Dairy RESEARCH REVIEW™

Making Education Easy

Issue 28 – 2021

In this issue:

Welcome to the latest issue of Dairy Research Review.

Included in this issue are an exploration of perceptions of lameness and its management, an investigation of the mid-diaphysis as a predictor of humeral fracture risk in NZ heifers, and an assessment of the effect of herd fertility and use of sexed semen on farm net profit. Also featured in this issue are a review article providing a critical appraisal of vaccines for bovine mastitis and an evaluation of the use of milk sample somatic cell count to identify major pathogen intramammary infection.

We hope that you enjoy this issue of **Dairy Research Review**. Your input is important so please keep sending us your comments and feedback.

Kind regards

Hamish Newton

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Cow-level risk factors for clinical mastitis in the dry period in cows treated with an internal teat sealant alone at the end of lactation

Authors: McDougall S et al.

Summary: This observational study attempted to identify potential cow-level risk factors for clinical mastitis during the dry period in cows that received internal teat sealant (ITS) alone at drying off, as well as associations with elevated somatic cell count (SCC) at the first herd test, or clinical mastitis in the subsequent lactation. Ten herds reporting an incidence of clinical mastitis during the dry period of >3% in cows infused with ITS at the end of lactation were enrolled. Of 2,401 cows that received ITS, 196 (8.2%) were diagnosed with clinical mastitis during the dry period. Cow age, milk yield before drying off, and timing of drying off were associated with risk of clinical mastitis in the dry period following infusion of ITS at the end of lactation. A higher risk of clinical mastitis and of elevated SCC in the subsequent lactation was apparent in cows diagnosed with clinical mastitis over the dry period.

Comment: As the title tells us, this paper looked at cow-level risk factors for suffering from mastitis in the dry period post infusion with an ITS – not herd-level risk factors that might predict the likelihood of an outbreak of dry period mastitis. The data was extracted from 10 herds that had reported a >3% incidence of clinical mastitis during the dry period among the cows that received an ITS alone at the end of lactation. The factors that increased the risk that a cow would suffer from dry period mastitis were being >4 years old and producing >10 L at the last herd test relative to younger cows. The risk was also increased if a cow was dried off in the last week of her herd's lactation. It is tempting to take the risk factors found in this study and apply them to all cows in all herds but these cows came from herds that had a self-reported issue with dry period mastitis. This is really the opposite of "survivor bias" as we do not know about cows in herds that did not have an issue with dry period mastitis. What I find more informative is that 3.3% of cows from seven herds had an elevated SCC (>120K for heifer or >150K for a mixed-age cow) at the last herd test and 6.5% of cows in nine herds had an elevated SCC during the season. Eight farms also reported that the dry off process did not follow best practice either (contaminated teat wipes, teeth to remove caps, full insertion of canula, etc). To me the value in this paper is reinforcing the importance of correct cow selection and correct administration. It would be great to know about farms that do not have issues and how far they deviate from best practice.

Reference: N Z Vet J. 2021;69(6):327–336

Abstract

Invited review: a critical appraisal of mastitis vaccines for dairy cows

Authors: Rainard P et al.

Summary: This review of past and current research on mastitis vaccines for dairy cows reveals similarities and differences among mammary gland infections associated with the major mastitis pathogens *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus uberis*, *Streptococcus agalactiae*, and *Streptococcus dysgalactiae*. The authors also discuss the main approaches used to design vaccines targeted at the major pathogens for the mammary gland and appraise current vaccines and those in development. Relating efficacy to vaccine-induced defence mechanisms, they identify some possible reasons for current vaccine failings.

Comment: Vaccines are topical now. This paper looks at where we are at for vaccines against bovine mastitis especially as we are looking for ways to reduce the usage of antibiotics in food producing animals. As expected, there is a large section on the J5 vaccines against *E.coli* and to keep the vaccine conspiracy theorists happy the mechanism by which these vaccines work is not fully understood. The section on vaccine development against *S. uberis* also finishes with statements such as "questions regarding the immune mechanisms that are inefficient in controlling *S. uberis* mastitis remain unanswered". Approaches that have been taken included vaccinating against the plasminogen activator PauA, which is used by *S. uberis* for getting peptides for nutrition, but PauA is not required if the *S. uberis* is in milk. Another approach has been to vaccinate against *S. uberis* adhesion molecule (SUAM) but this was not effective. Yet another approach has been to vaccinate against biofilms that *S. uberis* can live in and could be used to resist the mammary gland's immune defences. In summary, the vaccines developed to date have not met expectations. There are a few reasons proposed for this and the simplest to understand is that we have bred cows to make huge amounts of milk and this waters down the immune defences. Other issues are that passive movement of antibodies from blood to milk is low and that active transfer favours IgG_1, which does not act as an opsonin for neutrophils. The authors also point out there has been a great deal of attention focused on antigens and adjuvants (vaccinology) and relatively little on the induced immune response (immunology) so perhaps more research effort focused on the immunology could lead to a breakthrough.

Reference: J Dairy Sci. 2021;104(10):10427–10448
Abstract

Dairy farmer, hoof trimmer, and veterinarian perceptions of barriers and roles in lameness management

Authors: Wynands EM et al.

Summary: Using focus group methodology, these US researchers evaluated perceptions of lameness, perceptions of roles in lameness management, and barriers to improved lameness management among farmers, hoof trimmers, and veterinarians. Participants viewed lameness as a highly complex management challenge, highlighted that multiple stakeholders have a role in lameness management, and considered lameness to be a shared responsibility on a dairy farm.

Comment: This paper reports on a series of focus groups for farmers, hoof trimmers, and veterinarians on the topic of lameness management. There were two themes analysed. The first was "lameness as a management challenge". Reflecting where this study was undertaken (Minnesota and Wisconsin), digital dermatitis was most commonly discussed, but I think the problems identified are still applicable to us. Lameness was identified as a complex management problem (connections between facilities, pathogenesis, and management) and not easy to change and appeared to lead to some resignation that lameness was inevitable. Veterinarians and hoof trimmers agreed that farmers did not always notice lame cows in their own herd, and it can become common place or normalised. The advisors (hoof trimmers and veterinarians) saw their role as having three components: 1) technical, such as trimming, treating, and verifying foot bathing protocols were being followed; 2) consultative, such as preventative strategies, goal setting, education, and monitoring; and 3) as advocates for the cows. Hoof trimmers are becoming more common in NZ, and we should or could try to work closely with them. In the introduction was a summary of Main et al. 2012 that pointed out that "the reduction of lameness over time was greatest on farms that were monitored and offered support from researcher and veterinarian stake holders, compared with farms that only received monitoring". So, if part of your service offering is lameness monitoring it seems that lameness scoring alone might not result in improvement (but will fill in a box on an audit sheet). You might also need to provide support to elicit change, and the art or science is deciding what to change to reduce the incidence of lameness, which all participants in this study agreed was a complex problem.

Reference: J Dairy Sci. 2021;104(11):11889–11903
Abstract

Reproductive hormone use and its association with herd-level factors on Dutch dairy farms

Authors: van der Laan JSM et al.

Summary: The objective of this study was to estimate reproductive hormone use on a representative number (n=769) of year-round calving dairy farms in the Netherlands and to gain insight into herd-level factors that are associated with reproductive hormone use. The proportion of the dairy farms not using any reproductive hormones was small (5.8%). Prostaglandins were the most frequently used reproductive hormone (62.9%), followed by GnRH (33.1%) and progesterone (4.0%). Participation in a herd health management programme and use of an automatic milking system were associated with greater use of reproductive hormones. The presence of pedometers or activity monitors did not influence the quantity of reproductive hormones but these technologies were more often present on farms that used reproductive hormones.

Comment: As the title suggests, this study looks at the herd-level use of hormones on Dutch dairy farms. It is not really comparable to NZ farms, as hormones in Holland can only be used in a curative manner to treat fertility disorders and so are used to treat "disease" such as ovarian cysts, pyometra, or repeat breeders diagnosed at the individual cow level. This is quite different to NZ where most reproductive hormones we use are to synchronise ovulation in groups of cows. The authors draw attention to the potential for consumers to become concerned about the use of hormones in food production as has happened with antimicrobials. If they are right about consumer concern, we might not look too good by the volume of hormones used. Synchronisation programmes using multiple hormones or repeated doses of hormones result in quite a few mg (or however you want to measure quantity) being administered. We may not look too bad if hormone use is measured by the percentage of cows in a year that get a hormonal treatment. In this study, between 22% and 24% of cows got prostaglandin in a year and between 11% and 13% of cows got GnRH per annum. Herds that were participating in a veterinary herd health management programme were more likely to use reproductive hormones. Additionally, these herds if using hormones used them at a higher rate.

Reference: J Dairy Sci. 2021;104(10):10854–10862
Abstract

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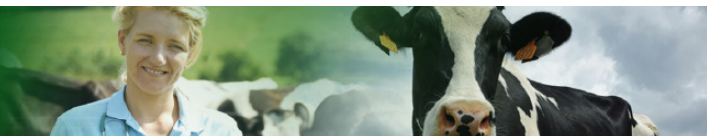


Economic impact of different strategies to use sex-sorted sperm for reproductive management in seasonal-calving, pasture-based dairy herds

Authors: Ruelle E et al.

Summary: These researchers used the Pasture Based Herd Dynamic Milk Model to investigate the effect of herd fertility and use of sex-sorted semen (SS) on farm net profit in a herd of 100 cows. Simulations were performed for herds with differing fertility performance and differing farm reproductive management. The method of allocating SS to cows was also examined. The results suggested that SS has considerable potential to facilitate greater integration between the dairy and beef production sectors, as well as to increase farm profitability when used appropriately.

Comment: One way to minimise the reputational risks associated with the production of bobby calves is to produce more calves with good beef merit. These Irish researchers modelled using SS to produce the female replacements and breeding all other cows to easy calving short gestation bulls with high "beef merit". Different scenarios were modelled. The first examined the effect of the fertility of the cows and there were three options, high, average, or low fertility, with a first service conception rate of 60%, 47%, and 37% respectively. There were also different insemination scenarios. The conventional scenario was mating with conventional semen until 50 cows were modelled as pregnant to get 25 heifer replacements then switching to beef semen (modelled herd size was 100 cows). For SS, three scenarios were modelled until 28 cows became pregnant (assumed 90% of those pregnancies were female). In one scenario, SS was used on the first cows to come up for artificial insemination (AI) until 28 pregnancies were obtained. In the second scenario, SS was prioritised for animals with a high predicted chance of conception (heiffers and mixed-aged cows with good body condition score [BCS], days in milk, no dystocia). The third scenario was basically the same as the previous one but selected cows/heifers were synchronised to receive fixed-time AI on the first day of mating. The final scenario examined the effect of the relative conception rate of SS compared with conventional semen and was allowed three options, 100% (no reduction), 85%, or 70%. If the relative conception rate to SS was ≥85% relative to conventional semen, a slight increase in farm profit was predicted. There was also an expected increase in profit if using SS in selected cows or synchronised cows if the underlying herd fertility was average or poor. The biggest take-home message was that farm profit was most influenced not by whether or how SS was used but by the underlying fertility of the herd. "An improvement in herd phenotypic fertility performance could come from either improving the genetic merit for fertility traits in the herd or improved fertility management such as optimal BCS and energy balance at insemination". What was not measured is the better alignment between what calf rearers want and when they want them, i.e. white face calves could be collected in August rather than mid-September.

Reference: J Dairy Sci. 2021;104(11):11747–11758
Abstract

The mid-diaphysis is a poor predictor of humeral fracture risk indicating that predisposing factors are recent

Authors: Gibson M et al.

Summary: The objective of this NZ study was to compare bone morphology in the mid-diaphysis of the metacarpus and humerus of heifers affected and unaffected by spontaneous humeral fractures, and to assess the effect of copper status at death on bone morphology. A total of 29 metacarpals and 30 humeri (29 sets) were obtained from 2-year-old dairy cattle, which had died from non-bone-related issues, and scanned using peripheral quantitative computed tomography (pQCT). The mid-diaphysis was shown to not be a useful model for identifying at-risk heifers, but the data did provide indications for the temporal pattern of nutritional challenge that is associated with humeral fractures.

Comment: Personally, I saw far fewer heifers with fractured humerus' this spring than previously. I do not know if there were fewer, or farmers have come to accept them, or farmers did not like the mess I left behind when I collected samples to send to the Massey Researchers who are the authors of this paper. These fractures seem to happen in heifers with lower cortical bone thickness and as a result have decreased bone strength. It is obviously difficult to measure this to predict whether a farm will suffer from an outbreak of this condition. At present, it seems the best we can do is wait for the first fracture to occur and tell the farmer to expect more and we are probably too late to alter anything to prevent more occurring this season by increasing bone strength. What is potentially accessible for measurement without a post-mortem though is the mid diaphysis of the metacarpus by pQCT. Metacarpal bones and humerii were compared between control heifers (died/culled for other reasons) and the bones sent in by many of you. The endosteal circumference of the metacarpal bones was greater and the bone density was less in the affected heifers than the control heifers. In the humerus, the cortical bone density was the only measure that was significantly different between affected and control heifers. In general though, there was not much difference in the mid diaphysis of either the metacarpus or humerus of the control or affected heifers. As these fractures originate at the metaphysis, and what is measured in the diaphysis represents what is likely to have occurred in the first year of life, this paper supports that whatever is predisposing heifers these fractures is recent. It seems at this stage the answer probably lies in the second winter and the missing clues might be found in the metaphysis.

Reference: Ruminants. 2021;1(1):23–30
Abstract

Prepartum level of dietary cation-anion difference fed to nulliparous cows: acid-base balance, mineral metabolism, and health responses

Authors: Zimpel R et al.

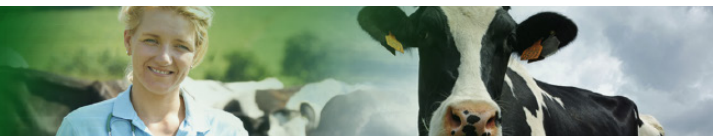
Summary: The objectives of this study were to determine the effects of manipulating the mineral composition of prepartum diets to result in three levels of dietary cation-anion difference (DCAD) fed to nulliparous cows on pre- and postpartum performance and reproductive responses. A total of 132 pregnant nulliparous Holstein cows at 250 (248–253) days of gestation were blocked by genomic merit of energy-corrected milk yield and assigned randomly to diets varying in DCAD (an alkalogenic, a moderately acidogenic, or a severely acidogenic diet). The investigators concluded that the data did not support the need to feed acidogenic diets to improve productive performance in nulliparous cows, but it might influence reproduction.

Comment: Despite many systems not allowing us to manipulate our pre-calving diets to really drive the DCAD down to levels reported here, we still get asked about DCAD diets and many pre-calving diets and supplements are used to try and acidify the cows. This paper looks at whether it is beneficial or even detrimental for first calves to be exposed to DCAD diets. The diets used here were formulated to achieve DCADs of +200, -50, or -150 mEq/kg of dry matter (DM). Reducing the DCAD prepartum resulted in a linear decrease in DM intake (DMI). The cows fed the +200 DCAD diet remained in positive energy balance until 7 days prior to calving. Cows in the -150 DCAD diet were in negative energy balance by 17 days pre-calving. Mean body weight and daily weight gain pre-calving decreased linearly with reducing DCAD. Postpartum, however, DMI and energy balance were not affected by pre-calving DCAD and neither were colostrum and milk production, and it did not alter the median days to pregnancy. The authors did note that there was a lack of power to detect reproduction effects so a lack of a statistical effect should not be interpreted as evidence of no effect. For the cows with the lowest DCAD diet pre-calving, the proportion pregnant by 305 days was numerically greater. Even if this effect is real, in our systems we have long stopped mating by 305 days in milk – in fact they are usually dry again. The lack of effect on any of the postpartum measures could well represent the relatively low prevalence of hypocalcaemia (clinical and subclinical) in first calvers compared to multiparous cows. To me, this paper says that if a client asks if it will be OK to feed a DCAD diet to their heifers then as long as their heifers do not need to gain a heap of weight in the last three weeks of the dry period then it is unlikely to do any harm but it is also unlikely to be beneficial due to the low likelihood they will suffer from hypocalcaemia anyway. If they do suffer from hypocalcaemia perhaps the bigger issue is pre-calving DMI intake not DCAD.

Reference: J Dairy Sci. 2021;104(12):12580–12599
Abstract

Independent Commentary by Hamish Newton

Hamish Newton graduated from Massey University with a BVSc in 1998 and started working in mixed practice at the Veterinary Centre – Oamaru. He then worked in mixed practice in the UK before starting a PhD at Bristol University examining factors that influence the cure of intramammary infections in the involuting mammary gland. Upon completing his PhD in 2007 he returned to the Veterinary Centre – Oamaru and became a partner in 2008. He now spends most of his working time dealing with dairy cows.



Genetic parameters and weighted single-step genome-wide association study for supernumerary teats in Holstein cattle

Authors: Wen H et al.

Summary: These researchers aimed to determine the incidence and genetic parameters of supernumerary teats (SNT) and to detect SNT-related genes in Chinese Holstein cattle. The incidence of SNT was recorded in 4,670 cattle from two farms, including 734 genotyped cows with 114,485 SNT. SNT had a total frequency of 9.8% and moderate heritability (0.22). The approximate genetic correlations between SNT and traits of milk production, longevity, health, and fertility were low to moderate and unfavourable. SNT were positively associated with body development. A specific region (112.70–112.90 Mb) on the BTA4 chromosome might play crucial roles in the development of SNT.

Comment: For those of you who remove extra teats at disbudding and have wondered about them then this paper is specially for you. It turns out the prevalence varies between breeds with 43% of German Simmentals being affected and an estimate in Holsteins of 15%. There is a wide range in the estimated heritability of SNT from 0.09 to 0.63 reported in the literature. The Brown Swiss Breed has had a strict selection policy for "clear" udders, which has resulted in estimates of the prevalence of SNT teats reducing from 31.2% in 2000 to 20% in 2017. This study of Chinese Holsteins found the prevalence of SNT to be 9.8% with an estimated heritability of 0.22. They also found genetic correlations between SNT and milk production, longevity, and fertility that were "low to moderate and unfavourable". Of course, genetics is never the whole answer and the introduction of this paper tells us the frequency of SNT increases with the parity of the dam. A possible reason for this is that "(1) multiparous cows are lactating during pregnancy and (2) the hormonal environment of the foetus differs in primiparous and multiparous cows" and "the nipple development is easily influenced by hormones, such as testosterone and estrogenic agents, resulting in retarded growth of the nipple". These authors also noted "differences in SNT frequency among 4 seasons were noticed, showing relatively low value for cattle born in uncomfortable weather summer or winter in comparison with cows born in other seasons".

Reference: J Dairy Sci. 2021;104(11):11867–11877
Abstract

Assessment of the prevalence of *Streptococcus uberis* in dairy cow feces and implications for herd health

Authors: Sherwin VE et al.

Summary: With *Streptococcus uberis* being a major causative agent of bovine mastitis, this paper reports the findings of two longitudinal studies that investigated the prevalence of *S. uberis* within dairy cow faeces and evaluated factors that may affect gastrointestinal carriage. In both studies, *S. uberis* was detected in the faeces of the majority of cows within the studied population. A seasonal increase in faecal detection of *S. uberis* demonstrated in first study corresponded with an increased incidence of clinical mastitis during the housed winter period. This finding suggests that there are factors in the management of the dairy cow population that influence infectious pressure of *S. uberis* by affecting the level of *S. uberis* in the environment (via gut carriage and faecal shedding).

Comment: There were two studies reported here that looked for *S. uberis* in the faeces using polymerase chain reaction (PCR). One study sampled an entire herd every eight weeks for nine months. In the second study, 46 cows were sampled three times a week for four weeks. We think of *S. uberis* as an environmental pathogen where the source is cow faeces so this paper is interesting as it gives us some insights into which cows are shedding the *S. uberis* and when. If we can better understand the faecal shedding of *S. uberis* then we might be able to reduce the environmental contamination. In the 9-month study, 18% of samples were positive for *S. uberis*. There were lower rates of detection when cows were at pasture (summer) than when they were housed (winter). The housing practices in winter could directly affect the efficacy of *S. uberis* faeco-oral transmission. One-third (34%) of cows that were sampled every time never tested positive, and no cow tested positive at every test. "Although *S. uberis* was detected in some cows more frequently than others, this was no more than would have been expected if the process of shedding was a random event across all cows". In the second more intensive sampling study, 15% of cows were positive in more than 50% of samples and no cow was positive on more than 75% of sampling occasions. Long term it seems that detection of *S. uberis* was random but in the short-term previous detection increased the odds of detection in the next six days. This suggests that colonisation of the gut with *S. uberis* is transient but frequent and requires repopulation by repeated ingestion. The effect of feeding on the faecal shedding of *S. uberis* is unknown but feeding did change over the course of the first study. The genome of *S. uberis* has revealed it has the potential to use a wide range of carbohydrates as energy and carbon sources so there may be altered survival or proliferation under different gut conditions. In summary, it seems that *S. uberis* is not a permanent inhabitant of the gut and there are not some cows that are "super shedders" that are worth trying to find. Feeding and managing our cows so that the risk of faecal-oral ingestion is minimised could reduce the faecal shedding of *S. uberis*. Conveniently feeding and housing outside might be the best way to achieve this and also is consistent with our messaging about how we try and manage the environment for our springers and colostrum cows.

Reference: J Dairy Sci. 2021;104(11):12042–12052
Abstract

Detecting intramammary infection at the end of lactation in dairy cows

Authors: McDougall S et al.

Summary: This study evaluated associations between somatic cell count (SCC) and major pathogen intramammary infection (IMI) in one or more quarters of 2,606 cows from 36 herds in four regions of NZ. In the last week of lactation, cows selected at random had milk samples collected from each quarter, and the teat-end condition and hygiene of the udder were scored. Herd- and cow-level data as well as SCC at each production were recorded, and bulk tank milk SCC (BTMSCC) and volume of milk shipped were collated. The investigators concluded that cow-composite SCC alone resulted in sensitivities of 0.76–0.86 and specificities of 0.71–0.80 for determination of presence of major pattern IMI, and that the predictive value was not improved by the addition of other predictor variables.

Comment: This paper, using NZ data, looks at the data we have available for most farms on how to predict which cows are infected (and those that are not) to make decisions about selective dry cow therapy. Using either the last SCC, the average of a cow's SCCs for the season, or the maximum SCC for the season to define a cow as infected or not, made no discernible difference to the predictive ability to correctly define a cow as infected or not when measured by calculating the area under the curve (AUC) of a receiver operator curve (ROC). Do a Google search on ROCs – they are very informative, and you do not need to be a statistics geek to understand them so long as you understand sensitivity and specificity. The prevalence of infection did vary with the age of the cow, a cow's clinical mastitis history, and varied with a herd's BTMSCC but adding these variables into a model to predict a cow's infection status did not change the predictive ability of the model to categorise a cow as infected or not. This means that "SCC on its own can be applied to populations of animals of different ages or from herds with differing levels of bulk tank SCC, and the sensitivity and specificity will remain similar". Life suddenly seems a bit simpler.

Reference: J Dairy Sci. 2021 Sep;104(9):10232–10249
Abstract

Using Dairy Research Review for CPD points

Reading relevant veterinary articles such as those in Dairy Research Review is a valuable way to keep current and can become part of your CPD record. Simply record the activity on your activity record and create a reflective record by writing a few sentences about what you learnt and how this impacts your practice as a veterinarian.

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