy (Se = 69.7% and Sp = 81.6% at 52 g/L). For GGT the optimal cut-points were different for 2- to 3-d-old calves (Se = 87.5% and Sp = 87.8% at 393 IU/L) or 4- to 6-d-old calves (Se = 90.0% and Sp = 86.4% at 254 IU/L).

**Conclusion:** for on-farm use, digital %Brix refractometer can be a valuable and inexpensive tool to help producers and veterinary practitioners in their calf health management programs.

**Keywords:** Passive immunity transfer, immunoglobulin, refractometer, serum total protein, GGT.



## HH-14

### Association of combined serum macromineral profiles with clinical diseases in post-partum Holstein cows

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**Objectives:** Post-partum serum concentration distortions of macrominerals (Ca, P, Mg, K) are negatively associated with health and productivity of dairy cows. The individual effects of each one has been studied separately from the others, so far. The objective of this research was to evaluate the association of combined macromineral concentrations during the first and second day in milk (DIM) on clinical diseases in early post-partum dairy cows.

**Material and Methods:** The research was conducted in compliance with international ethical standards. The study was conducted in 9 Holstein dairy herds; 938 cows were enrolled; parity 1, 2 and 3+ cows were 434, 232 and 272, respectively. Cows were blood-sampled on DIM 1 and 2 to assess serum concentrations of Ca (Ca1, Ca2), P (P1, P2), Mg (Mg1, Mg2) and K (K1, K2), and clinically examined on DIM 1, 2, 4 and 8. Body Condition Score (BCS) was evaluated at DIM 1 and 8. Calcium and Mg concentrations were determined with atomic absorption spectrophotometry, while those of P and K with a biochemical/electrolyte analyzer. The biochemical data set consisted of 7,504 macromineral records. The clinical data set consisted of 3,752 observations including retained fetal membranes (RFM), metritis, mastitis, displaced abomasum (DA) and clinical ketosis (KET). A new trait defined as at least one diagnosis on any of the aforementioned clinical diseases was created (CD\_1-8). An Exploratory Principal Component Analysis (PCA) analysis with Direct Oblimin rotation was performed in order to test the null hypothesis that factors to-be-extracted were correlated. After rejecting it, a second PCA with Varimax rotation and Kaiser Normalization, which assumes that factors are independent and uncorrelated, was performed. In both analyses, macromineral concentrations were used as variables. Principal components (PC) were extracted using the elbow rule and used as continuous variables in the subsequent analyses. Afterwards, a univariate binary logistic regression (U-BLR) was performed to assess the effects of herd, parity, calving season, BCS and PC on the likelihood that cows have any of the aforementioned diseases diagnosed on DIM 1 to 8. The interaction between potential covariates was also examined. Predicted probabilities derived from U-BLR were used in subsequent receiver operating characteristic (ROC) analysis in order to evaluate the overall U-BLR model performance and to determine proper macromineral thresholds. All analyses were performed with SPSS ver. 25. Statistical significance was set at  $P \leq 0.05$ .

**Results:** ROC estimated thresholds (in mmol/L) were: Ca1 $\leq$ 2.1, Ca2 $\leq$ 2.03, P1 $\geq$ 1.9, P2 $\geq$ 4.6, Mg1 $\leq$ 1.01, Mg2 $\leq$ 0.95, K1 $\leq$ 4.5 and K2 $\leq$ 4.8. All estimated model Areas Under the Curve were  $>0.70$  (0.64-0.78). Four components (namely first to forth) accounted for 68.3% of total macromineral variance. First component comprised mainly Ca1, Ca2 and Mg2; Ca and Mg concentrations above thresholds were associated with a decreased probability of metritis, DA and CD\_1-8, by 77% (64-94%), 63% (41-96%) and 76% (65-89%), respectively. Second component included mainly Mg1 and Mg2; Mg concentrations above thresholds were associated with a decreased probability of metritis by 84% (72-99%). Third component comprised mainly Ca2, P2, K1 and K2; concentrations of Ca, K (above thresholds) and P (below threshold) were associated with a decreased probability of KET by 69% (50-96%). Finally, Forth component consisted mainly of P1, P2 and K1; concentrations of P (above threshold) and K (below threshold) were associated with an increased probability of mastitis by 50% (20-90%). Herd significantly affected all post-partum clinical diseases studied. Compared to parity 1, cows in parities 2 and 3+ were 2.3 (1.4-3.6) and 2.1 (1.3-3.4) times more likely to be diagnosed with RFM; compared to parity 1, cows in parity 3+ were also 3.9 (1.7-8.8) times more likely to be diagnosed with KET. Cows with  $3.0 \leq \text{BCS} \leq 3.5$  and  $\geq 3.75$  were 7.1 (1.7-30.9) and 9.9 (2.0-48.0) times more likely, respectively, to be diagnosed with KET than cows with  $\text{BCS} \leq 2.75$ . Cows with  $\text{BCS} \geq 3.75$  were 3.7 (1.3-10.1) times more likely to be diagnosed with KET than cows with  $3.0 \leq \text{BCS} \leq 3.5$ . In U-BLR analysis no interaction between potential covariates were identified.

**Conclusion:** When implementing preventive health management measures, serum concentrations of all four macrominerals must be considered simultaneously. Appropriate Ca, P, Mg and K serum profiles would greatly reduce morbidity of post-partum dairy cows.

**Keywords:** Macrominerals, Principal Components, Calcium, Magnesium, clinical diseases.

## HH-15

### Telemetric and Long Term Measurement of Reticuloruminal Motility - Precision and Accuracy of Derived Rumination Time

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**Objectives:** Rumen motility is of basic importance for the physiological function of the digestive system and it is responsible for mixing, separating and transporting the ingesta. Reticuloruminal motility is described by specific contraction cycles. Reticular activity stands at the beginning of the primary contraction cycle. This is characterized by two reticular contractions and this is just found during resting and feeding. A third contraction is only seen during rumination, the so called rejection contraction (Kaske, 2015).

In order to evaluate the possibility of continuous measure-

ment of reticuloruminal activity, a trial was conducted at the Research Centre Raumberg-Gumpenstein. The objective of this study was to investigate, whether the extended contraction duration, due to the rejection contraction, is appropriate to record rumination time by continuously measuring reticular acceleration.

**Materials and Methods:** Reticular motility was measured continuously in four rumen fistulated cows over a period of 44 days by using a motility-monitoring bolus (MMB). On each day cows were visually observed for 120 minutes between 06.00 to 08.00 a.m. and rumination times were recorded. MMB were prototypes of a commercially available technology (smaXtec®). Boli were located in the reticulum as described by Gasteiner *et al.* (2015) and activity was recorded by an acceleration sensor. These data were used to determine the duration of reticular contractions (s), described as the pulse width (PW). The resulting rumination time recorded by the MMB was compared with visual observations by using the Pearson correlation coefficient ( $r$ ), the linear regression coefficient of determination ( $R^2$ ), and the Bland-Altman plot for validation of precision. The Pearson correlation coefficient and the coefficient of determination from the MMB were categorized according to Hinkle *et al.* (2003). They were considered as precise if the correlation coefficient and coefficient of determination were high ( $> 0.70$ ), and as accurate if the mean bias from the Bland-Altman plot included zero with the 95 % interval of agreement.

**Results:** PW was seen to be significantly higher during ruminating cycles ( $P < 0.0001$ ), when compared to feeding or resting. When comparing these results with the outcome of visual observations, the  $r$  for rumination time was 0.97 ( $P < 0.0001$ ) and the  $R^2$  was 0.94 ( $P < 0.0001$ ). The slope of regression was found to be  $0.92 (\pm 0.03)$ . The Bland-Altman plot was acceptable and did not show any bias. Mean differences  $\pm$  standard deviation (MMB – observation) were  $0.46 \pm 4.09$  min. The 95 % confidence interval encompassed 84 of 88 rumination time observations. Overall, the mean differences did, however, include zero within the 95 % interval of agreement, indicating no difference between the MMB and visual observation.

**Conclusions:** The rejection contraction during ruminating results in a longer reticular contraction time when compared to feeding or resting (12 s vs. 7 s). This enables us to record rumination time very precisely and accurately by using the described technique. When comparing our data with data from previous studies, the described MMB performed similarly to or better than other rumination monitoring systems. Thus the finding of the current study is important for implementation of the MMB on dairy farms because of the precise and automatic collection of physiologically relevant data gathered from the directly out of the reticulorumen. In addition to an exact definition of physiological functions the described technique has a great potential to detect reticuloruminal disorders and diseases at an early stage.

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**Keywords:** Rumen motility, indwelling monitoring bolus, smart farming,

#### HH-16

### Effects of Isoquinoline Alkaloids-based Product in Lactating Dairy Cows

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**Objectives:** Improving animal health and welfare with low/no chemical input while achieving high milk yield is a difficult task in modern dairy production systems. To this end, many solutions have been tested with uncertain results. Plant-derived products have been favorably used in several species, but scarce data are available on their effects in dairy cattle. The purpose of this study was to evaluate the effects of a plant-based product derived from *Macleaya cordata* containing standardized concentrations of isoquinoline alkaloids (IQs) on milk production, but also udder and uterine health of lactating dairy cows.

**Materials and methods:** Primiparous (PRIM;  $n = 84$ ) and multiparous (MULT;  $n = 602$ ) cows from 18 commercial herds in France were evaluated. Cows were matched by lactation number, previous lactation milk yield and SCC (MULT) within farms, and were randomly allocated to receive two boluses containing IQs (IQS;  $n=343$ ) or to serve as a control (CON;  $n=343$ ). Boluses were designed to release an equivalent of 37.5 mg/d of IQs for 60 days, and 18.75 mg/d of IQs thereafter for three months following administration. Boluses were administered during the close up period, approximately 21 days before the expected date of calving. Data (milk yield, fat and protein, urea, SCC) from the first five official milk test-days were collected and analyzed retrospectively. In an independent set of five herds ( $n=52$  cows in each group), mammary, uterine, hematological, and biochemical (NEFA, BHBA, haptoglobin) data were collected during the first three months of lactation. Statistical analyses were performed using R software (v3.5.1).

**Results:** Records show that raw and energy-corrected milk yields were higher (Two-way ANOVA,  $p < 0.05$ ) in IQS cows, with a mean increase over than 1.5 kg in the set of 18 herds. No difference in milk fat, protein, and urea concentrations were noticed. Overall, mean SCC was lower ( $50 \times 10^3$  cells/mL; Two-way ANOVA,  $p < 0.05$ ), and the prevalence of cows with subclinical mastitis ( $SCC \geq 250 \times 10^3$  cells/mL) was also lower ( $p < 0.05$ ) in the IQS group on milk test-days during the first three months of lactation. The effect of IQs supple-



mentation is more pronounced in high-producing PRIM cows and improved milk yield in the two lowest quartiles. The number of clinical mastitis was lower in IQS cows ( $p < 0.05$ ). No difference for retained placenta or endometritis between IQS and CON were noticed in the first 45 days post-partum. No difference of NEFA, BHBA, or haptoglobin measured in the first week of lactation or fat:protein ratio thereafter could be detected, indicating that improvement cannot be solely explained by changes of the metabolic profile in early lactation.

**Conclusions:** These results show that administration of a plant-based product with standardized concentrations of IQs increased milk yield and improved udder health. IQs supplementation can be regarded as a strategy to improve productivity and to reduce SCC in dairy cows.

**Keywords:** Health, dairy cows, milk, plant-based product.

## HH-17

### Analysis of daily activities of herd managers and interrelations with the animal production and health situation on dairy farms in eastern Germany

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**Objectives:** Different aspects of process controlling, such as establishment and assessment of control points and the analysis of workflows and daily activities of employees are standard in many industries to increase the quality and efficiency of production systems. Dairy production has evolved from traditional farming to modern and large-scaled production systems in many parts of the world. However, routines for process controlling are still in their infancy. Well-organized and efficient workflows allow the completion of tasks in an adequate manner and increase the quality of the result as well as the working conditions for employees. Animal production and health are measurable outcomes for the quality of herd management and animal husbandry. In a first approach, we therefore hypothesized an interrelation between daily activities of herd managers and the health status of the herd.

**Materials and Methods:** An analysis was conducted on 10 farms located in the state of Brandenburg with an average size of 592 German Holstein cows (229-1,221), an average milk production of 9,690 kg marketed milk per cow and year, and 32.9 % culling rate (excl. sales for breeding purposes). The daily workflows on the farm in different fields of activities (e.g. milking, feeding, reproduction, young stock rearing,

herd management) were assessed in interviews. The person responsible for herd management was followed throughout a three-week period (mean: 13 d; 11-15, min-max) by a project employee. Activities were continuously documented on a minute-basis. An average of 954 entries per farm (537-1,326; min-max) and a total of 1,092 h (excl. breaks and tasks in other areas than dairy production) were recorded and assigned to 13 categories during data-processing (see results section). Herd data included key figures in following areas: production level (kg marketed milk per cow and year), milk quality (bulk tank and test-day data), stillbirth rates, culling (culling and mortality rates, period: 07/20-06/21). No statistical, only a descriptive analysis was performed.

**Results:** Of the documented 1,092 h the herd managers invested 4 % (1-9 %, min-max) in administration, office and management, 17 % (9-23 %) in communication, 11 % (3-19 %) in animal documentation, 17 % (11-28 %) in animal organization and movement, 9 % (4-16 %) in animal controls, 9 % (2-16 %) in animal treatment and health measures, 1 % (0-3 %) in feeding, 12 % (4-29 %) in accompanying of external service providers (e.g. veterinary, hoof trimmer, inseminator), 5 % (1-11 %) in assistance of employees, 5 % (0-30 %) in shift takeover from employees, 5 % (0-9 %) in process controlling, 2 % (1-5 %) in other activities and 3 % (0-11 %) of the time was not assigned/not recorded. The five farms where herd managers invested more than average time in animal and process controlling (animal health, feeding and other,  $\geq 14$  %) exhibited a higher production level (9,782 vs. 9,598 kg/cow/year), lower somatic cell counts (161,000 vs. 202,000 cells/ml), culling (30.4 vs. 35.3 %) and mortality (5.9 vs. 9.7 %-point of culling rate) rates and thereby higher lifetime productions of culled cows (36,698 vs. 30,400 kg), as well as lower stillbirth rates (6.5 vs. 8.0 %) and losses during the rearing period until 3 months of age (3.5 vs. 8.3 %). The forementioned herd managers invested more time in administration, organization and communication (37 vs. 28 %), but less time in tasks that should be delegated (e.g. moving animals, assistance and taking-over shifts of employees; 22 vs. 32 %) and treatment of animals (7 vs. 11 %). No difference between herd size was observed between the two groups [average of 624 (min: 229, max: 1,221) vs. 560 (min: 399, max: 783) cows].

**Conclusions:** 1. A large heterogeneity between farms in the activities of their herd managers exists, 2. In many farms original herd manager activities (management and controlling) are postponed by taking over tasks that should be delegated, 3. In most of the farms the controlling of the feeding process is largely disconnected from the person in charge for herd management, 4. Herd managers who spent more time in controlling achieve better results concerning the production level, health and longevity of their herd.

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**Keywords:** Workflow analysis, process control, precision dairy farming, herd management, production diseases.

## HH-18

**The marginal cost of lameness in dairy herds: an integrated bioeconomic modelling approach**

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**Objectives:** Lameness is a major concern in dairy cattle and foot disorders are responsible for 92% of total lameness cases. Different strategies are available for the farmers to manage lameness: short-term actions (curative trimming, footblocks, antibiotics, footbaths) and overall medium and long-term actions (hygiene, detection, preventive trimming). The objective of this study is to estimate the marginal cost of lameness and foot disorders, to define optimal bioeconomic strategy for managing lameness in dairy herds.

**Materials and methods:** A dynamic and stochastic simulation model (DairyHealthSim©) was used to simulate as precisely as possible the herd dynamics, reproduction management, the production and health events. The model offers a holistic representation of a dairy farm and simulates the interaction between production functions, diseases or damage function and veterinary or damage control functions according to farmer's practices. This model was previously used for studies on mastitis, reproduction and culling. A specific development (DHS-Lame) was done for lame and its different herd-level management strategies. Lame occurrences are simulated with a base risk for each aetiology of lameness (digital dermatitis – DD, interdigital dermatitis – ID, interdigital phlegmon – IP, sole ulcer – SU, white line disease – WLD), associated to a relative risk according to a farmer's practices. Lameness is simulated as lame state machine (lame score – LS – from 1 to 5) associated to a DD state machine (M1 to M4.1). The impacts are computed on milk production and heat expression. Once detected, lame cows are treated, and a recovery rate is applied depending on aetiology and treatment. A total of 880 scenarios were run including (i) housing (concrete vs. textured) (ii) hygiene (2 different scrapping frequencies), (iii) the existence of any preventive trimming or not, (iv) different thresholds of detected DD prevalence from which a collective footbath is applied to treat DD and (v) detection rate scenarios to represent farmer ability to detect lame. The economic evaluation is performed to calculate farmers risk adjusted income for each scenario and the marginal cost is calculated as an income loss per additional case for each lame aetiology and for additional lame cow (LS  $\geq$  3) Calibration was done thanks to peer-review literature review, grey literature or authors' experience if not available.

**Results:** The simulation results show a lameness prevalence varying from 27% to 83% depending the scenarios, showing a high capacity of the model to represent field. Digital dermatitis represented half of total lameness cases, followed by ID, SU, WLD and IP. Validity of the model was overall considered as very good.

Housing surface scenarios dramatically influence the prevalence of SU and WLD, while scrapping frequency and footbath threshold for application mainly determine the presence of DD. Results interestingly shows that preventive trimming

allows a better reduction in lame prevalence than spending time for early-detection. Scrapping frequency was highly associated with DD occurrence, especially with a textured floor. The observed prevalence of DD reaches a plateau when the threshold of footbath application is over 30% (R<sup>2</sup> = 0.94). Lameness prevalence variations also show a sensitive negative impact on total milk yield, with a logarithmic trend (R<sup>2</sup> = 0.8).

Economic results show that the milk losses represent the first component of lame costs, in agreement with literature. The marginal cost curve for the prevalence of lameness shows a downward logarithmic trend (lower marginal cost for higher prevalence): the marginal cost for lameness ranges from 193€ to 5€ while prevalence ranges from 25% to 60%, all aetiologies included. For DD, the marginal cost ranges from 248€ to 12€ with a prevalence range from 10 to 35%. For WLD and SU, the marginal cost ranges is from 281€ to 87€ and from 414€ to 22€ respectively for prevalence ranging from 2.5% to 5.5% and from 4% to 25% respectively.

**Conclusions:** The models allow to mimic with high precision the lame dynamics in the herd. The marginal cost of lame describes a downward logarithmic trend, meaning lower cost of one extra lame case for higher prevalence. The present tool can also be used as support for decision making and to identify the best strategy depending on the farm contexts.

**Keywords:** Lameness, economics, cow, management.

## HH-19

**Nutritional and health supplements in molasses blocks delivers increased rumen efficiency in smallholder large ruminant production in developing countries**

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**Objectives:** Summarize field studies examining the four different molasses-block supplements (consumed @ 100-150g/day) provided to large ruminants, for improved health and production outcomes, in a developing country context. Trials were conducted in Laos, where productivity is compromised by low growth rates, endemic adult and calf endoparasitism by *Fasciola gigantica* or *Toxocara vitulorum* respectively, with limited farmer knowledge and facilities for administration of therapeutics. Further, discuss a marketing feasibility study of this supplementation strategy and consider the environmental impacts of improving rumen efficiency through this technology.

**Materials and methods:** Field trials were implemented in villages in mainly the dry season in Laos from 2017-2019, studying the impacts of *ad-libitum* supplementation with high quality molasses blocks (20kg) (4 Seasons Pty Ltd, Brisbane, Australia), containing: non-medicated (NMMB); urea-medicated (UMB8; @ 8% urea); triclabendazole-medicated (Fasinex®, Novartis Australia, TMB5 @ 5g/kg, and TMB10 @ 10g/kg); fenbendazole-medicated (Panacur100®, Coopers Australia; FMB5; @ 5g/kg). Animal cohorts were enrolled into one of



three groups: (i) access to either UMB8, TMB5 or TMB10, or FMB5 medicated molasses blocks; (ii) access to NMMB; and where possible (iii) control groups without access to blocks. To serve as positive controls, additional cohorts were treated with oral anthelmintics. This included two FMB5 trials where oral pyrantel was administered at 2-3wks of age, plus use of oral triclabendazole in TBZ5 and TBZ10 trials. Weight data and faecal samples were obtained at weeks 1, 4, 8 and 12 for growth rates (average daily gain; ADG = grams/day) and faecal egg counts (FEC). Where data from cohorts not receiving blocks was unavailable, the results were compared with recently acquired baseline ADG data.

**Results:** Baseline measurements obtained from studies of the free grazing systems in Laos, confirmed low mean weights (182–204kg in cattle; 325–357kg in buffalo) and low ADG's (55–84g in cattle; 92–106g in buffalo), with animals likely to lose weight during the dry season due to feed deficiency. Trials with UMMB and UMB8 compared the weight gains of lactating cows (n = 46), calves (n = 25) and growing calves (n = 35) of farmers (n = 20), with access to both blocks significantly increasing ADG in all 3 cohorts compared to baseline grazing-only data. The supplemented lactating cows (191g, 179g), calves (298g, 238g), and growing cattle (214g, 143g) all performed well respectively, but less than in a pen study conducted at a research station near Vientiane where UMMB-fed bulls achieved a superior ADG (320g). The initial triclabendazole trial (n=241) examined *Fasciola spp.* suppression over a 12 week period of access to TBM5 blocks, reducing FEC (~90%) and increasing ADG (201g) that was superior to the reduction in FEC (~19%), and ADG (124g) of those with NMMB access (P=001). A 2019 trial with TMB10 observed rapid elimination of the FEC following exposure to this block; these were replaced with NMMB for the remaining 10wks. In the fenbendazole trials, the FMB5 treatment produced rapid reduction in FEC relative to the control (P=0.062) and a high ADG (230g), exceeding that of control calves (170g) (P=0.002). Additional trials corroborated that FMB5 access was associated with higher predicted ADG (200g) compared to control calves (150g) (P=0.005). All farming families experiencing use of the blocks confirmed their animals were healthier with minimal parasites, they were easier to manage, plus they wished to purchase the blocks. Registration of molasses supplementation blocks in Laos has now occurred and sales of commercial blocks have commenced.

**Conclusions:** Provision of block supplements to large ruminants in Laos, especially lactating cows, enabled animals to maintain and even increase weight during the dry season when lactation occurs. Block supplementation also enabled efficient administration of endoparasite medication to large ruminants. Improved utilisation of low-quality forage and control of endemic parasitism, offers important opportunities for increasing large ruminant production efficiency. There is an emerging challenge to food security in providing more sustainable livestock systems in a climate emergency world. Significant improvements in cattle production efficiency means fewer animals required with shorter time periods necessary to achieve marketable levels of beef; one of several strategies that may help mitigate the impacts of beef production on greenhouse gas emissions from agriculture.

**Keywords:** Molasses-blocks, supplementation, anthelmintics, cattle, buffalo

## HH-20

### Veterinary consulting on dairy farms with high rearing losses

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**Objectives:** Although the causes and risk factors for losses in youngstock are well known, apparently this area does not receive enough attention on many dairy farms. This might explain that calf mortality has not changed over the years quite often reaching values on farm level between 10% and 20%. It was the aim of the following study to analyse the rearing conditions on dairy farms with high rearing losses, to identify problem areas and provide extensive advice to the farmers. In addition, the success of veterinary consulting should be evaluated during a second farm visit and the reasons for non-implementation of measures should be recorded.

**Material and Methods:** Fifty-six dairy farms in Lower Saxony, Germany, participated in the study. Inclusion criteria were at least 30 dairy cows and rearing losses of  $\geq 20\%$ . Rearing losses were defined as number of calves recorded as live animals in the National Data Base which died within the first 6 month of live devided by the total number of calves recorded as live animals within a given time period. A questionnaire was filled out together with the farmer followed by a farm inspection covering 10 different areas (calving management, newborn calf care, colostrum management, separation from dam, milk feeding, weaning, calf housing, heifer feeding, heifer housing, general monitoring of animals). The farmers received a thorough assessment and recommendations for improvements. Eight to 10 month after the first visit, the farms were visited again and analysed in the same way as during the first visit. In addition, the adoption of recommended measures was recorded. In case of non-implementation, the farmers were asked for reasons. Calf mortality was assessed during the intervall between the two farm visits and compared with the same time intervall in the preceding year to account for seasonal effects.

**Results:** Overall, 180 variables in the 10 different areas were analysed and evaluated whether or not good practices were fulfilled. The majority of farms ( $\geq 50\%$ ) performed only 42.8% of management measures accepted as good practice. Specific problem areas were newborn calf care, colostrum management, hygienic condition of calf housing and calving area as well as documentation and biosecurity. Overall, 250 different measures were recommended. Of those, 20.8% were not adopted at all; 40.8%, 30.0% and 8.4 % were adopted with a frequency of  $< 30\%$ , 30 to 80% and  $> 80\%$ , respectively. Recommendations which were not adopted very well were hygienic measures in the calving and heifer areas and management measures considering calf health (vaccination, treatment, etc.). The acceptance was greater for measures dealing with the hygiene of milk feeding, calving management, newborn calf care, feeding of calves before weaning including colostrum management, and calf housing. On farm level, the mean frequency of adopted measures was  $25.1\% \pm 10.4\%$  (4.0% to 53.2%). The most frequent reasons for non-implementation were „not practicable“ (19.9%), „to time consuming“

(13.7%) and „not promising“ (12.9%). Even though the selection criterium was  $\geq 20\%$  calf mortality at the time of random selection of the farms, calf mortality in the control time period was  $< 10\%$  on 14 farms (26.4%),  $\geq 10\%$  to  $< 15\%$  on 14 farms (26.4%),  $\geq 15\%$  to  $< 20\%$  on 12 farms (22.6%) and  $\geq 20\%$  on 13 farms (24.5%), respectively. Overall, the calf mortality did not change, improve or got worse in 28.3%, 49.1% and 22.6% of the farms, respectively.

**Conclusion:** Dairy farms with high rearing losses do not follow good practices primarily in the areas of newborn calf care, colostrum management and hygiene of calf and calving cows areas. With about 25%, the adoption of recommended measures was fairly low. Also, the success of a one time consultation was only mediocre. Even though 49.1% of the farms could lower calf mortality, it increased on 22.6% of the farms during the study period. Obviously, rearing management represents a complex time and personell intensive part on dairy farms. The tasks often are difficult to predict leading to a high risk of calf mortality. A continuous expert advice appears to be necessary in order to achieve long-term and sustained success.

**Keywords:** dairy farms, calf mortality, veterinary consultation.

## HH-21

### Implementation of precalving vaccination programme against rotavirus, coronavirus and enterotoxigenic *E. coli* (F5) and effect on dairy calf survival

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**Introduction and objectives:** Calves are born agammaglobulinemic and during the first weeks of life their resilience to infections depends on the extent of passive immunity acquired from colostrum. Diarrhea is one of the most common diseases and cause of death in neonatal calves whereas rotavirus is often reported as the most prevalent viral cause of diarrhea. Vaccinating cows and heifers before calving increases the level of pathogen-specific antibodies in the colostrum and enhances passive immunity potentially gained by the calf, however, the effect of precalving vaccination with trivalent vaccines on calf survival has not been thoroughly investigated. The current study aimed to investigate the implementation of the precalving vaccination programme against rotavirus, coronavirus and enterotoxigenic *Escherichia coli* (F5 antigen) in Estonian dairy farms and its effect on calf survival.

**Materials and methods:** The study included 13 dairy cow herds (herd size ranged from 242 to 2,457 cows) that applied precalving vaccination against bovine rotavirus, bovine coronavirus and enterotoxigenic *E. coli* (F5) (defined as PV). For each herd a questionnaire was filled out where the information about the vaccination procedures and calf feeding practices were asked. Farms were divided into correct and incorrect users (CU and ICU, respectively) of the PV based on the compliance with the product directions of use and colostrum feeding

practices. To qualify as a CU the farm had to vaccinate all cows and heifers 3-12 weeks before expected calving and feed the calves whole milk from vaccinated fresh (up to four days in milk) cows at least during the first two weeks of calves' life.

In order to analyse the effect of PV on calf survival the survival analysis was used comparing calf mortality rates in pre-vaccination (V-) and vaccination (V+) periods by using the registry data of Estonian Agricultural Registers and Information Board. The V+ period begun one month after the farm started vaccinating their animals and lasted for one year. The V- period was determined as exactly one year prior to V+ period. The start of the calf-level observation period started with birth or start of the observation period for calves that were born before the start of the observation period to account for left truncation. Calf-level observation period ended with either reaching 21 days of age or end of the observation period due to selling, slaughtering or death (euthanasia or unassisted death). Unassisted death and euthanasia (on-farm mortality) were considered as event of interest and observations that ended with selling, slaughtering or survival until the end of the study period were right censored. On a herd level, calf mortality rates were calculated as number of deaths per 100 calf-months for V- and V+ period. Farms were enrolled to the analysis only if they ear-tagged their calves during the first 4 days of life. The number of calf-based observations was 14,610 in the analysis.

**Results:** Six herds met the requirements of CU and seven farms were classified as ICU. Four out of the seven ICU farms did not vaccinate heifers and six fed the calves whole milk collected from vaccinated fresh cows for seven days or less.

In four out of the six CU farms, calf mortality rate decreased significantly during the V+ period compared to V- period. In one CU farm calf mortality rate was higher and in one CU farm it remained unchanged in V+ period compared to V- period. Average calf mortality rate over six CU farms was 17.08 per 100 calf-months during V- period (95% CI 15.85; 18.41) and 11.56 per 100 calf-months during V+ period (95% CI 10.64; 12.57). On average, calf mortality rate decreased among the CU farms during the V+ period compared to V- period (hazard ratio (HR) = 0.66, 95% CI 0.59; 0.74,  $p < 0.001$ ) according to the mixed-effects Cox regression model (herd included as random effect).

**Conclusions:** The study revealed that vaccination protocols and practices of feeding calves colostrum from vaccinated cows vary in the farms. Also, we confirmed a positive field effect of PV on dairy calf survival in the herds that followed vaccination directions and fed calves colostrum from fresh cows at least during the first two weeks of life.

**Keywords:** Precalving vaccination, lactogenic immunity, calf scours, mortality.



## HH-22

### Cow behavior predicts and monitors calving diseases along the transition period

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**Objectives:** Calving diseases are a major problem in most dairy herds, negatively influencing cow welfare and dairy economics. Rumination behavior proved to be a good predictor of some calving diseases. New generation of these monitoring technologies are now able to describe the behavior of cows in a more detailed way (adding e.g. eating, resting, activity, etc.) The objective of this study was to characterize behavior of cows along the transition period by their health status, to improve the ability to characterize normal behavior of healthy cows and deviations from this behavior.

**Material & Methods:** We analyzed the behavior of a total of 1,553 cows calving in 8 farms in Israel, between February 2019 and November 2019. Farms were from various geographical locations, but similar in their feeding management (Total Mixed Ration [TMR]) and cow sheds (open, covered, dry compost barns). Calving events (i.e. twins, stillbirths, milk fever, retained placenta, metritis or endometritis, ketosis, and left displaced abomasum [LDA]) were recorded by the farmers and in addition, all cows were checked by a trained veterinarian between 6 to 12 days after calving. These data were stored in the Israeli cattle breeder association herd management software. The behavior of cows (the major activity in each minute) was obtained from a monitoring system (Sensehub Dairy, Allflex livestock intelligence) and summed to a total minutes per day. After initial descriptive statistics which is beyond the scope of this abstract, we present here the average effect of each major calving event in the last 10 days before calving and in the first 10 days of the lactation. Total minutes ruminating, eating, resting, or expressing high activity per day were dependent variables in mixed effect models (using the lme4 package in the R Foundation for Statistical Computing software) containing the day relative to calving day, calving event or diseases as fixed effects and cow nested in farm and parity as random effects.

**Results:** Last 10 days before calving: Cows with milk fever or retained placenta had a significant reduction ( $P < 0.01$ ) in the time spent ruminating days before the events happened. A significant reduction ( $P < 0.01$ ) in eating time and high activity time was observed in cows suffering later from stillbirth or ketosis, these cows had also a significant increase ( $P < 0.01$ ) in resting time in the last 10 days before calving.

First 10 days after calving: Cows with retained placenta, metritis or endometritis, ketosis, or with left displaced abomasum had a significant ( $P < 0.001$ ) decrease in rumination, eating, and high activity time. These cows had also a significant ( $P < 0.001$ ), substantial (~25%) increase in the time spent resting in the first 10 days after calving.

**Conclusion:** The finding of this study demonstrates the ability to identify cows developing one of the calving diseases early, thus possibly reducing their negative impact on cow

welfare and farm profitability. Early identification of such cows before clinical signs are visible also faces the bovine practitioner with the challenge of how to best handle such cows. In addition, analyzing herd cow's behavior along the transition period, might provide insight into weak points and serve as an objective tool to monitor improvements.

**Keywords:** Dairy cattle, behavior, calving diseases, monitoring.

## HH-23

### Can an ATP bioluminescence meter be used as a cow-side tool for the evaluation of bacterial contamination of bovine colostrum?

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**Objectives:** Bovine neonates are born agammaglobulinaemic and rely on the absorption of immunoglobulins from colostrum shortly after birth. This absorption of immunoglobulins from the colostrum can, unfortunately, be hampered by a high bacterial load of the colostrum. Hence, strict hygienic procedures when collecting, storing and feeding colostrum are of paramount importance for a good transfer of passive immunity in bovine neonates. The adenosine triphosphate (ATP) bioluminescence meter has been advocated as a simple and useful tool for the evaluation of the degree of contamination of surfaces and liquids. The aim of the present study was to examine whether an ATP bioluminescence meter can be used as a cow-side tool to assess the degree of contamination of bovine colostrum and thus indirectly evaluate the hygiene applied during the collection, storage, and administration of colostrum on farms.

**Materials & Methods:** A total of 162 colostrum samples were collected from 88 different cattle farms in The Netherlands and Belgium. Samples of approximately 100 ml were collected immediately before the colostrum was fed to the calves. All samples were stored at  $-20^{\circ}\text{C}$  until processing. The degree of bacterial contamination (total bacterial cell count) was determined using a Bactoscan™ FC+ (FOSS, Denmark) automatic bacterial count reader. The ATP bioluminescence, expressed as the number of relative light units (RLU) for each colostrum sample, was obtained using a SystemSURE Plus meter (Hygiena™, California, USA). On each occasion, the mean of three consecutive ATP bioluminescence measurements was calculated and used for analysis. The relationship between the total bacterial count of colostrum and the ATP bioluminescence relative light units of colostrum was investigated with a Spearman's rank correlation. Statistical analysis was performed in R (R Core Team 2017).

**Results:** Samples originated from HF dairy cows ( $n = 86$ ) or from Belgian Blue beef cows ( $n = 76$ ). The median total bacterial cell count of the colostrum samples was 7.000 CFU/ml and ranged from 4.000 to 1.000.000 CFU/ml. The median ATP

bioluminescence of the colostrum samples was 255,00 RLU (range 1,00 – 2486,67 RLU).

The total bacterial cell count of colostrum and the ATP bioluminescence of colostrum were negatively correlated ( $\rho_{\text{spearman}} = -0,27$ ;  $CI_{95\%} [-0,4 \text{ to } -0,2]$ ;  $p < 0,001$ ).

**Conclusion:** The results of this study indicate that ATP bioluminescence measurements of colostrum cannot be used to evaluate the hygiene of the procedures applied during the collection, storage, and administration of bovine colostrum.

**Keywords:** Cattle, Colostrum, ATP bioluminescence, Total bacterial count.

## HH-24

### Dutch HF cow colostrum quality based on IgG concentration and total bacterial cell count

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**Objectives:** Because immunoglobulins cannot cross the epitheliochorial placenta of the cow during gestation, calves rely on the passive transfer of immunoglobulin G (IgG) through consumption of sufficient amounts of high quality colostrum within the first hours after birth. Besides by the concentration of IgG, colostrum quality is also determined by its bacterial contamination. To our knowledge, no recent data concerning the colostrum quality of Dutch Holstein Friesian (HF) cows are available. Therefore, the purpose of this study was to assess the colostrum quality from Dutch HF cows using different methods. The second aim of the study was to evaluate the influence of farm and veterinary practice on colostrum quality.

**Materials & methods:** Two large Dutch veterinary practices participated in this field study. 86 Dutch HF colostrum samples were collected at the time of first colostrum feeding on 19 different commercial dairy farms. For the quantification of the IgG's in colostrum, a commercial competitive ELISA-test kit (BIO K420, MonoScreen QuantELISA Immunoglobulin Easy, Bio-X Diagnostics S.A., Rochefort, Belgium) was used. Indirect evaluation of the IgG concentration of the colostrum samples was performed using a digital Brix refractometer (Milwaukee Refractometer MA871, Milwaukee Instruments Inc., NC, USA). On each occasion, the mean of three consecutive Brix refractometric measurements was calculated and used for analysis. The relationship between the IgG concentration and the Brix value of colostrum was investigated with a Pearson's correlation. The total bacterial cell count (TBCC) of the colostrum samples was determined using a bactoscan automatic bacterial count reader (Bactoscan™ FC+, FOSS, Denmark). The relationship between the IgG concentration and the TBCC of colostrum was evaluated using a Spearman's rank correlation. All statistical analyses were performed using R software (R Core Team, 2017).

**Results:** The number of colostrum samples collected per

herd ranged from 2 to 5. The colostrum IgG concentrations and the colostrum Brix values followed a normal distribution with a mean of  $53,19 \pm 17,61$  g IgG/l (range: 14,14 – 63,07 g IgG/l) and  $21,10 \pm 4,21$  % (range: 9,33 – 29,27 %), respectively. The TBCC of the colostrum samples ranged from 4.000 to 1.000.000 CFU/ml with a median of 9.000 CFU/ml. Furthermore, 38,1% of the colostrum samples had an IgG concentration below 50 g/l and/or a TBCC exceeding 100.000 CFU/ml. A significant positive correlation was found between the IgG concentration and the Brix value of colostrum samples ( $r_{\text{pearson}} = 0,65$ ;  $CI_{95\%} [0,51 \text{ to } 0,76]$ ;  $p < 0,001$ ). The colostrum IgG concentration and the TBCC of the colostrum were negatively correlated ( $\rho_{\text{spearman}} = -0,30$ ;  $CI_{95\%} [-0,49 \text{ to } -0,09]$ ;  $p = 0,005$ ). The mean IgG concentration ( $48,30 \pm 18,71$  g IgG/l) and the mean Brix value ( $19,90 \pm 4,4$  %) of the colostrum samples from practice A were both below the recommended threshold of 50 g IgG/l and 22 %, respectively. Compared to practice A, the colostrum samples from practice B had a significantly higher IgG concentration ( $58,68 \pm 14,65$  g IgG/l;  $p = 0,01$ ) and Brix value ( $22,45 \pm 3,59$  %;  $p < 0,001$ ). The non-parametric comparison of the TBCC of the colostrum samples revealed significant ( $p < 0,001$ ) differences between the two practices (median practice A : 16.000 CFU/ml [range: 4.000 – 1000.000 CFU/ml] , median practice B : 6.000 CFU/ml [range: 4.000-1.000.000 CFU/ml]). The mean colostrum IgG concentration was lower than the 50 g IgG/l threshold in 8 out of 19 farms. Only 10 out of 19 farms had a mean colostrum Brix value of at least 22%. The median TBCC of the colostrum samples was higher than 100.000 CFU/ml in 3 out of 19 farms. Between the farms, obvious differences were observed. Certain farms ( $n=3$ ) consistently presented poor-quality colostrum (IgG below 50 g/l and / or TBCC above 100.000 CFU/ml) results, whereas other farms ( $n=4$ ) showed colostrum samples that all were of good-quality.

**Conclusion:** The results of this field study indicate that the colostrum quality of Dutch HF cows in general is rather poor, with nearly 40% of all samples not meeting the minimal requirements for good-quality colostrum. The differences observed between the veterinary practices could indicate that in some practices more attention is paid to the colostrum management compared to others. Farm level analysis, however, indicates that focused attention on certain farms may be necessary.

**Keywords:** Dutch dairy cattle, Colostrum quality, IgG ELISA, Brix refractometer, Bactoscan.

## HH-25

### Association between prepartum nonesterified fatty acids serum concentrations and postpartum diseases in dairy cows

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**Objectives:** The objective of the present study was to evaluate the association between prepartum nonesterified fatty acids (NEFA) concentrations and development of post-partum diseases and culling occurring during the first 50 days in milk (DIM). A secondary objective was to identify optimal thresholds allowing identification of animals at greater risk of diseases or culling.

**Materials and methods:** We conducted a prospective cohort study over a 1-year period on 50 commercial Holstein dairy farms that were regular clients of the Bovine Ambulatory Clinic of the Faculté de Médecine Vétérinaire of the Université de Montréal (St-Hyacinthe, QC, Canada). Herds were selected by convenience based on being enrolled in a preventive veterinary medicine program involving herd health visits every 14 days, and on being willing to participate. At every herd visit, blood samples were taken from all cows within 35 days ( $\pm 7$ ) of subsequent predicted calving date. The samples were centrifuged (3,500 rpm x 10 minutes) and sera were stored at  $-20^{\circ}\text{C}$ . After calving, the number of days between sampling and calving were calculated. Cows sampled between 1 and 14 days before calving were included in the study; their serum samples were submitted for quantification of NEFA concentrations. Data about diseases occurring during the first 50 DIM were collected. Disease definitions were standardized during the study and included: retained placenta (RP;  $\geq 24$  hours after calving); hyperketonemia (HK; BHBA  $\geq 1.4$  mmol/l) during the first 15 DIM; puerperal metritis (MET) during the first 20 DIM (fetid watery vaginal discharge with general signs of illness); displaced abomasum (DA) during the first 30 DIM; clinical mastitis (CM) in the first 30 DIM (milk aspect alteration with or without quarter swelling, with or without fever/anorexia); purulent vaginal discharge (PVD) at  $35 \pm 7$  DIM inspected with a Metrichick device (threshold  $\geq 3$  based on McDougall et al., 2007), cytological endometritis (CYTO) measured at  $35 \pm 7$  DIM with a leucocyte colorimetric test (threshold  $\geq 1$ ). Diseases were diagnosed by veterinary practitioners except for RP and mild or moderate case of CM. Descriptive statistics and multivariable mixed logistic regression models were computed. Diseases and culling were considered to be the dependent variables of each model. Independent variables included prepartum NEFA serum concentration, parity, and season of calving. Herd was also included in the models as random variable. At first, NEFA concentrations were offered to the models as a continuous variable. Subsequently, for variables with significant correlation with NEFA, NEFA concentrations were dichotomized in order to find the optimal thresholds using non-nested models (lowest AIC value).

**Results:** A total of 1,299 cows were included in the study. The incidence of diseases was 10% for RP, 20% for HK, 16% for MET, and 7% for DA, 13% for PVD, 40% for CYTO, 9% for CM, 3% for culling. Overall, 47% of cows had experienced at least one disease during the first 30 DIM. In the study, the NEFA concentration was associated with a greater risk of developing every individual disease for RP, HK, MET, DA and CM ( $P < 0.05$ ); with a greater risk of developing any of the aforementioned diseases in the first 30 DIM ( $P < 0.05$ ); and with a greater risk of being culled in the first 50 DIM ( $P < 0.05$ ). Based on the lowest AIC value from non-nested models, the optimal NEFA thresholds were  $\geq 290$   $\mu\text{Eq/L}$  for RP (OR 2.2, 95%CI: 1.5-3.1;  $P < 0.01$ ),  $\geq 280$   $\mu\text{Eq/L}$  for HK (OR 2, 95%CI 1.5-2.7;  $P < 0.01$ ),  $\geq 300$   $\mu\text{Eq/L}$  for MET (OR 4.0, 95%CI: 2.7-5.7;  $P < 0.01$ ),  $\geq 300$

$\mu\text{Eq/L}$  for DA (OR 4.2, 95%CI: 2.9-6.1,  $P < 0.01$ ),  $\geq 280$   $\mu\text{Eq/L}$  for CM (OR 3.4, 95%CI: 2.2-5.3,  $P < 0.01$ ),  $\geq 260$   $\mu\text{Eq/L}$  for culling (OR 4.7, 95%CI: 2.2-10,  $P < 0.01$ ).

**Conclusions:** These study results confirm the association between prepartum NEFA serum concentrations and post-partum diseases (30 DIM) and culling (50 DIM). The optimal thresholds found in the present study were similar to those reported elsewhere. No association was found between NEFA and PVD or CYTO, in accordance with previous studies. We can conclude that prepartum NEFA thresholds of  $\geq 280$  can help to identify animals at greater risk of developing diseases in the first 30 DIM or being culled in the first 50 DIM.

**Keywords:** Nonesterified Fatty Acids, Post-partum diseases, Clinical mastitis.

## HH-26

### Relationship of nonesterified fatty acids with automated health-monitoring system variables and blood metabolic profile parameters in dairy cows

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**Objectives:** The aim of this study was to assess the dependence of changes in nonesterified fatty acids (NEFA) on lactation number and to assess the relationship of NEFA with automated health-monitoring system biomarkers (AMS) variables and parameters of the blood metabolic profile in dairy cows.

**Materials and methods:** The study was conducted on 105 clinically healthy cows of Lithuanian Black and White breed. Cows were grouped by lactation number: 1 (n = 30), 2 (n = 60), 3 (n = 15) and NEFA level: NEFA  $< 0.3$  (n = 67) and NEFA  $\geq 0.3$  (n = 38) (James K. Drackley, 2000). All samples for NEFA were analyzed using an automated wet chemistry analyzer (Rx Daytona, Randox Laboratories Ltd, UK) with using reagents (Rx Daytona, Randox Laboratories Ltd, UK). Blood serum parameters, including NEFA, aspartate aminotransferase (AST), albumines (ALB), and  $\gamma$ -glutamyl transpeptidase (GGT) were examined using the Hitachi 705 analyser (Hitachi, Japan), and DiaSys reagents (Diagnostic Systems GmbH, Germany). Cortisol level was measured using the fluorescence enzyme immunoassay method by Tosh Corporation AIA-360 (USA). Milk yield (MY), progesterone and beta-hydroxybutyrate (BHB) were registered from AMS Herd Navigator (Lattec/S. Hillerød, Denmark) in combination with a DeLaval milking robot (DeLaval Inc. Tumba, Sweden).

**Results:** The average NEFA value for all cows was  $0.145 \pm 0.013$  (95% CI = 0.120-0.171). The study showed that (NEFA) tends to increase with increasing lactation ( $y = -0.019x + 0.1808$ ;  $R^2 = 0.9998$ ,  $P < 0.001$ ). The average NEFA value in primiparous cows ( $0.162 \pm 0.034$ ) was 12.04% lower compared with lactation 2 cows and 23.46% lower compared to lactation 3 ( $P < 0.05$ ). Analysis of the estimated indicators by

level of NEFA indicated statistically higher values of albumins (ALB) (41.61%,  $P < 0.001$ ), aspartateaminotransferase (AST) (26.37%,  $P = 0.05$ ),  $\gamma$ -glutamyltransferase (GGT) (48.21%,  $P = 0.04$ ) and a lower value of milk yield (MY) (20.72). %,  $P = 0.015$ ) in cows of the NEFA group  $\geq 0.3$  compared to the group of NEFA  $< 0.3$ . NEFA values were reliably correlated with serum ALB ( $r = 0.446$ ,  $P = 0.001$ ), AST ( $r = 0.292$ ,  $P = 0.032$ ), MY ( $r = 0.296$ ,  $P = 0.05$ ) and milk progesterone ( $r = 0.371$ ,  $P = 0.006$ ) and were negatively associated with GGT ( $r = -0.298$ ,  $P = 0.028$ ).

**Conclusions:** According to our study NEFA concentration has tendency to change on different lactation number. Highest NEFA concentration affects the concentration of some blood serum parameters. Our study showed that lower NEFA levels were associated with higher productivity and lower cortisol levels in blood of dairy cows.

**Keywords:** NEFA, dairy cows, health management.

## HH-27

### A description of colostrum quality on Scottish dairy farms and risk factors associated with poor colostrum quality

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**Objectives:** Poor colostrum quality is a major risk factor for failure of passive transfer (FPT) in neonatal dairy calves. FPT contributes to high incidences of calf morbidity and mortality as well as more long-term detrimental effects on productivity (DeNise *et al.*, 1989; Tyler *et al.*, 1999; Faber *et al.*, 2005). The two main measures of colostrum quality are immunoglobulin (IgG) concentration and bacterial contamination (total bacteria counts (TBC) and coliform counts (TCC)). Brix refractometry measures the total solids in colostrum by refraction of light and is highly correlated with IgG concentration (a threshold of 22% is used to indicate adequate quality) (Quigley *et al.*, 2013; Deelen *et al.*, 2014). US industry guidelines for bacterial contamination of colostrum state that TBC should not exceed 100,000CFU/ml and TCC should not exceed 10,000CFU/ml (McGuirk and Collins, 2004). The objectives of this study were to:

- measure IgG concentration and bacterial contamination of colostrum at point of feeding to neonatal dairy calves.
- establish risk factors for poor colostrum quality on Scottish dairy calves.

**Materials and Methods:** Thirty-eight farms in the Stirlingshire, Lanarkshire and Dumfries and Galloway regions of Scotland were enrolled between February and June 2019. A farmer questionnaire was completed by interview, detailing colostrum management practices. Two hundred and fifty-two colostrum samples were collected by trained farm staff at point of

feeding. For each sample, Brix refractometry (Brix) was used to estimate IgG concentration and TBC and TCC were carried out using plate counts and Petrifilms™ respectively.

Brix, TBC and TCC were dichotomized to form categorical outcome variables either falling below, or exceeding industry thresholds and multi-level logistic regression models were constructed using farm as a random effect.

**Results:** Results for IgG concentration showed 111/252 samples, (44.05 %) were below 22% Brix and 77/252 (29.76 %) and 50/252 (19.84 %) exceeded the TBC and TCC thresholds respectively. When industry recommendations, in terms of Brix % and bacterial contamination, were considered only 99/252 (39.29%) met all the criteria.

Colostrum harvested from dams more than six hours after calving was half as likely to exceed the Brix threshold of 22% (reflective of adequate IgG concentration) (OR=0.47, 95%CI = -1.65–0.12,  $p = 0.09$ ) compared with colostrum harvested less than six hours after calving. Furthermore, colostrum that was left in the collection bucket as opposed to being stored or fed immediately post-harvest was found to be 28.09 times (estimate = 3.34; 95%CI = 0.66–6.00) more likely to exceed TBC thresholds compared with colostrum that did not sit in a collection bucket post-harvest ( $p = 0.014$ ).

**Conclusion:** A large proportion of colostrum samples (60.71%) failed to meet Brix thresholds, bacterial thresholds or both. Colostrum management strategies can be a risk for poor colostrum quality. Timing of colostrum harvest post calving was associated with a colostrum Brix  $< 22\%$ , and time spent in the bucket prior to feeding or storing was associated with a TBC exceeding 100,000CFU/ml. Poor colostrum quality could have significant impacts on calf health and welfare.

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**Keywords:** Colostrum, Brix, Bacteria, Risk Factors.

## HH-28

### The carry-over effect of heat stress during late pregnancy on production and functional traits in the offspring generation

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Due to climate change, heat stress (HS) for dairy cows frequently arises. HS has tremendous unfavorable direct effects on dairy cow traits. Additionally, the negative long-term effect of in utero HS on birth weight, fertility and performance in the offspring generation under hot climate conditions have been observed. Regarding this background, the aim of this study was to analyze the carry-over effect of HS in terms of the average temperature-humidity-index (THI) during the last eight weeks of pregnancy on offspring performances.

In this regard, we considered a comprehensive dataset including Hessian Holstein dairy cows from calving years 2003 to 2013. THI was merged with fat content measured on first test day (fat%; N=171,150), non-return-rate after 56 days of first insemination (NRR56; N=94,981), calving to first insemination interval after first calving (CFI; N=134,885), productive life (PL; N=119,599) and lifetime productivity (LTP; N=119,634).

For THI 50–59 and THI  $\geq$  60 least squares means for fat% were substantially lower (4.21 % and 4.20 %, respectively) than for THI  $\leq$  39 and THI 40–49 (4.24 % and 4.23 %, respectively) ( $P < 0.0001$ ). Moreover, offspring of mothers exposed to THI  $\geq$  50 had a lower ability to conceive than offspring of mothers exposed to THI  $\leq$  49 (80 % and 81 %, respectively) ( $P < 0.0318$ – $0.0454$ ). Calving to first insemination interval ( $P < 0.0001$ ) and PL ( $P < 0.0001$ ) in the offspring generation were also significantly negative affected (CFI: THI  $\leq$  39: 88 days, THI  $\geq$  60: 91 days, PL: THI  $\leq$  39: 915 days, THI  $\geq$  60: 889 days). Offspring of mothers, exposed to average THI  $\geq$  60, produced 18,137 kg milk during life. In comparison, offspring of mothers, who experienced THI-values  $\leq$  39 during late pregnancy, produced 18,422 kg ( $P > 0.0375$ ). Epigenetic modifications triggered in the uterus can explain this long-term influence on the offspring.

Due to this detrimental effect across generations, an optimized heat management during dry period is recommended to create optimal conditions in uterus for the fetus and thus, set the base for best possible performance of the offspring in adulthood and improved longevity.

**Keywords:** In utero heat stress, dry period, fetus.

## HH-29

### Fresh cow's diseases prevalence and consequences in 42 Spanish Dairy Farms

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**Objectives:** The transition period is the most important part of the lactation cycle for dairy farms profitability (Overton T. 2001). Most diseases occur during the first month of lactation (Leblanc S. et al., 2006) and can have a big impact on productivity. CONAFE, supported by Elanco Animal Health, started in 2015 a new project called “I-SA” on health traits monitoring with the aim of improving herd management and genetic selection. The scope of this data analysis is to increase the knowledge about fresh cow's diseases prevalence in Spanish dairy herds, understand their risk factors and impact on milk production.

**Materials and Methods:** 42 Spanish dairy herds across the country have been voluntary enrolled into a fresh cow's diseases data collection. Diseases occurrence have been recorded by the farmer and transferred to the local DHI association. Records include 18,043 lactations with 3 years calving dates from 2016 to 2018. Attempts to reach disease recording standardization have been made by providing disease definitions to farmers and suggesting to involve farm vets in disease diagnosis. Occurrence of the following diseases have been recorded throughout the first 68 days in milk (DIM), the highest 2<sup>nd</sup> test limit: Displaced Abomasum (DA), Clinical Mastitis (MAST), Retained Placenta (RP) and Metritis (METR). Other information proceed from the DHI database: herdcodes, birthdate, calving date, parity, somatic cell count (SCC) and milk production at first and second test, BHB levels at first test (except for 3 farms), 305 days milk production. First tests between 5 and 25 DIM having BHB levels  $>0,1$  mmol/liter have been considered as Ketosis (Viña C. et al., 2017, Renaud D. L. et al., 2019); first tests having  $>200$  000 SCC/ml have been considered as Subclinical Mastitis (Ruegg P. 2017). Other variables were created: first calving age in categories, estimated cumulative production of the first 68 DIM (ICAR 2002). Descriptive statistics and multivariate models have been used to describe disease prevalence, determine risk factors and quantify consequences on milk production. Statistically significant results were identified using a  $p < 0.05$ .

**Results:** The dataset is composed by 33% first lactation animals (parity 1), 27% second lactation (parity 2) and 39%  $\geq 3$  lactations (parity 3+). Mean age at first calving was 25.3 months, with farm averages ranging between 23.4 and 28 months. Mean clinical diseases prevalence during the first 68 DIM was 3.11% for DA (0.76-7.73%) 4.58% for MAST (0-35.91%), 8.50% for RP (1.21-20.90%), 10.29% for METR (0.56-30.94%). Ketosis prevalence was 23%, with a farm prevalence range 4.55-50%. 31% of the farms (n=12) had a Ketosis prevalence greater than 25%. Subclinical mastitis at first test (5-35 DIM) was 21%. Statistically significant differences across parities were found for the risk of: DA (3+ vs. 2, Relative Risk (RR)=1.73 and 3+ vs. 1, RR=1.94), MAST (3+ vs. 2, RR=1.86 and 3+ vs. 1, RR=2.24), RP (3+ vs. 2,

RR=1.36; 3+ vs. 1, RR=1.61; 2 vs 1, RR=1.17), METR (3+ vs. 2, RR=1.23 and 2 vs. 1 RR=0.80), Ketosis (3+ vs. 2, RR=1.23; 3+ vs. 1, RR=2.18; 2 vs 1, RR=1.33) and Subcl. Mastitis (3+ vs. 2, RR=1.99 and 3+ vs. 1, RR=1.92). Age at first calving categories had a correlation with Ketosis risk (>27mo vs. <24mo, RR=1.80) and Subclinical Mastitis risk (>27mo vs. 24-27mo, RR=1.22 and >27mo vs. <24mo, RR=1.36).

Production losses at first test for ketotic cows vs. non-ketotic cows were 1.7 kg for lact=1 and 1.3 kg for lact>1 ( $p<0.0001$ ). Production losses on 68 DIM cumulative production were 478 kg for DA, 179 kg for MAST, 163 kg for RP and 140 Kg for METR ( $p<0.0001$ ). 305d milk losses were 725 kg for DA, 651 kg for MAST, 302 kg for RP and 173 Kg for METR ( $p<0.0001$ ). Ketosis has not been included in the 305d milk model, as the proper way to analyze ketosis lactational impact on milk production is a testday model, which could not be built with currently available variables (Gröhn Y. et al. 1999).

**Conclusions:** Once again, transition cow's diseases importance have been demonstrated. Proper recording and analysis can increase our knowledge of the real prevalence at farm and country level, improve understandings of risk factors, estimate production losses and, finally, lead to a better transition management and genetic selection.

**Keywords:** Transition period, Dairy, Diseases, Spain.

### HH-30

#### Comparison between general and analytical results account in three Galician dairy farms. A descriptive evaluation

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**Objectives:** With the aim of evaluate the economic result and the main areas of improvement, economic management programs have been implemented in Galician dairy farms. These economic evaluations are mainly based on the development of the general income statement (CRG) of the dairy farm activity based on General Accounting Plan 2007 (Real Decreto 1514/2007, PGC) procedures. However, development of an analytical income statement (CRA) allowing the differentiation of the economic results of the main economic activities present in dairy farms (Dairy – milk yield, Land - agricultural production (corn and grass silage), and Rearing - replacement heifers) was proposed. So, the objective of this study was to verify if this analytical accounting could provide useful information in the economic management of dairy farms compared with the income statement not split by sections.

**Materials and methods:** Three dairy farms (A, B, C) located at Lugo province (Spain) with different business models were selected. Farm A is a dairy farm with intensive management system, containing an average of 113 milking cows in production, 1,23 million of liters sold and 56 hectares of land. Heifers were reared by an external company. Farm B is a cooperative dairy farm with intensive management system, containing an average of 218 milking cows in production and

2 million of liters sold. They owns 149 hectares of land and heifers were reared into the farm. Farm C is a ATC\* dairy farm (\*Agrarian Transformation Company) with intensive management system, containing an average of 110 milking cows in production and 1,1 million of liters sold. They owns 60 hectares of land and heifers were reared by an external company.

For the analysis of their economic results, both the CRG and the CRA were performed in the three dairy farms during 2018, following the principles of the PGC. In the CRA, the income and expenses corresponding to each of the defined sections (dairy, land and rearing) were allocated, so that we obtain three independent income accounts. The necessary information is obtained from the following sources: Invoices of expenses and income of the companies, official accounting of farms, ReproGTV® (on-farm dairy management software) and Gescarro® (RMH® TMR software). All information is processed using the Excel 2016® program.

**Results:** The results of the general accounting for the three farms indicated that all of them obtained positive benefits during fiscal year 2018:

- Farm A: € 46.158 net profit, € 37,75 /1.000 liter of SCM\* sold (\*Solid Corrected Milk: 4.0% fat, 3.3% protein) and a net sales benefit of 7.7%.
- Farm B: € 95.147 net profit, € 47,60 /1.000 liter of SCM sold and a net sales benefit of 9.7%.
- Farm C: € 32.403 net profit, € 29,95 /1.000 liter of SCM sold and a net sales benefit of 6.9%.

However, the CRA analysis indicated that the result of the different sections evaluated was independent of the overall result, and also variable among the 3 dairy farms. Thus, in farm A and C the sections Dairy and Land have yielded benefits (€ 31.147 and € 2.283 for milk; € 24.457 and € 39.827 for Land, respectively), while the Rearing section has been deficient for both (€ -9.446 and € -9.707, respectively). In farm B the Land and rearing sections have yielded benefits (€ 135.202 and € 12.229, respectively), while the dairy section caused losses (€ -52.284).

**Conclusions:** Implementation of the CRG is an essential tool to evaluate the economic result of the farm in general, as well as to know the structure of expenses and incomes. This evaluation helped us to visualize the CRA benefits to identify areas of improvement that CRG can not identify, due to the fact that results of some sections can mask the results of others.

**Keywords:** Dairy,account,galician,economic,results.

### HH-31

#### Use of a real-time location system to detect cows in distinct functional areas within a barn

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**Objectives:** Automated monitoring of animals by use of various sensor technologies is already used for many decades on dairy farms. Recent research and development of new sensor technologies and features aim to further improve animal health, welfare, and management procedures. Modern sensor technologies allow, among others, the tracking of animals in real-time in a barn. This can be used, for example, to estimate the time an animal spend at relevant 'functional areas' such as the feed bunk, cubicles, or alleys. The resulting data can then potentially be used as early indicators for disease, discomfort and to estimate the welfare status of an animal.

In this field study, we tested the real-time localization system (RTLS) of a commercially available system (SMARTBOW, Smartbow/Zoetis LLC, Weibern, Austria) to detect animals in predefined functional areas. The system consists of an ear-attached accelerometer that sends low-frequency signals to receivers, which transmit the data to a local farm server. Based on the incoming data of individual animals, the server software triangulates the location of an animal within the barn in real-time. The objective of this study was to determine the accuracy of the system to predict the location of the cow and the agreement between visual observations (VO) and RTLS observations for the total time spent by cows in relevant areas of the barn.

**Material and methods:** The study was conducted in May 2019 on a commercial dairy farm in Austria, housing approximately 35 Brown Swiss cows. The SMARTBOW (SB) tags were attached to the left ears of the animals. In advance of the study, functional areas of interest (i.e. the feed bunk, cubicles, and alleys) were predefined in the software of the sensor system. Cows were video recorded for three consecutive days using 9 digital cameras (DS-2CD2642FWD-IZS, Hikvision, Hangzhou, China). From these recordings, approximately 1 h was selected randomly each day for every cow (3 d × 35 cows). For each minute of an hour, animal position within a specific functional area was visually observed and labeled by use of specialized software for video analyses (Mangold Interact, Mangold International GmbH, Arnstorf, Germany). Data of the video observations (VO) served as gold standard in this study. A total of 6,030 pairs of location data, derived from VO and the SB system, were used for statistical analyses. Categorical data were used to estimate the agreement between the two methods. For each functional area of interest, the sensitivity (Se), specificity (Sp), and accuracy (Acc) were calculated. The total time spent (min/h) per cow in the specific areas was analyzed using Spearman correlations.

**Results:** Overall, a Cohen's kappa of 0.78, indicating a 'substantial agreement', between VO and SB was obtained. Se and Sp were determined for locating the cows in the alley (74.0 and 91.2%), feed bunk (93.5 and 86.2%), and cubicle (90.5 and 83.3%), respectively, and overall accuracy of 87.6%. The correlation between VO and SB for the 'total time' an animal spent within an hour in alleys, at the feed bunk, and in cubicles was 'good' to 'strong' with correlation coefficients of 0.82, 0.98, and 0.92, respectively.

**Conclusions:** Overall, the real-time localization feature

from SB was successful in predicting the position of an animal in a specific functional area. The estimated times, which an animal spent per hour in these specific areas were good. Future research should focus on, whether these times could be used as early indicators for disease, discomfort and to estimate the welfare status of an animal.

**Keywords:** Animal tracking, dairy cow, precision dairy farming, real-time location system, time budget.

## HH-32

### Application of Culling Form reveals patterns of dairy cow culling reasons

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**Objectives:** Culling dairy cows often occur as a result of several, possibly related health issues however the registration forms for culling reasons are mostly not designed to capture the chain of the health problems that eventually lead to culling. The aim of this study was to develop and implement a Cow Culling Form (CCF) to reveal diseases or conditions resulting with culling, and their combinations. Also, farmers' behaviour in marking culling reasons was analysed.

**Materials and methods:** The CCF developed to capture the culling reasons of cows slaughtered and dead on-farm was based on the Certificate of Death developed by McConnel and Garry (2017). It registered the general information of the cow, asked the respondent to list all diseases or conditions that could predispose or result in cow slaughter or death together with the time of onset and details about recovery. Also, it was asked to list all diseases the cow suffered in the ongoing lactation (date of onset, diagnosis, overall treatment protocol) and describe other problems or chronic diseases / conditions the cow had. Respondent was also asked to mark the culling reason that was inserted to the Estonian Livestock Performance Recording Ltd (ELPR) database for the culled cow.

In eight dairy farms, CCF was completed for every culled cow within the 12 months period. All completed CCFs were interpreted by the authors and were coded into underlying (disease or condition which initiated the possible chain of consecutive diseases or problems), intermediate, immediate (sequentially the last disease or disorder due to which the cow died or was sent for slaughter), and influential culling reasons (other diseases or problems that were outlined by the respondent as being related with culling but were not considered to be biologically related with other culling reasons). Based on the CCF data, culling code including three culling reasons (immediate, intermediate/influential and underlying) was created for each cow applying the extended coding system developed by McConnel and Garry (2017).

**Results:** The mean number of cows in eight study herds was 383 cows (range 126-564). The mean yearly cow culling rate of the study farms was 31.8% (range 23.0-40.7%) and the average on-farm mortality was 9.3% (range 3.7-18.5%).

Altogether, 686 and 250 CCFs of slaughtered and dead

cows were analysed in this study, respectively. Out of 686 slaughtered cows 14 (2.0%) were culled due to voluntary reasons, i.e. due to low milk yield only.

The number of unique three-reasons culling codes were 261 for slaughtered cows and 119 for cows that died on-farm. The most frequently identified underlying culling reasons in slaughtered cows were generic lameness (20% of slaughtered cows), impaired fertility (19.1%), abortion (9.8%), mastitis (8.5%), leg injury (5.8%), sole ulcer (4.2%) and metabolic disorders (3.8%). For the dead on-farm cows leg injury (14.8%), liver pathology (12.0%), milk fever (7.2%), generic lameness (7.2%), intestine inflammation (5.2%), mastitis (4.8%), dystocia (4.4%), sudden death (4.0%), displaced abomasum (3.6%), uterine torsion (3.2%), metabolic disorders (3.2%) and ketosis (2.8%) were identified most often as underlying culling reasons.

In general, the culling reason marked into the ELPR database more often concurred with the underlying culling reason (72.6% and 63.6%) than with immediate reason (62.5% and 61.2%) identified from the CCFs of slaughtered and dead cows, respectively.

**Conclusions:** In general, herds that were included in the study had relatively high culling and mortality rates. Only negligible proportion of culls were voluntary reflecting deteriorated cow health and welfare also restricting the economic return of dairy farming.

Improved registration of culling reasons is needed to support informed herd-based decisions. Diagnosis tree, together with more broader disease categories, should be available in the recording systems to capture the relevant details related with death and slaughter. It is imperative to identify the triggering diseases or conditions to help to break the chain of sequential diseases that eventually cause culling. A tool which provides guidance to farmers through recording all important diseases and disorders, associated with culling, could be developed.

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**Literature:** McConnel, C., Garry, F., 2017. Dairy cow mortality data management: the dairy certificate of death. *Bov. Pract.* 51, 64–72.

**Keywords:** Dairy cow, slaughter, death, causes, data registration.

### HH-33

#### Association between rumination patterns detected by an ear-tag based accelerometer system and rumen physiology in dairy cows

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Public Health, University of Veterinary Medicine Vienna, Vienna, Austria; <sup>2</sup>Zoetis International, Dublin, Republic of Ireland; <sup>3</sup>Zoetis Deutschland GmbH, Berlin, Germany.

**Objectives:** Rumination is an essential part of the physiology of dairy cows. In this context, rumination activity is considered as a useful indicator for early detection of diseases and metabolic disorders.

The accelerometer-based sensor system SMARTBOW (SB, Smartbow/Zoetis LLC, Weibers, Austria) provides health alerts based on individual thresholds of rumination patterns in dairy cows. Detailed knowledge about the association between sensor-based rumination patterns and rumen physiology would help to interpret the clinical significance of rumination alerts. To the authors knowledge, no research has been carried out into the interaction between rumination alerts and changes of rumen fluid in dairy cows. These results could lead to a better interpretation of sensor-based rumination alerts.

**Material & Methods:** The study was conducted between April and October 2021 on a conventional dairy farm in the north of Germany, housing approximately 1900 Holstein-Friesian cows fitted with SB ear tags. According to our study 102 cows were matched in pairs based on the appearance of a rumination alert (ALRT) vs. no rumination alert (NALRT) and the lactation status. NALRT cows had to meet health criteria including a rectal temperature of < 39.5 °C and no signs of lameness (Sprecher >2). SB algorithms provided an 'acute rumination alert' and a 'long-time rumination alert' which were presented in Smartbow software and sent to a mobile device. A rumination alert was considered as valid if it persisted for at least 12 h, and the sample of rumen fluid was collected within the first 12 h of the alert.

Rumen fluid was taken twice using an oral stomach tube (SELEKT Rumen Fluid Collector, Nimrod Veterinary Products, Moreton-in-Marsh, UK). The first extraction (Ex1) was performed at the beginning of the alarm and the second extraction (Ex2) after the end of the alarm. The cows' status (ALRT vs NALRT) of each sample was blinded prior to examination by replacing the animals' identification number with a sample number randomly assigned by a second person.

The following parameters were examined in each sample: (1) rumen pH and redox potential by a portable electronic pH-meter (G1501 Serie, GHM Group Greisinger, Regenstauf, Germany; pH electrode GE 114-WD; redox electrode GR 175 BNC), (2) duration of methylene blue reduction time and sedimentation/flotation time, (3) microscopic evaluation of protozoa in a counting chamber (Fuchs-Rosenthal, Paul Marienfeld GmbH & Co.KG, Lauda-Königshofen, Germany).

To investigate potential differences in rumen physiology parameters between ALRT and NALRT, the rumen fluid parameters of the groups were compared at both extraction times (Ex1 and Ex2) by the Mann-Whitney U-test. For the detection of changes in rumen physiology within each group during the extraction period, rumen fluid parameters between Ex1 and Ex2 were compared for each group by related-samples Wilcoxon signed-rank test.

**Results:** The rumen parameters: pH, redox potential, methylene blue reduction time and sedimentation/flotation time differed significantly between ALRT cows and their NAL-



RT counterparts at Ex1 ( $P < 0.01$ ). In contrast the number of protozoa showed significant differences between groups at Ex1 and Ex2 ( $P < 0.01$ ). No differences were apparent for the other parameters at Ex2. The rumen fluid parameters of ALRT cows reached alignment with the values of their NALRT partners during the extraction period, except for the number of protozoa. Furthermore, ALRT animals differed in all rumen fluid parameters within the extraction period ( $P < 0.01$ ) while those of NALRT cows remained constant.

**Conclusions:** The rumen fluid parameters were within the physiological ranges for ALRT and NALRT cows at both extraction times, but a higher variation was in ALRT cows at Ex1 was found. Higher variations in rumen fluid parameters of cows with rumination alerts could indicate a higher vulnerability to rumen health disorders. Considering the regeneration of protozoa to be a continuous process, protozoa were not able to fully replicate themselves until Ex2, which justifies the difference existing between ALRT and NALRT animals at Ex2. The collection of rumen fluid shows snapshots of rumen physiology in matched cows during and after rumination alert. Further research might focus on continuous measurement options for detecting rumen fluid parameters of cows at different health levels.

**Keywords:** Rumen fluid, rumination time, health alert, rumen disorders, accelerometer.

### HH-34

#### Single and combined quality and quantity criteria of bovine colostrum and factors affecting them

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**Objectives:** Colostrum administration ensures passive transfer of immunity to newborn calves. The common recommendation is to provide colostrum of adequate quality (IgG $\geq$ 50g/L, Brix value  $\geq$ 22%) and quantity (4kg), as soon as possible after calving. The objective of this study was to evaluate the effect of various management and cow factors on colostrum quality and quantity.

**Materials and Methods:** The study was conducted in 10 commercial dairy herds in Northern Greece, from February 2015 to September 2016. A total of 1,013 Holstein cows and their calves were included in the study. All cows were milked completely 232 $\pm$ 195 minutes after calving, colostrum yield was recorded and a sample was collected. A Brix refractometer was used cowside to measure % total solids (TS); IgG con-

centration was calculated according to published equations. Body weight of calves was estimated using a heart girth tape. For each cow, records regarding calendar season and age at calving, milk yield of previous lactation, dry period length, time interval between calving and colostrum collection (TI) and body condition score (BCS) at calving were available. Target colostrum criteria were: a) colostrum TS content  $\geq$ 22% (indicative of IgG content  $\geq$ 50g/L), b) colostrum yield  $\geq$ 4kg, c) 200g IgG in  $\leq$ 4kg of colostrum and d) IgG quantity equal to 0.5% of calf body weight in  $\leq$ 4kg of colostrum. Criteria (a) and (b) are individual colostrum traits while criteria (c) and (d) combine quality and quantity traits and represent practical recommendations regarding colostrum administration to newborn calves. Effects of calendar season, age at calving, milk yield of previous lactation, dry period length, TI and BCS on colostrum criteria were assessed with univariate general linear models. Farm was fitted as a random effect and all other factors as fixed ones in the models.

**Results:** Target values were not met by 18.3%, 25.4%, 23.5% and 19.8% of samples, for the 4 criteria, respectively. Farm ( $P < 0.05$ ), age at calving ( $P < 0.05$ ) and TI ( $P < 0.05$ ) had a significant effect on all criteria. Older cows produced colostrum of better quality and in higher quantities. When TI was longer, colostrum yield was higher but quality was lower. Adequate IgG quantity ( $\geq$ 200g and  $\geq$ 0.5% of calf body weight) in a target colostrum quantity ( $\leq$ 4kg) was easier to achieve when TI was shorter. Autumn was the season with the highest quality (criterion a,  $P < 0.05$ ) but colostrum yield (criterion b,  $P < 0.05$ ) was low. Adequate IgG quantity ( $\geq$ 0.5% of calf body weight) in a target colostrum quantity ( $\leq$ 4kg) was more difficult to achieve during winter (criterion d,  $P < 0.05$ ). Previous lactation milk yield ( $P < 0.05$ ) and BCS at calving ( $P < 0.05$ ) had a positive significant effect only on colostrum yield (criterion b). Dry period length had a significant positive effect on colostrum yield (criterion b,  $P < 0.05$ ) but a negative one ( $P < 0.05$ ) on criterion c; adequate IgG quantity ( $\geq$ 200g) in a target colostrum quantity ( $\leq$ 4kg) was more difficult to achieve when the dry period length was  $>85$  days.

**Conclusions:** Milking cows immediately after calving is a highly beneficial practice, resulting in colostrum of best quantity and quality combined, in most cases. Negative effects on colostrum quality associated with season, age at calving and dry period length were identified; however, they are inevitable under practical farm conditions. Recommended management practices (stock of frozen colostrum) can help overcoming them. The consistent effect of farm on all colostrum criteria necessitates the investigation of management factors associated with it.

**Keywords:** Dairy cow, colostrum quality.

## HH-35

**Factors affecting the skeletal muscle reserves during the transition period in Holstein cows**

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**Objective:** Association of dairy cow energy balance during the transition period with health status and performance has been thoroughly investigated. On the other hand, research on protein balance during the same period is limited. The objective of *this study* was to assess factors affecting protein balance, expressed as skeletal muscle tissue reserves, during the transition period in Holstein cows.

**Materials and methods:** Two-hundred and thirty-eight multiparous cows in different parities (2: n=101; 3: n=72; 4+: n=65) from 6 Holstein dairy farms were included in this cohort study. Body condition score (BCS) and *longissimus dorsi* muscle thickness (LDT) of each cow was assessed at 7 time-points relative to calving: -45d; -21d; -8d; 0d; +8d; +21d and +28d, by the first author. Cows were scored for BCS on a 5-point scale with 0.25-unit increments; LDT was measured by ultrasonography, using a 5.0-7.5 MHz linear transducer. The probe was placed perpendicular to the vertebral column on the transverse process of the 4<sup>th</sup> lumbar vertebra, using ultrasound gel as a couplant. When a clear image was captured, LDT was measured at the site of the larger diameter of the muscle between the fasciae. Cows were classified as thin (BCS <3.00), normal (BCS 3.00–3.50) or fat (BCS >3.50) at their first assessment. The fixed effects of herd, time-point, parity, dry period duration, milk production of previous lactation, BCS\_class, and the interactions of herd, BCS\_class and parity with time-point on LDT measurements were assessed with repeated measures linear mixed models, accounting for the random variation of each cow's measurements. Factors with non-significant effects at the P>0.20 level, were excluded from the final model. The appropriate covariance structure was selected resulting in the lowest Akaike's information criterion value. Analysis was performed with IBM SPSS v.25.

**Results:** On a descending *F*-value order, time-point, BCS\_class, herd, BCS\_class × time-point interaction, herd × time-point interaction, parity and parity × time-point interaction had significant effects on LDT measurements. The effect of dry-period duration, although non-significant (P=0.144), remained in the final model as a covariate. On average, cows gained ca. 5% (P<0.001) muscle thickness from -45d (estimated marginal mean ±se: 34.0mm ±0.4) until -21d (estimated marginal mean ±se: 35.4mm ±0.4). Between -21d and -7d, LDT practically stabilized (estimated marginal mean ±se: 35.2mm ±0.4). Then, they lost ca. 26% (P<0.001) muscle thickness until +21d (estimated marginal mean ±se: 26.0mm ±0.4); LDT measurements appeared to stabilize again until +28d (estimated marginal mean ±se: 25.6mm ±0.4). Fat cows had significantly higher LDT measurements than normal and thin ones from -45d up to 0d and +7d, respectively, meaning

that fat cows mobilized at the same time proportionally more muscle reserves than normal and thin ones. Moreover, significant differences were detected among herds in each time-point. Differences among parities were more obvious during the dry period.

**Conclusions:** Negative protein balance of transition Holstein dairy cows begins pre-partum and lasts until about 3 weeks post-partum. Mobilization of muscle reserves differed among parities, body condition scores and herds. Determination of specific herd factors affecting its variation is an essential step in developing appropriate management measures.

**Keywords:** Longissimus dorsi, transition, dairy cattle.

## HH-36

**Assessing the predictive capacity of a health monitoring system based on body condition score at the herd level**

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**Objectives:** The objectives of the current study were: 1- to define the herd threshold for cows with poor body condition based on its predictive capacity for disease risk at the herd level, and 2- to estimate the impact measures on disease rates due to body condition indicators in the transition period.

**Material and methods:** Data from two commercial grazing dairy herds (Herd A=5,034 and herd B=7,965 lactations) from Buenos Aires Province, Argentina were used to perform a longitudinal retrospective study during a 4-year period (January 2014-December 2017). Health, reproductive and body condition score (BCS) records were gathered. The BCS (5-point scale) was performed by farm personnel at calving (C-BCS), and at the end of the voluntary waiting period (40 and 50 days in milk [DIM] in herds A and B, respectively) by one of the authors. The difference between both measures of BCS was used to assess the change in body condition loss ( $\Delta$ BCS). All the cows not bred by 70 DIM were checked for anestrus (AN [yes/no]; defined as the absence of corpus luteum and a flaccid uterus). For herd monitoring, calving cohorts of 21-day were defined at each HERD (A or B) and PARITY (primiparous vs. multiparous cows) through the entire study period. The frequency of cows with CBCS<3 or  $\Delta$ BC>-0.5 (BC%) at each cohort were calculated and used to define position measures (quartiles) through the whole study period, at each HERD and PARITY level. Quartiles were used, one at a time, as the threshold to dichotomize the cohorts (i.e.; over and above threshold) to predict the risk that a cohort has a frequency of AN over the median. The sensibility (SE), specificity (SP), area under the curve (AUC), and odds ratios (OR) for



each threshold were estimated, and the higher AUC was used as selection criterium to determine the herd level threshold at each HERD and PARITY level. Another visual approach was performed for herd monitoring by calculating the population attributable fraction ( $AF_p$ ) of anestrus rate to body condition indicators at each cohort, for every HERD and PARITY level. The  $AF_p$  was calculated from the adjusted risk ratio that was estimated by adjusting a stratified logistic model, for each HERD and PARITY level, which explain AN by main categorical predictor of body condition status ( $CBC < 3$  or  $\Delta BC > -0.5$ ; yes/no), and adjusted by calving season, calving year, and parity.

**Results:** According to the AUC, the herd threshold in primiparous cows was the 2<sup>nd</sup> quartile ( $BC\% = 6\%$ , [ $AUC = 0.679$ ;  $OR = 4.545$ ;  $SE = 69.2\%$ ;  $SP = 66.6\%$ ]) in Herd A. Providing that these cohorts having more than 6% of cows with poor BCS had 4 times higher odds for having anestrus rates over the herd median, the predictive capacity is moderate due to the estimated AUC, Se and Sp. Similarly, the 2<sup>nd</sup> quartile ( $BC\% = 74\%$ ) in primiparous cows was defined as the herd threshold in Herd B [ $AUC = 0.673$ ;  $OR = 1.485$ ;  $Se = 66\%$ ;  $Sp = 68\%$ ]. Regarding multiparous cows, the herd threshold was set in the 3<sup>rd</sup> quartile ( $BC\% = 20\%$ , [ $AUC = 0.574$ ;  $OR = 2.212$ ;  $Se = 81.5\%$ ;  $Sp = 33.3\%$ ] in Herd A, and in the 1<sup>st</sup> quartile in Herd B ( $BC\% = 78\%$ , [ $AUC = 0.611$ ;  $OR = 3.448$ ;  $Se = 37\%$ ;  $Sp = 85\%$ ]).

The 21-day anestrus rate in primiparous and multiparous cows was higher in herd B than in herd A. In herd A, the median  $AF_p$  in multiparous was 0.36 [Inter Quartile Range (IQR)=0.58], which means that around 36% of anestrus events would have been avoided if no cows would have poor BCS (assuming a causal relationship between BCS and anestrus). On the other hand, multiparous cows in Herd B, most of the time anestrus events were fully explained by the BCS (median  $AF_p = 0.98$ ;  $IRQ = 0.51$ ). However, in those cohorts where anestrus incidence was high, the  $AF_p$  decreased in both herds.

**Conclusions:** We concluded that indicators of BCS are associated with the risk for anestrus at the herd, but their application as a monitoring tool has a limited predictive capacity. Therefore, other exploratory models such as those using impact measures (e.g.;  $AF_p$ ) could represent a more useful approach for monitoring performance during the transition period at the herd level.

**Keywords:** Body condition score, Anestrus, Herd monitoring, Dairy cows.

### HH-37

#### Comparative case of Automated Health Monitoring and Health Scoring systems for dairy suckling calves

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**Objectives:** Calf health control is one of the biggest challenges for dairy farms. Dairy producers have now access to new technologies to monitor the health of suckling calves,

improving proper health management. The aim of the following trial was to compare the efficacy of an automated health monitoring system vs an intensive standardized health scoring system in a US dairy nursery.

**Materials & Methods:** For 9 months, a total of 586 female calves were monitored from 1-2 days of age until day 90, at weaning. The animals were reared in single hutches and were nipple fed. An ear monitoring tag (Allflex® Livestock Intelligence™) was applied to automatically monitor the health of each calf. The tag monitors the calf's behavior on a minute-by-minute basis and uses a proprietary algorithm to calculate an individual health index every hour. The health index values range from 40 to 100. The lower the value, the more severely sick the calf is. All monitored calves were also evaluated daily using a modified Wisconsin scoring system. Data on milk refusals, treatments, and mortalities was also captured. Rectal temperature was additionally measured for calves with one or more of the following: milk refusal, a total respiratory score equal or greater than 4, a fecal score of 2 or 3. Based on the collected health records, each Sickness Event evaluated with the modified Wisconsin scoring system was classified as mild, moderate, or severe. Mild cases were not considered for treatment. Farm and trial personnel were blinded to all data calculated by the automated monitoring system.

**Results:** From the standardized health scoring evaluation, 522 calves (89%) had at least one sickness event, and 265 calves (45%) had at least one moderate or severe sickness event. Average length of sickness events was 2.6 days. According to the automated monitoring system, average of the minimal daily health index (HI) was  $97.51 \pm 0.02$  for healthy days. Average of the minimal daily HI was  $85.54 \pm 0.40$ ,  $82.03 \pm 0.52$ , and  $78.76 \pm 1.65$  for mild, moderate, and severe sickness events, respectively.

As the user can tune the desired sensitivity, the performance of the automated health monitoring system was evaluated using a HI score of 86 as a low sensitivity threshold for sickness (86-T), and 90 as a high sensitivity threshold (90-T). For 86-T, overall sensitivity and specificity were 63.6% and 96.9%, respectively. Sensitivity for mild, moderate, and severe cases was 56.7%, 73.3%, and 77.3%, respectively. For 90-T overall sensitivity and specificity were 75.7% and 92.4%, respectively. Sensitivity for mild, moderate, and severe cases was 71.1%, 82.2%, and 84.1%, respectively. Detection time (requiring continuous alert by the system) relative to treatment time by the farmer was 11 and 16 hours earlier for 86-T and 90-T, respectively. Severe cases detection time relative to treatment time by farmer was 27 and 37 hours earlier for 86-T and 90-T, respectively.

**Conclusions:** Our results indicate that the automated monitoring system (Sensehub Dairy, Allflex® Livestock Intelligence™) equals or betters an intensive health management system, while enabling to reduce the dependency on skilled labor. In addition, it provides the health index value that reflects the calf's sickness severity. Thus, providing another tool to improve health management and decision making.

**Keywords:** suckling calves, health index, monitoring, dairies.

## HH-38

**Changing the Course of Fresh Cows by Using Objective Monitoring**

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**Objectives:** The implementation of an effective postpartum health control program is probably one of the main management goals of dairy farms. It is estimated that approximately 75% of disease in dairy cows typically happens in the first month after calving (LeBlanc et al., 2006). Conditions such as ketosis, metritis, endometritis, displaced abomasum, and retained placenta have a direct negative impact on reproductive performance and milk yield during the current lactation. Choice and efficacy of postpartum health screening methods depend on many factors including farm size, labor experience, and facilities. Visual observation is probably the most often used but is not always accurate or efficient. The aim of this study was to evaluate the impact of using insights from an automated monitoring system (Allflex® Livestock Intelligence™) on postpartum cow health by measuring milk yield performance at week 4 post-calving in a commercial dairy farm in the US.

**Materials & Methods:** In May 2019, a US Midwest dairy farm, milking approximately 5,500 cows implemented the insights generated by an automated monitoring system (Allflex® Livestock Intelligence™) to identify sick animals in the postpartum period (calving to 4 weeks). Every postpartum cow was wearing a collar device that monitors cow behavior on a continuous basis. Based on these data, the monitoring system calculates a rolling health index (HI), estimating the possible sickness status based on individual animal pattern changes. The HI range is from 0 to 100; the lower the value the more probability of animals being sick. This system provides the user with a health report listing animals with a Health Index below 86 to be checked for sickness. Prior to May 2019, the postpartum group was locked up daily for individual visual health observation; body temperature was checked only if animals were identified as sick by the farm staff. Animals were treated following the farm protocol. Cows assessed as healthy were moved to the general lactation pens before passing 4 weeks post-calving. After the system was installed, only animals included in the health report were evaluated in the fresh pen, reducing the time the pen was locked up. The system also identified cows for whom the movement to the general lactation pen was too early or otherwise problematic. No other relevant transition management changes took place except the implementation of an automated monitoring system. To assess the impact of this monitoring system on that farm, the average milk yield and the percentage of cows producing less than 60 lb (27 liters) at week 4 post-calving were evaluated. Only cows in the 2nd or higher lactation that calved during 2019 and with milk yield data available at week 4 were included in this analysis. Comparative results pre and post implementing of the system were analyzed.

**Results:** The results for 3,501 cows which calved between January and December were analyzed. Out of 1,707 cows calved between January and June, 183 (10%) did not

reach 60lb (27L) at week 4 post-calving. Between July and December, after the automated monitoring implementation, 1,794 cows calved. Of these, only 29 (1%) failed to reach at least 60lb (27L) at week 4 post-calving.

Average milk yield at week 4 post-calving in cows (≥2 lactations) that calved between January and June was 101.4lb (45.9L). Cows with 2 lactations produced 103.8lb (47L), and cows with 3 or more lactations produced 99.5lb (45L). Average milk yield at week 4 post-calving (>2 lactations) in cows that calved between July and December was 105.6lb (48L). Cows with 2 lactations produced 103.5lb (47L) and cows with 3 or more lactations produced 107.2lb (48.6L).

**Conclusion:** The results of this study indicate benefits of implementing an automated monitoring system (Allflex® Livestock Intelligence™) for postpartum cow health on this particular farm. Objective health assessment compared to visual observation reduced labor skills impact and identified sicknesses earlier, in both the fresh and early lactation groups. This appeared to contribute to an improvement in daily milk yield by 4lb (2.1L) per cow and reduced the percentage of ≥2 lactation animals that did not reach 60lb (27L) at week 4 post-calving from 10% (calving from January through June) to 1% (calving July through December).

**Keywords:** Postpartum, health, monitoring, fresh cows, milk yield.

## HH-39

**Effect of twice vs. thrice milk replacer feeding/day on productive and health parameters in Holstein calves**

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**Objectives:** The management of calves and their health from the early stages is a fundamental aspect that can influence their entire productive life. Nutritional strategies during lactation are essential to ensure the proper growth of calves on the farm and their welfare. Historically, calves have been fed twice a day because producers milked cows twice a day. However, calves nurse their mothers more than 6 times per day. Therefore, the objective of this study was to compare two different nutritional management of dairy calves with an isocaloric diet administered twice or three times daily, evaluating its effect on productive and health parameters, up to 4-4.5m of age.

**Material & methods:** The study was carried out in a commercial rearing farm (Cowvet SL) in Valencia, Spain. We in-



cluded 288 Holstein calves between 5 and 38 days of age at entry, randomly distributed (block randomization controlling farm of origin and entry weight) into two feedings per day “2Fd” group or “3Fd” group, both groups of equal size ( $n = 144/\text{group}$ ). The diet consisted of 6l per day of milk replacer without casein, formulated specifically for the farm (7% protein, 17% fat, 0.1% fiber; 1% calcium; 0.6% phosphorus and all recommended trace elements and vitamins) until weaning. The calves had *ad libitum* starter and water from the day of entry. The parameters studied were: Weight (kg), Ultrasonographic score respiratory disease (USRD; 0-5; according to Ollivett and Buczinski 2016), backfat thickness by ultrasound (BF; mm; Schröder and Staufenbiel, 2006) and calf health score (CHS; 0-21, according to Mahendran *et al.*, 2017) at three moments: 1) Farm entry (16.9±8.6 days old); 2) Weaning (53.8±3.3d) and 3) Grouping in growing batches (148.2±27.4d). The average daily weight gain (AWDG; kg/d) was calculated between moments.

We analyzed the effect between the 2Fd and 3Fd groups at each time point using non-parametric tests (non-normal distributed variables). Differences over time and interactions between factors were assessed with repeated measures ANOVA, including weight and age at entry as covariates (IBM SPSS® Statistics v. 25.0). Data are expressed as mean ± standard deviation.

**Results:** Age at entry was kept in the model of repeated measures ( $P < 0.05$ ). We found no significant differences between the treatments at any moment for Weight (Entry: 43.5±6.5 vs. 44.1±7.7; Weaning: 63.8±7.4 vs. 64.9±8.8; Grouping: 163.2±32.3 vs. 162.3±32.9 for 2Fd and 3Fd, respectively); for USRD (Entry: 2.03±0.2, vs. 2±0.2; Weaning: 1.95±0.5 vs. 1.8±0.6; Grouping: 2.1±0.25 vs. 2.1±0.25 for 2Fd and 3Fd, respectively); for Backfat (Entry: 3.2±0.5 vs. 3.1±0.4, Weaning: 4.2±0.3, vs. 4.2±0.3, Grouping: 5.4±0.2 vs. 5.5±0.3 for 2Fd and 3Fd, respectively), and AWDG (Entry-Weaning: 0.5±0.2 vs. 0.6±0.2, Weaning-Grouping: 0.8±0.2, vs. 0.8±0.2, and Entry-Grouping: 1±0.3 vs. 0.9±0.2 for 2Fd and 3Fd, respectively).

The health score (CHS) was significantly ( $P < 0.05$ ) higher in the 2Fd group calves (1.8 ± 0.51 vs. 1.66 ± 0.57). This seems to indicate that feeding the calves three times per day could be associated with a better health condition of the calves until weaning, but we did not observe any effect of the treatment studied (two vs. three feedings) over time in any other variable assessed.

**Conclusions:** The nutritional regimen of three feedings/day could have a beneficial effect on lung health in rearing calves until weaning, but this improvement does not induce higher growth-rates, nor better health rates, long-term.

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**Keywords:** Nutritional Management, Rearing, Dairy, performance.

#### HH-40

### Efficacy of the oral administration of specific immunoglobulins against *e. coli*, Rota- and Coronavirus for the prevention of neonatal calf diarrhea in dairy herds

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**Objective:** The objective of the study was to evaluate the efficacy of a concentrate of specific immunoglobulins against *E. coli* F5/K99, Rotavirus and Coronavirus (Locatim®) given orally in addition to the dam's colostrum to the calves for prevention of Neonatal Calf Enteritis (NCE).

**Material & Methods:** A total of 489 calves from 35 central Swiss herds without history of vaccination against NCE were included: 246 in the LOCATIM® group and 243 in the PLACEBO group. Within herds, calves were alternatively given either 60 ml of LOCATIM® or PLACEBO orally shortly before the first colostrum meal. LOCATIM® is a biological medicament manufactured from colostrum of cows hyper-immunized against *E. coli* F5, Rotavirus and Coronavirus, containing high levels of specific IgG to be given orally to the calf during the first hours of life. Every calf received the dam's colostrum according to the routine practice of the farm.

The farmer registered the clinical scoring of diarrhoea during the first 14 days of life. Diarrhoea score was defined according to following criteria: 0=no diarrhoea; 1=light diarrhoea without medical treatment; 2=severe diarrhoea requiring oral treatment; 3=more severe diarrhoea requiring parenteral rehydration or leading to death. Before treatment, a faeces sample was analysed for the presence of pathogens with a rapid immunochromatographic strip test (Speed® V-Diar 4).

A colostrum sample of the first milking was taken by the farmer. After at least three feedings, blood samples were taken from each calf by a veterinarian. Blood samples were analysed for total protein and IgG concentrations as well as for titers of specific antibodies against Rotavirus and *E. coli* F5. Colostrum samples were analysed for total protein and IgG-levels.

**Statistical analyses:** Univariable Chi-square analysis

was performed for diarrhea scores against all explanatory variables. For the multivariable logistic regression analysis, all explanatory variables with a univariable Chi-square p-value < 0.15 were included in the starting model. Non-significant variables were successively withdrawn with backwards elimination until only variables with a p-value < 0.05 were included.

The titers of the specific antibodies were logarithmically transformed and means were compared using the Student's T-test. As the transformed variables were still slightly skewed, an additional comparison of the median was performed with a non-parametric Kruskal-Wallis analysis.

**Results:** In 28 of 35 herds (80%), at least 1 calf had some kind of diarrhoea. A total of 138 calves (28.2%) suffered from diarrhoea during our study, 65 calves (13.3%) showed moderate to severe signs of diarrhoea (scores 2/3) requiring treatment. Four calves died in the first two weeks of life (mortality rate 0.82%). All 4 calves received the placebo.

The proportion of calves with diarrhoea was significantly lower in the LOCATIM group (21 calves = 8.5%) than in the PLACEBO group (44 calves = 18.1%). The crude Odds Ratio (OR) was 0.42 (p = 0.002). In the final multivariable logistic regression model, the OR was even slightly lower (0.39, p=0.001).

There were no differences in serum total IgG or specific antibodies against *E. coli* F5 and Rotavirus within treatment groups and between sick or healthy calves.

**Conclusion:** Even in a region with good general management of dairy calves and good overall colostrum quality, the oral application of a concentrate of specific immunoglobulins against *E. coli* F5, Rotavirus and Coronavirus was effective to reduce the occurrence of NCE. The odds of getting NCE was statistically reduced (OR = 0.387) in the LOCATIM® group.

As the serum concentrations of IgG and specific antibodies measured 2-3 days after birth were not different between groups, the hypothesis concerning the mechanism of action for the clinical difference is that the protective effect was caused by antibodies present in the "kill zone" of the gut before the first contamination to support the local immunity in the very early phase.

Furthermore, the high level of the serum concentration of specific antibodies was possibly achieved earlier in the LOCATIM® group, leading to a more efficient protection against infection.

From a clinical point of view, the application of a sterile solution containing high levels of specific antibodies against *E. coli* F5, Rotavirus and Coronavirus given orally to the calf before the first colostrum meal, appears to be a valuable solution to reduce the risk of neonatal calf enteritis in addition to good management practices.

**Keywords:** Calves, Neonatal diarrhea, Prevention, Specific antibodies.

#### HH-41

### Cost-benefit analysis of vaccination against Bovine Respiratory Disease

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**Objectives:** Rearing young stock provides the future cows for a dairy farm. It entails, however, a large proportion of the cost price of milk (5-10 %). One of the diseases associated with rearing young stock is Bovine Respiratory Disease (BRD), which negatively impacts the health of the animal during its rearing phase as well as its performance during the first lactation. Vaccination is a possible management strategy against BRD. It reduces the number of cases in dairy herds but its cost-effectiveness has not been determined yet. The aim of this study was to assess the net economic benefit of vaccination against BRD.

**Materials and methods:** An existing calf level, bio-economic simulation model was adapted to first estimate the distribution of rearing costs under Dutch circumstances from two weeks of age until first calving and subsequently estimate the distribution of costs and revenues during the first lactation. The model simulates calf growth stochastically using a two phase growth function and incorporates the temporal uncertainties of BRD with the associated effects on morbidity and mortality until first calving. The model was extended with a Wilmink lactation curve and culling rules to simulate milk production and the associated effects of BRD throughout the first lactation until drying off. The model was adapted to compare the effect of two injections with a multivalent inactivated vaccine (Bovilis® Bovipast RSP, MSD Animal Health) at the age of 2 and 6 weeks with a default scenario without vaccination. An efficacy of 80% was assumed. All model input was based on scientific literature and, if not available, expert knowledge. Output of the model consisted of non-economic output such as BRD incidence, birth weight, first calving age, weight, milk production and culling incidence. Economic output included healthcare costs (vaccination costs, prevention costs and treatment costs), feed costs, barn costs, breeding costs, labour costs, depreciation costs, and milk and slaughter revenues. Total rearing costs and production revenues were estimated using 10,000 simulations. A sensitivity analysis was performed to investigate the effect of vaccine efficacy, BRD incidence risk, and other input parameters on the net economic benefit of vaccination.

**Results:** BRD incidence and death during the rearing phase and milk production of completed first lactations were 26.9%, 5.6% and 8117 kg on average, respectively, in the default scenario whereas they were 13.9%, 3.2%, and 8143 kg in the vaccination scenario. Reduced treatment costs (€4 vs €29 per animal) and reduced costs due to mortality (€41 vs €29) during the rearing phase only partially compensated the costs associated with vaccination (€25). However, increased rearing costs (€1727 vs €1735) were compensated by increased profits during the first lactation. Milk revenues (€2833 vs €2842) and revenues due to culling (€26 vs €28) were higher for the



vaccination scenario than for the default scenario. This resulted in an overall net economic benefit of €9 for each animal reaching its first dry-off. The model was sensitive to the BRD incidence risk and the efficacy of the vaccine. The net economic benefit became positive when the BRD incidence risk was around 18% assuming an 80% vaccine efficacy.

**Conclusions:** The estimates from this model are assumed to be conservative since only the effect of clinical BRD was simulated. Literature on production effects of subclinical BRD was scarce and was therefore not incorporated in the simulation model. Moreover, the vaccine efficacy of 80% was hypothetical given the lack of good data on this important input parameter. Nonetheless, this bio-economic simulation study showed that young stock vaccination against BRD is economically beneficial in dairy herds.

**Keywords:** Bovine Respiratory Disease, vaccination, cost benefit, dairy, Netherlands.

#### HH-42

### Conducting herd health program in large commercial dairy herds – impact on herd health and farm economy

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**Introduction:** Veterinary herd health and production management (HHPM) programmes are defined as certain activities aimed to maintain the health and productive capacity of farm animals at the most efficient level while ensuring the farm's competitiveness and profitability. Although implemented in several countries the content and methods of these programmes vary. The health and economic impacts of implementing HHPM in large commercial dairy farms are not widely studied and previous studies have even shown controversial results. The aim of the present study was to analyse the health and economic consequences of implementing dairy herd health programmes in large commercial dairy herds.

**Material and methods:** Five dairy herds with loose-housing cowsheds were enrolled in the study including roughly 100, 600, 600, 700 and 1700 dairy cows, respectively. Between April 2017 to March 2019 HHPM programme was implemented in these herds. In every quarter, four visits were performed by four herd health veterinarians covering the following topics: youngstock health and infectious diseases, udder health and milk quality, cow and heifer fertility, metabolic diseases and claw health. After each visit a summary report including analysis of the herd health data and the problem analysis together with recommendations for improvement was submitted to the farm managers. In all farms herd health and production-related data as well as farm treatment records were summarized on a monthly basis. Also, the following herd health related costs were analyzed routinely: cost for medicaments, value of discarded milk, heifer rearing costs related with delayed calving, lower milk yield associated with longer calving interval, costs for sperm and artificial insemination and extra charge or

discounts for milk fat and protein content. Changes in herd health, production and economic performance over two years were analyzed to evaluate the impact of the implementation of herd health programmes.

**Results and Discussion:** During the study period, cattle health improved in most areas that were consulted by the veterinarians. Still, in some farms an increase of disease incidence and associated costs occurred. In some cases this could be explained by an improved disease detection and more complete registration of the disease data instigated by the consulting veterinarians. In general, the incidence of first month calf diarrhoea reached below 20% by the end of the study in four herds but constant increasing trend of the diarrhoea incidence occurred in one herd. Cost of antimicrobials used for the treatment of calfhood diseases decreased by 56% on average over four farms (could not be analysed in one farm due to lack of data). On average, the length of calving interval decreased from 412 to 396 days across five farms. The level of somatic cell count decreased in two herds but increased in three herds. In total, the number of clinical mastitis cases decreased from 54.1 to 41.6 cases per 100 cow/year. The linear trend of subclinically infected mastitis cows decreased in four, but increased in one farm. Proportion of cows with a diagnosis of hoof diseases decreased from 27% to 22% within two study years averaged over five farms.

The positive impact of the HHPM implementation was also illustrated by the change in the economic performance of the farms. While the weighted average of the herd health related costs for the study period was EUR 22 per tonne of milk produced, the costs decreased by an average of EUR 7-8 per tonne of milk produced in four farms by the end of the study. The main economic costs associated with livestock health were the cost of medicines (36%), discarded milk (34%) and milk price discounts due to lower content of milk fat and protein (15%).

**Conclusions:** In general, implementation of HHPM programmes improved animal health and productivity and, as a result, the economic performance of the farms.

**Keywords:** Herd health, economy, dairy herd, commercial farm, Estonia.

#### HH-43

### Evaluation of Failure of Passive Transfer in neonatal dairy calves in the Netherlands

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**Objective:** The absorption of maternal immunoglobulins in the small intestine during the first 24 hours after birth, termed passive transfer, helps to protect the calf against common endemic disease organisms until its own immature immune system becomes fully trained and functional. Colostrum management is the single most important management factor in determining calf health and survival. Although good progress has been made in the past years, there remains a consider-

able opportunity for many dairy farmers. A recent US study reported Failure of Passive Transfer (FPT) to affect 15.6% of calves tested, indicating a need for continued efforts to improve colostrum management. The objective of this study was to obtain prevalence data on FPT in dairy calves in The Netherlands and to identify risk factors for FPT at herd level.

**Material and Methods:** Neonatal dairy calves (n = 274) from several commercial farms in the Netherlands were enrolled in the study. Only calves aged between 2 and 7 days were included in the trial.

Serum samples were tested at Royal GD Deventer (The Netherlands) with a validated turbidimetric assay on a clinical chemical analyzer.

Different cut-off values for FPT and for evaluation of colostrum management were used to analyse test results. A cut-off value for FPT was defined as a serum gamma-globulin level lower than 10 g/L (Gay, 1983); a second cut-off value of 15g/L serum gamma-globulins was also used based on studies by Furman-Fratczak and colleagues (2011) and Windeyer and colleagues (2014) showing that dairy calves with serum IgG levels greater than or equal to 15 g/L experienced lower rates of respiratory disease. In addition, the revised individual and herd-based evaluation standards by Godden and colleagues, 2019 were used. These include ranking in 4 categories: excellent ( $\geq 25.0$  g/L), good (18.0-24.9 g/L), fair (10.0-17.9 g/L), and poor (<10 g/L). These categories can be applied to individual calves and to the operation for herd-based evaluation based on the percentage of calves that should be represented in each category.

On each farm the following information was gathered to identify risk factors for FPT: number of lactating cows, young-stock raised on the dairy farm, number of animals younger than 1 year, number of animals between 1 and 2 years, average age at first calving, vaccination against respiratory disease, vaccination against scours, prevalence of scours, prevalence of respiratory disease and neonatal mortality.

**Results:** The average as well as the median of the serum gamma-globulin level in the sampled animals was 16 g/L ranging between 0 and 35 g/L. When using a cut-off value of 10g/L, 21% of the animals experienced FPT, while using a cut-off value of 15g/L would mean that 44% of the animals experienced FPT.

When using the four categories defined by Godden and colleagues, 11% of the samples were excellent, 33% good, 35% fair and 21% poor. These results are worse than the proposed distribution reflecting good colostrum management (>40% excellent, ~30% good, ~20% fair and <10% poor).

At the moment of submission of the abstract, the farm information was not collected yet. This will be presented in the final presentation during the World Buiatrics Congress. The aim is to identify risk factors for FPT on calf and herd level.

**Conclusion:** Depending on the used threshold 21 to 44 percent of neonatal calves in this study experience Failure of Passive Transfer. Although good progress has been made in the past years, there remains a considerable opportunity to improve the colostrum management practices on Dutch dairy farms.

**Keywords:** Failure of Passive Transfer, dairy calves, Netherlands, colostrum.

#### HH-44

### Feeding calves with pasteurized colostrum and milk improves health in heifers and has a positive long-term effect on their productive performance

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**Objectives:** The main objective of this study was to observe whether feeding female calves with pasteurized colostrum and cow's milk improved future reproductive performance, productive parameters and health over the course of the heifer-rearing process and the three first lactations.

**Materials and methods:** We carried out a study feeding calves non-pasteurized and pasteurized colostrum and cow's milk under the same environment and management conditions. Female calves born during 2013 and 2015 entered the study at 22 days of age, after having received pasteurized colostrum and milk (P group, n= 127) or non-pasteurized colostrum and milk (NP group, n= 134) during the first 21 days of life. All calves submitted to study showed a total serum protein  $\geq 5.8$  g/dL between day 2 and 5 of life. Calves were randomly grouped during the rearing period mixing animals from groups NP and P. During heifer rearing, reproduction parameters (number of artificial inseminations (AI) per pregnancy), production parameters (body weight (BW) and average daily gain (ADG)) and health parameters (Bovine respiratory disease (BRD) and diarrhea) were recorded. Productive (305-d milk yield, life milk yield and ADG), reproductive (AI per pregnancy and calving interval), and health parameters (milk somatic cell count (SCC/mL)) and age at culling were also recorded in a follow-up study for 6 years (2013 to 2019). Suitable statistical analyses were carried out to decipher the effects of the experimental group (P or NP) on productive performance throughout the study.

**Results:** A total of 261 female Holstein calves entered the study (134 in the NP group and 127 in the P group). Of these, 216 reached at least first parturition (NP=110 and P=106), 184 reached second parturition (NP=90 and P=94) and 139 reached third parturition (NP=71 and P=68). We did not observe significant differences in the probability of reaching the first, second or third parturition between the two groups.

Feeding on-farm pasteurized colostrum and milk during the first 21 days of life reduces morbidity of bovine respiratory disease during the first year of life and diarrhea during the first 180 days of life. In heifers that never reached first parturition (NP group=24 vs. P group=21), morbidity from both diarrhea ( $P=0.0492$ ) and BRD ( $P=0.2797$ ) was lower in the P than in NP group. Similar trends were seen in animals that reached first parturition and differences were significant for both diseases (BRD;  $P=0.02111$  and diarrhea;  $P=0.0341$ ). Moreover, it increases ADG from birth to first calving ( $P=670.5\pm 5.6$  vs.  $NP=616.2\pm 6.2$  g/day) and increases BW after first ( $P=531.7\pm 3.8$  vs.  $NP=492.6\pm 3.8$  Kg), second ( $602.2\pm 4.6$  vs.  $NP=575.1\pm 4.6$  Kg) and third lactation ( $P=645.9\pm 5.3$  vs.  $626.4\pm 5.3$  Kg). Finally, it also significantly increases milk production at first lactation ( $P=10,147\pm 160$  vs.  $NP=9,574\pm 209$  kg). However, there were no differences in relation to reproduction performance and health of cows between animals be-



longing to the NP or P group.

**Conclusion:** Colostrum and milk pasteurization for dairy calves improves health and production parameters in heifers and cows, and has a positive long-term effect on cow's production parameters.

**Keywords:** Colostrum, milk, pasteurize, long-term effects, dairy.

#### HH-45

### Is Brix refractometry an appropriate on-farm tool for measuring the IgG concentration in colostrum of Belgian Blue cows?

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**Objectives:** Transfer of passive immunity through the administration of colostrum is essential in bovine neonates because the epitheliochorial placenta of cows is impermeable for immunoglobulins (Ig). Adequate transfer of passive immunity can only be achieved when calves are fed sufficient amounts of good-quality colostrum shortly after birth. Colostrum quality is mainly determined by its concentration of immunoglobulins. However, the degree of bacterial contamination can have a negative impact on the intestinal absorption of these Ig's. The aim of the present study was to evaluate the quality of colostrum of Belgian Blue cows considering not only the IgG concentration but also the bacterial load of the colostrum. Additionally, the accuracy of indirect evaluation of the IgG concentration of colostrum from Belgian Blue cows by means of a digital Brix refractometer was assessed, as this is considered a handy cow-side on-farm tool.

**Materials & Methods:** For this field study, 23 Belgian bovine practices participated in the collection of colostrum from freshly calved Belgian Blue cows. On 69 commercial Belgian Blue farms, a total of 76 colostrum samples were collected. Sampling occurred immediately after caesarean section. Colostrum samples were stored at -20°C until further processing. IgG concentrations were measured using a commercial competitive ELISA-test kit (BIO K420, MonoScreen QuantELISA Immunoglobulin Easy, Bio-X Diagnostics S.A., Rochefort, Belgium). Indirect evaluation of the IgG concentration of the colostrum samples was performed using a digital Brix refractometer (Milwaukee Refractometer MA871, Milwaukee Instruments Inc., NC, USA). On each occasion, the mean of three consecutive Brix refractometric measurements was calculated and used for analysis. The relationship between the IgG concentration and the Brix value of the colostrum samples was investigated with a Pearson's correlation. Total bacterial cell count of the colostrum samples was determined using a bactoscan automatic bacterial count reader (Bactoscan™ FC+, FOSS, Denmark). Colostral IgG concentrations of < 50 g/l or a colostral Brix value of < 22% were considered as poor-quality colostrum. Furthermore, colostrum samples with a total bac-

terial cell count of > 100.000 CFU/ml were also classified as poor-quality colostrum. All statistical analyses were performed using R software (R Core Team, 2017).

**Results:** Colostrum from Belgian Blue cattle contained on average 81,24 ± 24,90 g IgG/l. The IgG concentration ranged from 24,90 to 150,00 g/l. The Brix value of the colostrum from Belgian Blue cattle had a mean of 25,27 ± 4,05 % (range: 16,77 – 36,40 %). A low non-significant negative correlation was found between the IgG concentration and the Brix value of colostrum samples from Belgian Blue cows ( $r_{\text{pearson}} = -0,16$ ;  $CI_{95\%} [-0,38 \text{ to } 0,07]$ ;  $p = 0,172$ ). The bactoscan values of the colostrum samples were highly skewed and were, therefore, analysed using non-parametric methods. The colostrum samples from Belgian Blue cattle had a median total bacterial cell count of 5.500 CFU/ml (range: 4.000 – 390.000 CFU/ml). The IgG concentration was lower than the norm of 50 g IgG/l in 8,22 % of the colostrum samples. The total bacterial cell count was above the acceptable threshold of 100.000 CFU/ml in 5,48 % of the colostrum samples. Combining these two quality parameters (IgG concentration and bacterial count) 13,7 % of the colostrum samples were classified as poor-quality colostrum.

**Conclusions:** The colostrum quality of Belgian Blue cows can be classified as high since 92 % of the samples had an IgG concentration of at least 50 g IgG/l. Concerning bacteriological contamination, 95 % of the colostrum samples from Belgian Blue cattle were clean, defined as < 100.000 CFU/ml. When both quality criteria are taken together, more than 85 % of the colostrum samples from Belgian Blue cows fulfilled the requirements for high-quality colostrum, suitable for administration to new-born calves. In this study, no correlation could be found between the IgG concentration, as measured by competitive ELISA and the digital Brix refractometric value of colostrum from Belgian Blue cows. Hence, Brix refractometry seems inaccurate for the assessment of IgG concentration in Belgian Blue cow's colostrum.

**Keywords:** Belgian Blue cattle, colostrum quality, IgG concentration, Brix refractometry, Total Bacterial Count.

#### HH-46

### Evaluation of metabolic health by pooled sample metabolic profiling on 305 Flemish dairy herds

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**Objectives:** Monitoring metabolic health of transition cows using pooled serum sample metabolic profiling (PMP) has been well described and reduces laboratory costs con-

siderably. PPM, including 21 biomarkers, was commercially introduced in Flanders (Belgium) by Animal Health Care Flanders (DGZ) in October 2020. Furthermore, DGZ developed an interpretation tool which presents results in a web diagram containing 8 metabolic key areas (Metabolic Scan). Study objectives were to evaluate metabolic profile results for close-up, fresh, and peak lactation cows from Flemish herds pooled and analyzed at the DGZ-laboratory between 12 October 2020 and 12 December 2021.

**Materials and methods:** A retrospective analysis was carried out. Beef cattle samples, incomplete and outlier results were excluded (50 profiles and 42 herds). Finally, 368 submissions from 305 different farms were analyzed and included 288, 265, 245 pooled sample metabolic profiles of following production groups: close-up (P1: 21-3 days prior to calving), fresh (P2: 3-21 days in milk (DIM)), and peak lactation (P3: 60-120 DIM) cows, respectively. Statistical analysis was performed using JMP computational software (version 15, SAS Institute Inc.). Evaluation included pool results and corresponding percentages of abnormal values per pool (methodology of Van Saun) for the following biomarkers: albumin, alpha, beta and gamma globulins, total protein (TP), beta hydroxybutyrate (BHB), calcium (Ca), chlorine (Cl), creatinine, phosphorus (P), magnesium (Mg), sodium (Na), potassium (K), non-esterified-fatty-acids (NEFA), selenium (Se), urea, vitamin E, copper (Cu), zinc (Zn), gamma glutamyl transferase (GGT) and beta-carotene. Based on the biological significance for interpretation, individual biomarker results were assigned to metabolic key areas. Subsequently, results were converted into the percentage of animals at risk for these 8 key areas: Ketosis-negative energy balance (NEB-ketosis): BHB and NEFA; water intake: Cl and Na; liver function: GGT and urea; Cu and Zn; macro minerals: Ca, Mg and P; antioxidants: vitamin E, Se and beta-carotene; inflammation: alpha and gamma globulins, TP; dry matter intake (DMI): TP, albumin and urea. The key area results were categorized into 2 groups: CatA (0-20% at risk) and CatB (21-100% at risk).

**Results:** We found that 23%, 31% and 46% of the submissions contained 1, 2 or 3 production groups, respectively. The mean herd size was 187 (range 25 to 1955). Herd numbers located in Antwerp, Limburg, East Flanders, West Flanders, and Flemish Brabant (provinces) were 104, 21, 73, 94 and 13, respectively.

The following results concerning CatB are in order of P1, P2 and P3, respectively. In the NEB key area, 48, 58 and 42% were classified in CatB. The key area of water intake showed 39, 22 and 24% in CatB. In the key area liver function 47, 35 and 22% of the samples were found at CatB level. For the key area Cu and Zn 83, 82 and 78% were found in CatB. The macro mineral key area showed 18, 20 and 9% CatB results. For the antioxidant status, the percentages were 75, 55 and 26 respectively. In the inflammation key area 41, 46 and 22 % was found. Finally, the DMI key area showed 72, 54 and 22% in CatB for P1, P2 and P3 respectively. Significant correlation ( $p < 0.05$ ) was found between key area percentages of all 3 production groups for NEB-ketosis, water intake, Cu and Zn, antioxidants, and DMI.

**Conclusions:** A considerable proportion of metabolic profiles showed signs of NEB-ketosis, most prominent in P2 and P1, but still proportional in P3 animals. Suboptimal water in-

take was seen most frequently in P1. For key areas, liver function, antioxidants and DMI, P1 was most often impacted, followed by P2, whereafter P3 seems to recover. Big deviations were found for Cu and Zn key area in all production groups. Further investigation is needed to see whether a low uptake, a poor homeostatic character of both elements or an erroneous reference value is responsible for this observation. The macro mineral key area showed the least deviation within all production groups. A state of inflammation was most often found in P2, followed by the P1 cows. Key area's NEB-ketosis, water intake, Cu and Zn, antioxidants and DMI showed correlation in percentages of animals at risk for all 3 production groups, indicating a need for further evaluation of farm management, feeding, cow comfort, animal welfare and preventative strategies.

**Keywords:** Metabolic profiling; pooled samples; transition.

#### HH-47

#### Effect of initial health status in Holstein calves on production and health parameters

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**Objectives:** Health status can affect productivity and growth especially in the first growth periods of calves. The animals, at farm entry, are evaluated for their health status using a "calf health score" (HSc; Wisconsin Health-Score; Mahendran et al., 2017), which evaluates different health aspects simultaneously (rectal temperature, cough, nasal discharge, eye discharge, ear posture and fecal score), giving a higher score to those animals with the worst health status (0-21). The aim of this study was to evaluate how different productive and health parameters evolved in animals up to 4-4.5m of age with different health status at farm entry.

**Material & methods:** We randomly selected 235 calves from a commercial rearing-farm (Cowvet SL), Valencia, with an entry age of 5-38 days of age. All animals were evaluated by a modified version of the Wisconsin-Health-Score, and we categorized them into three study groups: HSc1 (HSc value=1; n=70), HSc2 (value=2; n=128) and HSc3 (value=3; n=37). We did not select calves with a value > 3 (only 5 individuals). Calves had *ad libitum* starter and water from the day of entry. The parameters studied were: weight (kg), ultrasonographic score respiratory disease (USRD; 0-5; according to Ollivett and Buczinski 2016), backfat thickness by ultrasound (BF; mm; Schröder and Staufenbiel, 2006) and HSc at three moments: 1) Farm-entry (17.7±8.6 days old);



2) Weaning ( $53.8 \pm 3.3d$ ) and 3) Grouping in growing batches ( $148.2 \pm 27.4d$ ). The average daily weight gain (AWDG; kg/d) was calculated between moments.

We analyzed the effect among groups at each time point using ANOVA and Tukey test for the means comparison ( $P < 0.05$ ; SAS® 9.0). Data are expressed as mean  $\pm$  standard deviation.

**Results:** Health status at farm entry was associated with higher values of USRD ( $P < 0.05$ ;  $1.96 \pm 0.2^a$ ,  $2 \pm 0.1^a$  and  $2.11 \pm 0.3^b$ ) and BF ( $P < 0.05$ ;  $3.07 \pm 0.4^a$ ,  $3.25 \pm 0.5^b$  and  $3.23 \pm 0.5^{ab}$ ), indicating that this initial classification by health status is related to pulmonary status and physical condition of the animal. At Weaning, we observed a lower weight in animals with worse HSc at entry ( $P < 0.05$ ;  $66.1 \pm 8.4^a$ ,  $63.1 \pm 7.8^b$  and  $62.5 \pm 7.7^b$  for HSc1, HSc2 and HSc3 respectively) and again a lower BF in animals with a worse health status ( $P < 0.05$ ;  $4.25 \pm 0.3^a$ ,  $4.14 \pm 0.25^b$  and  $4.21 \pm 0.25^{ab}$  for HSc1, HSc2 and HSc3 respectively). However, at the moment of Grouping there were no significant differences in any of the variables. This could indicate that the initial health status slightly retards the growth rate until, at least, weaning, recovering later, with the AWDG reduced exclusively until weaning ( $0.634 \pm 0.21^a$ ,  $0.543 \pm 0.21^b$ ,  $0.551 \pm 0.17^{ab}$  for HSc1, HSc2 and HSc3 respectively), and a compensatory growth when the animals improved their health status. The Health Scoring showed how the animals reached similar health values, regardless of the HSc value at entry, showing the animals an average HSc of  $1.7 \pm 0.5$  at weaning and  $2.1 \pm 0.25$  at Grouping. Ultimately, all animals showed a similar, slightly increased health score, but no overcoming the value 6 (related to clinical condition). It is to highlight, the generally low HSc observed at this rearing farm.

**Conclusions:** The initial health status of the animals, even when very low ( $< 4$ ) slightly reduces the growth of rearing calves until weaning, but after this period the animals compensate the growth and achieve a similar state of health.

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**Keywords:** Health Score, Dairy, rearing farm, performance.

#### HH-48

### Effect of dairy heifer pre-breeding growth rate on first lactation milk yield in spring-calving, pasture-based herds

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**Objectives:** There is evidence that early life growth rate can have positive effects on future milk production, however very little is known about the impact in seasonal, pasture-based dairy systems. Therefore, the objective of this study was to investigate the association between pre-breeding growth rate and first lactation milk yield in spring-calving, pasture-based dairy herds.

**Methods:** Heifer calves ( $n=399$ ) from a convenience sample of seven commercial, spring-calving dairy herds were weighed at birth and prior to breeding. Average daily gain (ADG) was calculated. Following first calving (22 to 27 months old), milk recording data were collected from the 265 cows that completed their first lactation using a minimum of three recordings/cow. Milk yields (305-day) were then standardised according to fat and protein content. A mixed linear regression model was used to investigate the relationship between ADG and milk yield.

**Results:** The final model included farm and month of calving within year as random effects. Heifer ADG was quadratically related to first lactation standardised milk yield. An ADG of 0.82kg/day was associated with maximum predicted yield. A heifer with an ADG of 0.82kg/day was predicted to yield 1120kg more than a heifer growing at 0.55kg/day, 218kg more than a heifer growing at 0.7kg/day and 103kg more than a heifer growing at 0.9kg/day. Age at first calving and predicted transmitting abilities for protein production and calving interval were also significant in the final model.

**Conclusions:** Pre-breeding ADG was quadratically related to first lactation milk yield, with an ADG of 0.82kg/day associated with maximum predicted yield.

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**Keywords:** Heifer, average daily gain, milk yield.

## HH-49

**Systematic evaluation of different fresh cow monitoring procedures**

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**Objectives:** Intensive and well-structured monitoring of fresh cows is considered beneficial for the health and well-being of the cows and is an important factor for the success of the cows' further lactation. Due to the various metabolic and infectious diseases caused by a negative energy balance at the time of calving, fresh cow monitoring can become a very time-consuming task. However, currently it is necessary to lock up the animals for examinations and treatments, which restricts their natural behaviour and thus has a negative impact on the health and performance of the herd. However, performing this important but time-consuming examination during the fresh cow period without excessively affecting the animals' natural behaviour is often a challenge, especially when many animals need to be examined on larger farms. Automated monitoring by use of 'precision livestock farming' technologies is progressively applied on farms to identify animals at risk of disease at an early stage and to reduce routine examination times. Determining the exact times that cows are fixed in headlocks for examinations and treatments under practical conditions can be used to evaluate existing and develop new management strategies. This is particularly important for practitioners that want to develop time- and cost-efficient management strategies while minimising the impact on the dairy cow's time budget. PLF technologies could be a support here to reduce the fixation times of cows in headlocks and stuff working hours.

The aim of the study was to describe in detail the time required for routine examinations in the fresh cow area as well as the total duration each cow stayed in headlocks during these examinations.

**Material and methods:** This study was conducted from June 2021 to August 2021 on a commercial dairy farm in Germany, housing approx. 1,900 Holstein-Friesian dairy cows. Different methods of fresh cow monitoring procedures were compared against each other. These included, on the one hand, different routine examinations of fresh cows, on the other hand, three different workflows (systems) which differ in the order of examinations and treatments.

Prior to conducting the study, standard operating procedures (SOPs) were prepared in which the various examination and treatment steps, in particular the start and end times, were specified. For this purpose, the working times for conducting individual examination steps as well as the resulting fixation time of the animals were systematically recorded.

Sixteen digital observation cameras (network camera HYU-405, HYUNDAI Corporation, Korea) were installed in the fresh

cow pen and recorded the fresh cow management procedures during the morning. Mangold-Interact (version 17.1.0.0, Mangold International, Arnstorf, Germany), a specialized software for visual evaluation of video footage, was used to analyze the time required for specific fresh cow management procedures. In total, 3973 examination steps and 1848 headlock times per cow were eligible for statistical analyses. For comparison of the different systems as well as the examination steps, performed by the investigators, the Kruskal-Wallis test, respectively the analysis of variance (ANOVA) was used.

**Results:** Overall, the most frequently observed examinations were temperature measurement (n=2239, 56%), percussion-auscultation (n=329, 8.2%), succession-auscultation (n=325, 8.1%), and rumen fill estimation (n=217, 5.4%). The different examinations lasted on average between 1 and 115 seconds. Significant differences in the time needed to perform specific examinations were identified between the investigators.

The resulting fixation time differed significantly between the three different fresh cow management systems ( $P < 0.05$ ). The animals were fixed in headlocks between 1 and 106 minutes.

**Conclusion:** Although significant differences in the examination times of different investigators were identified, these can be neglected from a practical point of view. Significant differences in the fixation time of the animals in the headlocks were determined based on the order in which the animals were examined and treated. The results of this study can be used in the future to develop optimal management strategies that consider cow needs, available labour and other economic factors. In this context, it could also be evaluated what contribution PLF technologies can make to reduce fixation times of cows in headlocks and stuff working hours.

**Keywords:** Dairy cow, health monitoring, transition period, accelerometer, fresh cow.