

Dairy RESEARCH REVIEW™

Making Education Easy

Issue 21 – 2020

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Welcome to the latest issue of Dairy Research Review.

This issue features three local papers including a review of selenium intake recommendations for NZ dairy cattle, a modelling study of feed use intensification and animal health expenditure on NZ dairy farms, and a study that quantifies the carbon footprint of milk from NZ dairy production.

International selections include a review of the evidence on antibiotic resistance spread via dairy cattle manure, a study assessing a therapeutic role for thiamine supplementation in high concentrate diet-induced sub-acute rumen acidosis (SARA) in lactating goats, and a review elucidating the role of teat-end hyperkeratosis as a risk factor for mastitis in dairy cows.

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.

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.



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Invited review: fate of antibiotic residues, antibiotic-resistant bacteria, and antibiotic resistance genes in US dairy manure management systems

Authors: Oliver JP et al.

Summary: This comprehensive review paper discusses the potential impact of the US dairy industry on antibiotic resistance as well as that of human antibiotic use on US dairy operations. The review goes on to consider studies of antibiotic resistance in conventional, organic, and untreated dairy manure. Also discussed is the stockpiling and composting of manure, including the effect of composting on antibiotic-resistant bacteria (ARB) and antibiotic resistance genes (ARG). The authors conclude that additional research is needed to understand antibiotic resistance in long-term storage, which is a critical component of modern dairy manure management systems.

Comment: Antimicrobial resistance is an issue we need to get our heads around and the NZVC has signalled this pretty strongly with the new code about authorising the use of critically important antibiotics. This review paper looks at the spread of antibiotic residues, ARB, and ARG from cattle via manure and urine to the environment. The authors suggest this is a more likely way for resistance to spread to the human population than via people handling cattle or contaminated food products (as long as withholding periods are followed). There does not seem to be a simple correlation between antibiotic usage and ARB possibly due to sampling issues and/or a lack of understanding of the naturally occurring ARB in conventional and organic farms. As an example of the complexity, in *Campylobacter*, resistance has been found to kanamycin (not used in dairy medicine) but the gene encoding for tetracycline resistance is “co-localised” on a mobile genetic element with the gene for kanamycin resistance – so is it possible if we select for tetracycline-resistant *Campylobacter* we are also likely to get kanamycin resistance genes becoming more prevalent. Kanamycin is a drug of last resort if you get tuberculosis. Studies are also cited here that seem to show a reduction over time in the prevalence of antibiotic-resistant *Salmonella*. Studies have also been done on the ARG in manure and more than 60 have been found. One of the technically difficult questions to answer is whether these genes are from the bacteria themselves, phages, or exist on plasmids or transposable elements. Once again, there seems to be a limited understanding of what the “baseline” ARG looks like.

Composting manure generally resulted in a decline in antibiotic residue levels, but this was not necessarily true for ARB and over 50 ARG have been found in cattle manure composts. There does not seem to be a consistent theme of what happens to the level of ARG in compost in the papers reviewed here. Relevant to most of us, is a small section on “anaerobic lagoons” for long-term storage of manure. Very little work has been done on these, with some studies showing an increase in ARG and others showed a decrease in ARG and the author’s state “additional research is particularly needed”. Read this paper to get a broad idea of antimicrobial resistance, not to understand how to treat effluent to reduce the risk as I don’t think anyone actually knows. As an added bonus you can worry about where all the sludge from human sewage treatment plants ends up.

Reference: *J Dairy Sci.* 2020;103(2):1051–1071

[Abstract](#)

On-farm use of disease alerts generated by precision dairy technology

Authors: Eckelkamp EA & Bewley JM

Summary: In this US study, data from 1,171 cows on four commercial farms in the state of Kentucky were collected to assess the perceived usefulness that producers attributed to alerts from a daily generated alert list designed to identify sick or injured cows. Each cow was equipped with two precision dairy monitoring technologies: a leg tag to measure activity and lying time and a neck collar to measure eating time. Farmers indicated that 55% of alerts represented a real behavioural change and only 8% of alerts were doubted; however, 37% of alerts were not evaluated and producers visually followed up on only 21% of alerts.

Comment: Collars and pedometers are becoming more widely adopted for oestrus detection but can also be used to alert managers to sick cows. This paper examines how people are actually using these alerts. The managers sorted alerts into three categories.

1. Alert perceived to be true and the cow visually examined
2. Alert perceived to be true and the cow not visually examined
3. Alert doubted and the cow not visually examined

Overall, 55% of alerts were perceived by the farmers to be true but only 21% of alerts resulted in the cow being visually assessed (ranged from 2% to 45% between farms). Producers were more likely to evaluate alerts during weekdays, if the alert occurred prior to peak lactation and when ≤ 20 cow alerts occurred a day. The longer the alert systems were in place on a farm the more likely a farmer was to decide that an alert was due to some management change rather than a cow being sick, e.g. a change of pen or group, or pregnancy testing or hoof trimming. Managing alerts by lactation stage might increase the usefulness of these technologies. Anecdotally, I don’t think the health alerts are acted on by the farmers I know at a rate any greater than those reported here, and probably less.

Reference: *J Dairy Sci.* 2020;103(2):1566–1582

[Abstract](#)

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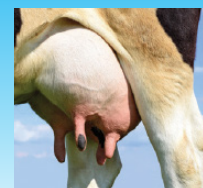


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Production intensification and animal health expenditure on dairy farms in New Zealand

Authors: Ma W et al.

Summary: These researchers used a fixed-effects model, estimated with a panel data set from 3,119 NZ dairy farms (during 2005 to 2014), to analyse the relationship between feed use intensification and animal health expenditure, while controlling for a range of confounding effects. According to empirical estimations, feed use intensification was associated with a statistically significant increase in health expenditure per cow. The positive effect was mainly due to the expenditure patterns of the farmers who have adopted the most intensive farming systems. Profitability (measured by cash surplus) did not appear to be significantly related to the level of animal health expenditure during the 10-year study period.

Comment: This paper from Lincoln University looked at the relationship between feed use intensification and expenditure on animal health. The data for the study were extracted from the DairyBase system. Feed use intensification was measured using the five systems defined by DairyNZ (System 1 – zero input of supplementary feed, through to System 5 – more than 30% of feed imported). The dependent variable was “animal health expenditure” from DairyBase (Vet fees and supplies, bloat treatment, drenches, vaccines, and minerals). To keep everything in perspective, the average spend on animal health per cow per year was \$80.76 (trended up from \$57 in 2005 to \$90 in 2014). Spend on animal health trended up as the farm system increased and was strongly driven by the System 5 farms. There was not a statistically significant effect of cash surplus on animal health expenditure found, which surprised me (but the coefficient was positive and the animal health expenditure did reduce in the low pay-out years of 2009 and 2012). It would be great to know whether the increasing spend with intensification was used for disease prevention or disease treatment.

Reference: *J Dairy Sci.* 2020;103(2):1598–1607

[Abstract](#)

Herb species inclusion in grazing swards for dairy cows – a systematic review and meta-analysis

Authors: McCarthy KM et al.

Summary: This systematic review and meta-analysis by Irish researchers was conducted to estimate the effect of herb species on milk production and urinary nitrogen excretion from grazing dairy cows. Grazing swards consisting of herb species grown with either a grass species or a grass and legume (multispecies swards) were compared with non-herb-containing swards consisting of a grass species grown as a monoculture or grass-legume swards (simple swards). The results showed the potential benefits of multispecies swards, with statistically significant increases in milk production and levels of fat and protein compared with simple swards. However, there was no significant difference between the two grazing swards in terms of urinary nitrogen excretion.

Comment: This is a meta-analysis of 11 studies (seven were from NZ) examining the production effects and the urinary nitrogen excretion of feeding a traditional sward (perennial ryegrass and white clover) or a sward containing herbs such as chicory and plantain. It is worth remembering a meta-analysis is often performed to get some sort of consensus when there are varying results between studies. It was found the addition of herbs to sward increased the daily yield by 1.2 kg of milk. The second part of the analysis looked at whether these mixed swards can reduce urinary nitrogen loss. Disappointingly, the analysis of these 11 papers did not show a decrease in urinary nitrogen excretion but it was discussed that some of these herbs have a diuretic effect so the urine patches may be less concentrated. Perhaps any advantage from a nitrogen perspective will come from the findings in other studies that have shown that similar dry matter yields can be achieved with mixed swards compared with traditional ryegrass/white clover mixes but with fewer nitrogen inputs.

Reference: *J Dairy Sci.* 2020;103(2):1416–1430

[Abstract](#)

Reproductive efficiency and survival of Holstein-Friesian cows of divergent Economic Breeding Index, evaluated under seasonal calving pasture-based management

Authors: O’Sullivan M, et al.

Summary: These Irish researchers examined phenotypic fertility performance and survival to gain insight into underlying factors that might contribute to greater fertility performance in two divergent genetic groups of Holstein-Friesian cows, which were elected using the Irish Economic Breeding Index (EBI). The results highlighted the ability of the EBI to deliver reproductive performance and longevity consistent with industry targets across a range of seasonal pasture-based feeding treatments. Also demonstrated was the potential of intensive genetic selection to reverse negative fertility trends incurred through previous decades of selection for milk production alone.

Comment: Two groups of cows were followed for four years. One group (elite) represented the top 5% of cows in Ireland based on the EBI (average EBI of 154) and the other group represented the average Irish cow (average EBI of 47). The study ran from 2013 to 2016. The High EBI cows had better reproductive performance and greater survivability. It seems that one of the biggest drivers of the improved reproductive performance of the elite cows was that they had greater body condition score (BCS). This is good news as now in NZ 7% of the breeding worth index is made up of BCS. The increased survival of the elite cows should result in increased profitability, and this has been modelled in a NZ context by [Lopez-Villalobos et al. \(2000\)](#). Increased profitability resulted from reduced replacement rates, and greater milk yields due to more mature cows in the herd. This study demonstrates that breeding indices can deliver the phenotypic results. With increasing emphasis away from yield in breeding indices the decline in fertility can be reversed.

Reference: *J Dairy Sci.* 2020;103(2):1685–1700

[Abstract](#)

Thiamine ameliorates inflammation of the ruminal epithelium of Saanen goats suffering from subacute ruminal acidosis

Authors: Zhang H et al.

Summary: The objective of this study was to assess the role of thiamine in the local inflammation of ruminal epithelium caused by high-concentrate diets. Eighteen mid-lactating Saanen goats were randomised (1:1:1) to receive a control diet (concentrate:forage 30:70), high-concentrate diet (concentrate:forage 70:30), or high-concentrate diet with 200 mg of thiamine/kg of dry matter intake (concentrate:forage 70:30) for 8 weeks. Based on blood samples and ruminal tissue sample analysis from animals in the three groups, the results demonstrated that thiamine supplementation mitigates high-concentrate diet-induced local inflammation and ruminal epithelial disruption.

Comment: In many parts of the country, cows will very soon start eating a bit of, and unfortunately some will eat a bit too much, fodder beet. This will likely result in some cows getting clinical acidosis and presumably many more will get sub-acute rumen acidosis (SARA). This study was on goats so I won’t extrapolate too far but some of you could well deal with milking goats. The goats received either a forage-based diet or a diet higher in concentrates (to induce SARA) with or without additional thiamine. Thiamine is involved in carbohydrate metabolism, can increase rumen pH, and can regulate inflammation.

The goats that were on the high-concentrate diet with additional thiamine did have a higher rumen pH and lower lactate levels than the goats on the un-supplemented concentrate diet. The thiamine-supplemented goats also had a lower expression of mRNA for many inflammatory mediators compared with the goats receiving a high-concentrate diet alone. Looking at outcomes that are more “real world” for those of us who wear overalls, rather than lab coats, the goats that were on the concentrate diet with thiamine or the forage-based diet outperformed the goats on the concentrate diet (un-supplemented) with respect to dry matter intake, and milk yield (volume) and actual yield of protein, fat and lactose (g/day). Perhaps if there is a ratio formulation mistake or other reason for a herd outbreak of SARA, finding a way of getting thiamine into the herd’s diet is worth considering.

Reference: *Dairy Sci.* 2020;103(2):1931–1943

[Abstract](#)

Selenium requirements in grazing dairy cows: a review

Authors: Hendriks SJ & Laven RA

Summary: Some advisors in NZ suggest that selenium intake recommendations for our pasture-based dairy cattle are too low and that recommendations from the US should be used. This review evaluated whether the published evidence supports the existing dietary requirements and associated selenium status thresholds, or if change is required. The authors concluded that the current evidence base does not support the hypothesis that NZ dairy cattle on a mainly pasture-based diet should be fed at ≥ 10 -fold the current recommendations. Proponents of the hypothesis need to prove their case.

Comment: This review of the evidence for selenium levels in dairy cattle predominantly grazed on pasture does not support a change to our recommendations towards the values that come out of the US. The daily recommended intakes the Americans have are 10-times higher than our recommendations and appear not to be needed here. Neither does the top of the marginal range for serum selenium need to rise as high as the 440–890 nmol/L the Americans use from our current value 140 nmol/L. Of the 10 studies reported here where the animals were defined as marginal by our measures, five reported a positive effect of selenium supplementation. In the studies where the cattle were not deemed deficient by NZ values (but well deficient by US standards), none resulted in a “unequivocal evidence of a benefit of selenium supplementation”. One caveat that was mentioned that resonated with me was that discontinuous supplementation may not result in the same response as continuous supplementation (either oral or parenteral). At the risk of sounding too political, just because something is American and big does not mean it is necessarily relevant.

Reference: *N Z Vet J.* 2020;68(1):13–22

[Abstract](#)

Association between teat-end hyperkeratosis and mastitis in dairy cows: a systematic review

Authors: Pantoja JCF et al.

Summary: These Brazilian researchers conducted a systematic review to elucidate the role of teat-end hyperkeratosis (THK) as a risk factor for clinical or subclinical mastitis in dairy cattle. Of 152 records identified, 18 articles were selected: eight prospective cohort studies, nine cross-sectional studies, and one hybrid case-control study. Based on this evidence base, severe THK is a risk factor for both clinical and subclinical mastitis, as defined by the microbiological examination of milk.

Comment: This review article summarised 18 papers that looked at the effect of THK and the risk it represents for clinical mastitis. I don't think we will be surprised that severe THK was found to be a risk factor for clinical mastitis, especially that caused by *Staphylococcus aureus*. It is a bit harder to make a strong statement about THK on somatic cell counts and subclinical mastitis due to some of the studies reviewed not accounting for parity as a confounding factor. There is a bit of evidence to suggest that mild THK could be protective against mastitis, so if you set up a monitoring scheme on a farm at least make sure you are recording and monitoring “severe THK” separate to “any THK”.

Reference: *J Dairy Sci.* 2020;103(2):1843–1855

[Abstract](#)

Temporal, spatial, and management variability in the carbon footprint of New Zealand milk

Authors: Ledgard SF et al.

Summary: This study determined temporal, regional, and farm system variability in the carbon footprint of milk from NZ dairy production using national database farm production and input data. Total greenhouse gas emissions were calculated using a life cycle assessment methodology for the cradle-to-farm gate. The results demonstrated a small reduction in the carbon footprint of NZ milk over a period of eight years (from 2010/11 to 2017/18) and with limited temporal variation, despite reliance on year-round grazing of pastures with production being susceptible to climatic changes.

Comment: This paper set out to quantify the size of the carbon footprint left behind when a kg of fat and protein corrected milk (FPCM) is produced from the “cradle to the farm gate”. It has been estimated that in the US the time from “cradle to farm gate” accounts for 72% of the carbon footprint for milk that finally reaches the consumer. Globally, food production contributes >20% of greenhouse gas (GHG) emissions. The GHG that were examined in this paper were methane (CH₄), nitrous oxide (N₂O), and carbon dioxide (CO₂). The average carbon footprint number that fell out of the analysis was 0.75–0.81 kg of CO₂ eq/kg of FPCM (average values from around the world are 0.8 to 1.3). 69% to 70% of our footprint was derived from CH₄, 12% of which came from replacement stock. 15% of the GHGs came from N₂O (60% from urine and dung and 20% from fertilisers). The balance of the footprint came from CO₂ and was almost all attributed to production of supplementary feed. The carbon footprint per kg FPCM decreased with cow productivity. The cows in the top quartile produced milk with a 15% lower footprint than cows in the lower quartile. As a general statement, the footprint decreased with increasing proportion of the diet from pasture and increased production. Part of our advantage in the size of our footprint comes from our replacement rate of 22% compared with the 30% to 38% replacement rates in some confinement systems. In general, this is a good news story for our dairy industry after the bad press about waterways and winter grazing practices.

Reference: *J Dairy Sci.* 2020;103(1):1031–1046

[Abstract](#)

Efficacy of dairy on-farm high-temperature, short-time pasteurization of milk on the viability of *Mycobacterium avium* ssp. *paratuberculosis*

Authors: Fechner K et al.

Summary: Despite its high nutritional value and economic benefits, one of the disadvantages of feeding waste milk to suckling calves is the potential for exposure to *Mycobacterium avium* ssp. *paratuberculosis* (MAP), the causative agent of Johne's disease (paratuberculosis). These researchers evaluated the efficacy of a new commercial high-temperature, short-time pasteurizer (73.5°C for 20 to 25 sec) in terms of MAP inactivation under experimental on-farm conditions. While not recommending feeding waste milk to new-born calves given hygiene concerns, the authors recommended that pasteurisation of colostrum or milk become a standard on-farm procedure before feeding to suckling calves based on the results of this and other studies.

Comment: This paper examined a new pasteuriser's ability to reduce the Johne's disease bug's presence in calf milk. This pasteuriser used a heat exchanger to heat milk to 50 or 60°C. Then a small amount of steamed water was introduced into the milk to get milk to 73.5°C for 20 to 25 seconds. The idea behind this system is to prevent “clumping during pasteurisation of transition milk” but the authors state the colostrum from the first milking could not be used without technical difficulties. The milk was then cooled to 40°C via the heat exchanger. One of the limitations of the commercially available pasteurisers in NZ, that I am aware of, is the slow throughput of the volumes of calf milk we have to process a day due to our block calving systems. A high-temp short-time (HTST) pasteuriser if it can handle colostrum would likely solve this issue. This pasteuriser did not remove all MAP but did reduce it.

Other studies using HTST pasteurisers have shown no MAP surviving but there are technical difficulties in MAP detection that result in low sensitivity. The infective dose of MAP for cattle is not known but the number of colony-forming units of MAP in faeces is orders of magnitude greater in faeces than in milk (10⁹ vs 10³). Although this method did not eliminate the risk of infection with MAP via the milk it did reduce the risk. Assuming this pasteuriser is not overly detrimental to milk quality it seems reasonable to expect the benefits to calf health from feeding pasteurised milk to calves that have been reported in other studies will also apply to this machine and allow a quicker throughput of calf milk. This paper highlighted to me how important faeces are as a risk for infecting calves with Johne's compared to milk or colostrum. There are definite benefits to pasteurising calf milk, but it seems very unlikely pasteurising calf milk will control Johne's spread.

Reference: *J Dairy Sci.* 2019;102(12):11280–11290

[Abstract](#)



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