

Dairy RESEARCH REVIEW™

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Issue 33 – 2023

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Welcome to the latest issue of Dairy Research Review.

This issue features two papers that investigate the pathology of spontaneous humeral fracture in heifers, one focusses on the role of collagen and other on the role of protein-energy malnutrition. Another common theme in this issue is infection with research on colostrum as a therapy for diarrhoea in young calves, the effect of supplementary trace minerals on immune function, and the value of predictive algorithms for mastitis. Other research investigates the effect of breed and heterosis on a range of reproductive measures and production data, use of NSAIDs for claw horn lameness, and heat stress reduction.

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

Kind regards

Hamish Newton

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Research Review thanks AgriHealth for their sponsorship of this publication, and their support for ongoing education for animal health professionals.

Evaluating the effectiveness of colostrum as a therapy for diarrhea in preweaned calves

Authors: Carter HSM et al.

Summary: To investigate a non-antimicrobial therapy for diarrhoea in calves, these investigators evaluated the effects of feeding spray-dried maternal-derived bovine colostrum replacer at the onset of diarrhoea on calf growth and duration and severity of the disease in preweaning dairy calves. A total of 108 male Holstein dairy calves were randomised to treatment: 35 into a control group, 35 into a short-term colostrum supplementation (STC) group, and 38 into a long-term colostrum supplementation (LTC) group. The calves were followed for 56 days. Median times to resolution of a case of diarrhoea were 3.5 (range: 0.5–11.5), 2.75 (range: 0.5–11.0), and 2.75 days (range: 0.5–7.0) in the control, STC, and LTC groups, respectively. Also, calves in the LTC group grew more than those in the control group.

Comment: This paper reports on a randomised controlled trial that evaluated the effect of bovine colostrum on diarrhoea resolution in young dairy calves. At the onset of diarrhoea, calves received a mixture of half milk powder and half powdered colostrum for two days (four feeds; short-term supplementation) or else four days (eight feeds; long-term supplementation) or were control calves and stayed on milk replacer. The four days on a milk powder/powdered colostrum mix resulted in earlier resolution of diarrhoea. In a NZ context, perhaps if you have scouring calves on alternating milk and electrolyte feeds and there is excess colostrum (or perhaps the colostrum that fails the Brix test?) consider swapping the milk feeds out for colostrum. Interestingly, the hazard of being treated with antimicrobials (given if a calf refused more than 25% of a feed or had a depressed attitude) did not differ between feeding regimens but was influenced by the weight at which a calf arrived at the rearing facility (big is best in the scenario).

Reference: *J Dairy Sci.* 2022;105(12):9982–9994

[Abstract](#)



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Graduate student literature review: a systematic review on the associations between nonsteroidal anti-inflammatory drug use at the time of diagnosis and treatment of claw horn lameness in dairy cattle and lameness scores, algometer readings, and lying times

Authors: Mason WA et al.

Summary: These authors systematically reviewed the literature to assess the association between NSAID use during the treatment of claw horn lameness in dairy cattle and lameness score (LS), nociceptive threshold, and lying times. Of 229 studies initially identified, only six articles met the criteria for inclusion in the review. There was also a high degree of between-study heterogeneity. Five of the six studies reported LS, two reported nociceptive thresholds, and one reported lying times. The authors concluded that given the scarcity of evidence and its inconsistency it is not currently possible to properly evaluate the effect of NSAID use on the key treatment outcomes, or the factors that influence the response to NSAIDs.

Comment: This paper reviews six papers that look at the use of NSAIDs when treating lameness caused by lesions to the claw. I suspect the usage of NSAIDs when treating lameness in cows in NZ is becoming more and more "normal" and I think the younger members of my practice look at the rate I go through NSAIDs when treating lame cows and wonder if I am a scared of needles. I was surprised that only six papers met in the inclusion criteria to be reviewed. "This scarcity of evidence, combined with the between-study heterogeneity, means that we lack the data to properly evaluate the effect of NSAID use on LS (lameness score), nociceptive threshold or lying times, or the factors that influence the response to NSAID use". Do not take this paper as reason to reduce NSAID usage (or to not start using them more) when treating lame cows as I think it reasonable to assume that even the act of trimming a cow's foot will sometimes result in additional inflammation/pain. Even though lameness scores, pain thresholds, and lying times were not influenced by NSAID use it seems to be the "right thing to do" and it may be these measures are just too insensitive to be able to detect an effect. Could it be we are not using NSAIDs for long enough? An ounce of prevention is worth a pound of cure, or whatever that quote is, springs to mind.

Reference: *J Dairy Sci.* 2022;105(11):9021–9037

[Abstract](#)

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Voluntary heat stress abatement system for dairy cows: does it mitigate the effects of heat stress on physiology and behavior?

Authors: Grinter LN et al.

Summary: Dairy cattle are variable in their responses to an increase in heat stress. The aims of this study were to: i) investigate the effect of two mandatory soakings at the exit of the milking parlour and free access to a voluntary soaking system compared with cows with access to a voluntary soaking system only; ii) assess the heat abatement capability of voluntary soaking of cows by assessing cow physiology, behaviour, and milk production; and iii) determine the individual use of the voluntary heat abatement system and its relationship with temperature-humidity index (THI). Fifteen mid-lactation Holstein cows were enrolled in this study and had free access to a motion-activated soaker located adjacent to the research pen. Data was collected over an 8-week period. The results of the study indicate that voluntary soaker use was: i) related positively to the THI, with no major productive, physiological, or behavioural differences observed between soakings; ii) highly variable among cows; and iii) related positively to milk yield, whereby higher producing cows used the soaker more frequently.

Comment: I feel a bit bad writing about heat stress after watching the weather reports that have shown rain and more rain for the North Island all summer but perhaps the THI has been high? Heat stress has been associated with reduced dry matter intake and increased metabolic requirements (panting, increased respiratory rate and sweating), so it makes sense that there is the potential for lower production. A cow's tolerance to heat stress varies due to genetics, production level, body size, and "a myriad of other factors". So giving cows the option to seek out heat mitigation seems a nice thing to do, rather than cool all cows at the same time the same way. This study looked at the use of a "soaker," which was two shower heads that were activated by movement and sprayed water for 5 seconds (approx. 4.1 litres per 5 seconds). What I found surprising was the variation in voluntary soaker use between cows (range 0 to 227 soaking cycles per day) probably due to cows experiencing heat stress differently. While I doubt that we need to provide voluntary access for our cows to sprinklers, or how we could do it in a paddock, another finding from this study was where cows elected to wet themselves. They seemed to like having wet backs but very few tried to wet their heads. I suppose we already know this as in rotary sheds often use water directed at a cow's head to get them backed out of the bail, but it is something to consider if designing a wetting system for cows that is not voluntary.

Reference: *J Dairy Sci.* 2023;106(1):519–533

[Abstract](#)



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Neutrophil function and antibody production during the transition period: Effect of form of supplementary trace minerals and associations with postpartum clinical disease and blood metabolites

Authors: Ogilvie L et al.

Summary: This randomised study evaluated the effect of the form of supplementary trace minerals (TMs) – inorganic salts of TMs (STM) or organic sources of TMs (OTMs) – fed at 100% of recommended levels in both pre- and postpartum diets on the *in vitro* phagocytic activity of neutrophils and *in vivo* immunoglobulin G (IgG) responses to an ovalbumin (OVA) challenge during the transition period. The associations of these immunological responses with incidence of postpartum clinical diseases and the dynamic changes of metabolic markers during the transition period were also assessed. Pregnant heifers and cows (n=273) were enrolled at 45±3 days before expected calving, blocked by parity and body condition score, and allocated randomly to STM (n=136) or OTM (n=137) supplementation. Although a modest increase in postpartum phagocytic activity by neutrophils in cows supplemented with OTM was observed *in vitro*, which was also greater in cows that did not develop postpartum clinical disease, no differences between OTM and STM in the percentage of cells performing phagocytic activity were detected, or in IgG responses to OVA injections.

Comment: This study examined whether different forms of TM supplementation had effects on neutrophil function and disease. The TMs were either inorganic salts or where complexed with organic molecules (amino acids, peptides, or saccharides). The type of trace element given did not affect the phagocytic activity of neutrophils (% of neutrophils phagocytosing *in vitro*) taken from cows pre or post calving but when the authors looked at the “intensity” of phagocytosis (number of particles phagocytosed by neutrophils) the neutrophils harvested from cows supplemented with organic TMs seemed have an increased ability to phagocytise multiple particles. Cows were also injected with ovalbumin to induce an IgG response, again the source of TM supplementation had no effect on the magnitude of the IgG response. There was not an association between a cow’s anti-OVA IgG response and her getting clinical disease post calving, this suggests a cow’s ability to mount a humoral response is unlikely to be the most important thing for preventing post-partum infections. It is probably still important for vaccine responses and colostrogenesis though. The cows that did respond better to the OVA injections had greater post-partum dry matter intake and lower non-esterified fatty acids, which seems a bit odd as an IgG response must require energy. This seems to reinforce the importance of finding ways to maximise pre-calving energy intakes. The lack of a benefit from using TMs attached to organic molecules found in this study is at odds with some other studies but supports others cited in this paper. In this study, regardless of source of TM, the TMs were given to “top up” the ration to 100% of calculated requirements. It may well be in a “more real” situation where we may or may not be meeting 100% of TM requirements that TMs complexed with organic minerals might have a benefit.

Reference: *J Dairy Sci.* 2022;105(12):9944–9960

[Abstract](#)

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Evaluation of 4 predictive algorithms for intramammary infection status in late-lactation cows

Authors: Rowe SM et al.

Summary: This observational study compared four cow-level algorithms to predict cow-level intramammary infection (IMI) status in late-lactation US dairy cows using standard measures of test performance. The likely effect of each algorithm, if used to guide selective dry cow therapy (DCT), on dry cow antibiotic use in US dairy herds was also assessed, as was the importance of including clinical mastitis criteria in algorithm-guided DCT. Cows (n=1,594) from 56 dairy herds were recruited as part of a previously published cross-sectional study of bedding management and IMI in late-lactation cows. Based on the results obtained, the investigators recommend that producers implementing algorithm-guided DCT use algorithm criteria that match their relative aspirations for reducing antibiotic use (high specificity, positive predictive value) or minimising untreated IMI at dry-off (high sensitivity, negative predictive value).

Comment: We are approaching dry off time, and the New Zealand Veterinary Association in September issued a statement about authorising DCT, and in the Dairy Cattle Veterinarian’s December issue of HoofPrint there is an article about clinical *Staphylococcus aureus* infections occurring in the dry period, so this seems topical. This American article looked at four algorithms that are used to select infected cows (or uninfected cows if you want to think that way) to allocate antibiotic DCT to. One of the algorithms evaluated was from NZ where cows were classified as low risk if all test-day somatic cell count (SCC) from the lactation of enrolment were <120,000 cells/mL for primiparous cows and <150,000 cells/mL for multiparous cows and no clinical mastitis (note that this is different to current advice from DairyNZ’s Technote 14 2020). One other slight difference was to be included in this study; a cow’s latest SCC had to be within 42 days of dry off not the 80 days suggested currently. The prevalence of major pathogens in this study was 16.2% (compared with the example in the Technote 14 of 7.5%). The “NZ algorithm” had a sensitivity of 70% (vs 85% in the latest Technote). These different measures of test performance might be explained by differing relative prevalence of the species within the major pathogen group between farming systems. When mastitis history was removed from the algorithm, 3.6% of the high-risk cows were reclassified as low risk and 41% of the reclassified cows had an IMI (not just with a major pathogen). None of the algorithms examined had great sensitivity and specificity so I do not think we need to change anything but just bear in mind if the farmer is really averse to not treating an infected cow (wants to maximise negative predictive value) tweak your “rules” to maximise sensitivity, i.e. include mastitis history or more herd test data. It will not make a great deal of difference though as evidenced by the reclassification of only 3.6% of high-risk cows in this example.

Reference: *J Dairy Sci.* 2021;104(10):11035–11046

[Abstract](#)

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Invited review: current enteric methane mitigation options

Authors: Beauchemin KA et al.

Summary: This review has its origins in a comprehensive technical guidance document for the Food and Agriculture Organization of the United Nations (FAO) under the Livestock Environmental Assessment and Performance Partnership (FAO LEAP Partnership) programme developed by an international group of scientists working on solutions for enteric CH₄ mitigation. The authors discuss and analyse the current status of available enteric CH₄ mitigation strategies with an emphasis on opportunities and barriers to their implementation in confined and partial grazing production systems and in extensive and full grazing production systems. The authors also discuss the effectiveness of different enteric CH₄ mitigation options to reduce total CH₄ emissions and emissions on a per animal product basis, animal safety and productivity issues, impacts on the emissions of other greenhouse gases, as well as other economic, regulatory, and societal aspects that are relevant to implementation.

Comment: This is a 30-page review so I cannot summarise it any detail, but I can say there are no “magic bullets”. From a NZ perspective, there is also not a great deal of information or research reviewed here that is directly applicable to extensively grazed or unsupplemented cows. This article is available on the Journal of Dairy Science website and is free to access so do get a copy of it if you think the latest magic cure you see on Facebook is likely to be a winner – this will give you a “healthy dose” of scepticism. Without going into the various technologies available the message I got was that even though intensification will very likely decrease the emissions intensity of CH₄ per unit of production, if a life cycle assessment (LCA) is done “intensification usually increases upstream emissions of carbon dioxide (CO₂) and nitrous oxide (N₂O) resulting from the production of animal feed or even from pasture management, and also increases manure emissions”. The other message is a pragmatic one, that to get producers to reduce CH₄ emissions some incentives may be required (or a brand premium?) as “in most cases, decreased CH₄ production has not increased animal performance”.

Reference: *J Dairy Sci.* 2022;105(12):9297–9326

[Abstract](#)

Novel assessment of collagen and its crosslink content in the humerus from primiparous dairy cows with spontaneous humeral fractures due to osteoporosis from New Zealand

Authors: Wehrle-Martinez A et al.

Summary: This case-control study compared collagen and collagen crosslink content in humeri from primiparous cows with and without humeral fractures and determined the role of copper in the occurrence of these fractures. Humeri were collected from 26 cows with and 14 without humeral fractures, ground, and the collagen and collagen cross-link content measured using high-performance liquid chromatography. Collagen content was found to be significantly higher in the humeri of cows without humeral fractures and total collagen crosslink content to be significantly higher in the humeri of cows with humeral fractures. Mean liver copper levels were adequate in cows with and without fractures, although they were significantly higher in cows without fractures ($p < 0.001$). Hence, other factor(s) might be more important than copper status in the occurrence of humeral fractures in dairy cows in NZ.

Comment: This paper finally explains what is going on with the low liver copper levels we tend to find in the heifers we sample that have fractured a humerus. Nearly two-thirds (62%) of the affected heifers in this study had a low liver copper level (but 85% had adequate serum copper levels). The liver copper level in heifers that suffered a fracture was significantly lower than control heifers but the copper levels in the affected bones was higher than in control bones. To put these finding in perspective, “increased bone Cu (copper) concentration was associated with increased odds (56.1 times) of having a humeral fracture while for decreased liver Cu concentration, the odds of having a humeral fracture increased by a factor of 3.2”. Fractured bones had less total collagen but the collagen from affected heifers had more collagen cross links, more immature cross links, and more mature collagen cross links than collagen from control bones. So, there is indeed, a correlation with low liver copper concentration and fractured humeri but these heifers are not copper deficient as they usually have adequate serum copper. It seems the liver copper is being depleted and put into the bone in affected heifers. Further evidence that these heifers are not copper deficient is that “In Cu deficiency there is a reduction in the activity of LOX (lysyl oxidase), which impairs collagen crosslinking”, affected bones in this study had more cross links but less collagen. The low collagen content of these bones could suggest protein or calorie under nutrition. In summary, this paper tells us the low liver copper levels found in affected heifers is not the cause of the fractures but the result of the bones utilising copper reserves to try and stabilise the reduced amount of collagen these osteoporotic humeri have. I still do not understand why some heifers end up with osteoporosis.

Reference: *Biology (Basel).* 2022;11(10):1387

[Abstract](#)

Biochemical profile of heifers with spontaneous humeral fractures suggest that protein-energy malnutrition could be an important factor in the pathology of this disease

Authors: Wehrle-Martinez A et al.

Summary: In this case study, serum and liver samples from 35 dairy heifers that had fractured one or both humeri post-calving were submitted to a diagnostic laboratory for analysis. In some of the heifers, there was evidence for protein and/or energy malnutrition in the form of elevated non-esterified fatty acids and β -hydroxybutyrate (BHB) levels and low creatinine levels in serum. Liver copper levels were also reduced in most of the heifers. In the absence of a control group, data were compared to published reference intervals. Hence, it was not possible to determine if these are risk factors for fracture or features common to all periparturient heifers.

Comment: This paper describes the results from heifers that suffered a fractured humerus. There are no control bloods in this study so the results found are compared to reference ranges from the lab. Sixty-nine percent of bloods had low creatinine levels and 57% had increased BHB levels while 79% had adequate or high serum copper levels but 69% had low or marginal liver copper levels. All of the heifers with low or marginal serum copper had low or marginal liver copper levels. Of the remaining heifers with adequate or high serum copper levels 62% had low or marginal liver copper levels. I think we need to be careful not to over interpret the BHB levels as only 57% were increased and the average BHB level across all bloods was within the adequate range. I do not feel that 57% of heifers with an increased BHB level an unknown time after breaking a leg (and presumably stopped eating?) is surprising. I find the low creatinine levels more interesting though. Creatinine levels are positively correlated with body condition score (BCS) and the heifers with fractured legs I have dealt with have not been in poor BCS (my anecdotes are not data though). One possible explanation for the low creatinine levels is reduced muscle mass. This survey supports the findings of the paper above that copper deficiency is not the cause of these fractures but the result of increased usage or mobilisation of copper (79% had more than adequate serum copper levels).

Reference: *N Z Vet J.* 2023;71(1):37–41

[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.

Estimation of genetic parameters and individual and maternal breed, heterosis, and recombination loss effects for production and fertility traits of spring-calved cows milked once daily or twice daily in New Zealand

Authors: Jayawardana JMDR et al.

Summary: These investigators estimated genetic parameters and individual and maternal breed, heterosis, and recombination loss effects for milk production and fertility traits in Holstein Friesian (F), Jersey (J), and crossbred Holstein Friesian and Jersey (F × J) cows milked once daily (OAD) or twice daily (TAD) in NZ. Data on 278,776 lactations from 30,217 OAD and 170,680 TAD milking cows across 644 spring-calving herds were available. Reported heritability and repeatability estimates in cows milked OAD were largely similar to those of TAD milking cows. Most of the individual breed and heterosis effects for production and fertility traits were significant in both milking populations. The maternal heterosis effects for fertility traits of start of mating to the first service, first service to conception, calving to first service, submission within the first 21 or 42 days of start of mating were significant in cows milked TAD but not in cows milked OAD. Recombination effects, which were small, showed a mix of favourable and unfavourable effects for production and fertility traits.

Comment: This paper examined the effect of breed and heterosis on a huge range of reproductive measures and production data as well as whether being milked OAD or TAD altered the size or even direction of these measures. The measures did not vary much whether a cow was being milked OAD or TAD but the heritability estimate for 6-week in-calf rate (PR42) tended to be higher for cows milked TAD. It is worth remembering “that management, feeding, and environmental factors have a greater influence on reproductive performance than genetic factors”. Unsurprisingly, Friesians outperformed Jerseys in the production measures regardless of milking regimen with their superiority being even greater in the TAD system. The opposite was true for the fertility traits with Jerseys outperforming Friesians in both milking regimens. Finally, the cross breeds performed better than the average of Jerseys and Friesians and the “heterosis effects for PR42, CR21 (calving by 3 week), and CR42 (calving by 6 week) tended to be greater in magnitude in the TAD milking population compared with the OAD milking population”. It seems that as about 50% of the national herd are already cross breeds many farmers are already well aware of the benefits of heterosis.

Reference: *J Dairy Sci.* 2023;106(1):364–380

[Abstract](#)

Modeling the economic impacts of mobility scores in dairy cows under Irish spring pasture-based management

Authors: O'Connor AH et al.

Summary: The aim of this modelling study was to estimate the economic consequences of varying levels of suboptimal mobility (mild to severe deviations from optimal gait) within spring-calving, pasture-based dairy herds. A new sub-model predicting mobility scores was developed and integrated within an existing pastured-based herd dynamic model. A total of 13 scenarios were simulated, representing a typical spring calving, pasture-based dairy herd with 100 cows. The analysis showed that a 17% reduction in farm net profit was achieved in the worst outcome (only 5% of the herd had optimal mobility) compared with the perfect herd. This was attributed to reduced milk yield, increased culling, and increased treatment costs for mobility issues versus the ideal scenario.

Comment: This is a paper that reports on a model created to simulate the cost of “sub optimal mobility” in a 100-cows spring-calving pasture-based (but winter-housed) Irish dairy herd. Suboptimal mobility was a mobility score ≥ 1 (scale 0–3). Milk losses were assumed to occur for an average of 3 months with a daily reduction in milk production of 6% for score 2 and 16% for score 3. The model assumed a base risk of being culled of 9% (for a reason other than reproduction) and this increased by an additional 2%, 4%, and 28% for lameness scored of 1, 2, and 3, respectively. The model also factored in three levels of herd management and three levels of genetic merit for lameness. The model predicted that as the prevalence of suboptimal mobility increased predicted profit decreased. In the model's hypothetical worst-case scenario 45% of the loss was due reduced milk production (culling 29% and treatment 26%). In the non-hypothetical worst-case scenario put into the model milk loss accounted for 22% of the loss (culling 22% and treatment 56%). Although modelling a system that in the title sounds applicable to NZ it may not be so with a herd of only 100 cows the reduced walking distances/yarding times may not be applicable here. They also assumed sole ulcers and digital dermatitis required two veterinary visits and were more prevalent than I feel they are in NZ.

Reference: *J Dairy Sci.* 2023;106(2):1218–1232

[Abstract](#)

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