Milk South Africa
Melk Suid-Afrika

Milk SA: Summary of the 2023 Annual Progress Reports of the R & D Project

Compiled by Heinz Meissner.

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A. Research Projects:

PRJ-0336: Diagnostic investigation of sporidesmin toxicity: Histological study

PRJ-0361: Sporidesmin toxicity in dairy cattle – Snapshot study

Project leader: Anthony Davis (Humansdorp Veterinary Clinic)

Objectives:

1. To estimate the prevalence of sporidesmin toxicity in pasture-fed dairy cattle based on histological examination of liver tissue from slaughtered cattle.
2. To determine whether liver biopsy samples are potentially useful as a diagnostic test for sporidesmin toxicity.
3. To establish whether the liver enzyme GGT is an acceptable indicator of liver damage caused by sporidesmin toxicity
4. To do spore counting of fungus for early warning of sporidesmin build-up
5. To endeavour to link skin lesions with photosensitivity and possible indicator metabolites such as phyloerythrin.

Progress: Samples from two abattoirs in the Tsitsikamma area, East London abattoir and Cookhouse area were examined under the microscope at the Onderstepoort Pathology Department. In several samples, clear evidence of typical periductular fibrosis was present, a lesion which characterises sporidesmin toxicity. Other non-specific changes both in parenchymal tissue and in bile duct tissue were noted. Even though these are non-specific, they are described by other authors as early changes associated with sporidesmin toxicity.

Liver biopsy samples showed lesions in both left and right lobes, which indicate that liver biopsy samples are representative of changes in other parts of the liver and can therefore be used for diagnostic purposes. The liver enzyme GGT was consistently increased in cattle with affected skin originating from farms with high spore counts. Of all the parameters used, GGT seems to be most useful, but it is known that it does not detect early cases. None of the other blood chemistry parameters tested seemed to be useful to pick up early cases.

The spore counting service to farmers as an early warning tool has been continued, also to support grass sampling for tests of the fungus *Pseudopithomyces chartarum* by FABI.

The approach in the snapshot study has been to throw out a broad net to try and understand the condition, but with the progress made, specific pointers have been identified. A specific pointer is to try and link sporidesmin toxicity with photosensitization and a metabolite of importance in skin lesions appear to be phyloerythrin. In the next phase of the study a biochemical and physiological investigation into photosensitivity and phyloerythrin will be targeted.

PRJ-0362: Exploring the facial eczema problem in dairy cattle in the Eastern Cape of South Africa, with a focus on the fungus *Pseudopithomyces chartarum.*

Project leader: Neriman Yilmaz-Visagie (FABI, UP).

Aim 1: To resolve the taxonomy of the genus *Pseudopithomyces* with focus on *Pseudopithomyces chartarum* and to determine which species are associated with Sporidesmin Induced Liver Disease.

Progress: A total of 886 sequences have been generated to date. These include sequences for the following gene regions: ITS (n=164), *BenA* (n=141), *RBB2* (n=151), LSU (n=158), *TEF* (n=139) and G*APDH* (n=133).

Aim 2: To determine whether *Pseudopithomyces chartarum* is seed-borne.

Progress: During the isolation, *P. chartarum* was not detected. For the coming experiments, it is planned to do next generation sequencing (NGS) directly on the seed samples. NGS offers several benefits for exploring the mycobiome of grass seed compared to traditional sequencing methods.

Aim 3: To determine which *Pseudopithomyces* species predominate the outbreak areas in the Eastern Cape.

Progress: All grass samples taken during various trips to the Tsitsikamma area have been processed by plating non-surface disinfested grass onto filter paper on isolation media, as well as directly onto the isolation media for top, base and dead samples. In addition, the top and bases samples will be surface disinfested and plated onto filter paper on isolation media, as well as directly onto the isolation media. Testing of these samples for the relevant *Pseudopithomyces* species will be initiated in early 2024.

Aim 4: To study the relationship between sporidesmin production and the population diversity of *Pseudopithomyces chartarum.*

Progress: With a grant from Inqaba Biotec, Dr. Yilmaz successfully sequenced two genomes of *P. chartarum.* Collaborating with Dr. Jerome Collemare from the Westerdijk Fungal Biodiversity Centre in the Netherlands, she compared South African genomes with the New Zealand genome. Dr Yilmaz has furthermore been invited to deliver a seminar at the International Mycological Congress in August 2024 in the Netherlands.

Of the population sampled, the genomes of three isolates were sequenced. These were subsequently used to test different sporidesmin extraction methods. A number of extraction methods have been tested to find the most appropriate one, which will allow effective extraction of sporidesmin in early 2024.

PRJ-0314: The effect of season on trace mineral status of dairy cows in the Tsitsikamma

Project leader: Elizabeth Kuhn of Chemunique

Aim of investigation: To determine whether seasonal stressors affect the cow trace mineral status of dairy cows in the Tsitsikamma region of the Eastern Cape.

Summary of main results and associated discussion: Stress effects were anticipated to result in inflammation which is classified as a non-infectious stress, heat stress being an example, which could implicate higher requirements. However, apart from higher liver Zn levels, there were very little indication of either inadequate tissue levels of the trace minerals, or stress. The comparatively high liver contents of Zn in summer and autumn is probably a reflection of high ZnO supplementation during this period. This was to counteract sporidesmin toxicity caused by the fungus *Pseudopithomyces chartarum* and resulting in Facial eczema primarily on ryegrass pastures during summer and autumn.

Conclusions: Although season did effect the trace mineral status of the dairy cows, the opposite of what was maybe expected was observed. The expectation that chronic inflammation associated with seasonal stressors, e.g. heat stress, would increase trace mineral demand to the extent of reducing trace mineral status was expected. This may have supported the need to improve trace mineral supplementation during such stressful times. However, there was no consistent trend with spring through to autumn, when high temperatures were observed. This may suggest that the trace mineral status of the study cows was adequate and the requirement of the immune system for activation not so large as to the extent of depleting mineral reserves, or it could simply imply that heat stress occurrences were infrequent and of too short duration to have a significant effect. One furthermore could have expected that the high Zn supplementation to counter sporidesmin toxicity, might have resulted in negative interaction with other trace minerals. However, there was no trend to that effect. A possibility though is that the high ZnO supplementation may affect macro mineral metabolism in bone and this possibility should be investigated in future.

PRJ-0344: Development of probiotic yoghurt with potential anti-candidal and antibacterial activity.

Project leader: Elna Buys (UP).

Progress:

- Stress-adapted *Bifidobacterium* spp. variants: The viability of different *Bifidobacterium* strains in yoghurt over a 28-day period revealed interesting patterns. The stress-adapted *B. bifidum* showed enhanced viability compared to its unadapted counterpart, suggesting the potential benefits of stress adaptation. *B. animalis* demonstrated robust viability regardless of stress adaptation, indicating its inherent

resilience in yoghurt. Together with the results from the yoghurt shelf-life study, the process of adapting *Bifidobacterium* species to improve their survival during yoghurt production and storage has proven effective, although the degree of success varies depending on the specific species.

- Effect of homogenisation pressure on probiotic viability: *Lacticaseibacillus rhamnosus* GG remained at a stable level of viability over 28 days of cold storage at 4°C regardless of whether the milk base was unhomogenised or whether it was homogenized at 200 or 250 bar. For *Bifidobacterium animalis* subspecies *lactis* BB12 the levels of viability remained stable with no difference for samples where the milk base was homogenised at 200 or 250 bar. All samples maintained a probiotic viability above the general therapeutic minimum.
- Aggregation and antibiofilm activity of probiotic lactic acid bacteria (LAB) species against *Listeria monocytogenes*: The study investigated the aggregation and antibiofilm activity of the probiotic species against *Listeria monocytogenes* strains. (Aggregation capability influences adherence to the intestinal mucosa which improves the competitive advantage through the release of antimicrobial metabolites and inhibitory exopolysaccharides close to the pathogenic microorganism that interact with components of its biofilm matrix. It contributes to the efficacy of probiotics in inhibiting biofilm formation by the pathogen. The adhesion and biofilm inhibition of pathogens in the intestines could avert translocation and consequent infection). The strains auto-aggregate and showed coaggregation abilities with the pathogen which demonstrated their potential to exhibit probiotic benefits when incorporated into foods.
- The nutritional trial study received ethics approval and has now started with advertising for the recruitment of participants with the aim of starting with the pre-intervention assessments end of January/ beginning of February 2024.

PRJ-0339: The significance of *Enterobacteriaceae*, coliforms and *E. Coli* in milk in the SA market with the aim of updating microbial specifications in R1555 of 1997 (Act 54 of 1972)

Project Leader: Chané Pretorius (DSA).

Background: Regulation 1555 is under revision and there appears to be a notion to follow international trends to specify only *Enterobacteriaceae* and not coliforms and *E. coli*. We are not convinced that this is in the best interest of the industry and therefore the aim of the project is to measure the status of these organisms in milk.

Progress: The study was registered for a PhD at the University of Pretoria and the provisional literature review commenced early in 2023. To update specifications as set out in Regulation

1555, data collection continued in 2023 which included the enumeration of *E. coli*, coliforms and *Enterobacteriaceae* (EB) in pasteurised milk samples. Statistical analyses of the results commenced in the second quarter in consultation with Mr Roelf Coetzer, Prof Elna Buys and Dr Heinz Meissner. The final statistical model is in progress, but in the meantime frequencies have been generated, significance levels established and interactions recorded.

The results showed that 54% of samples were within the criteria for coliform counts in pasteurised milk (<10cfu/ml according to R1555), 88% were within the specification for *E. coli* counts in pasteurised milk (absent according to R1555), 58% were compliant for total plate count in pasteurised milk (<50 000 cfu/ml according to R1555), and 68% were within the proposed specification for EB (<100 cfu/ml) in pasteurised milk. Furthermore, valuable information was derived for the packaging effect, for instance, coliform counts in sachets showed significant differences in comparison to other packaging, suggesting that sachets may be less effective with regards to product hygiene.

With an analysis of variance procedure, the following was revealed: Packaging, year, season, and province were significant variables for *E. coli*, and the interaction between packaging and season was significant. Similarly, for coliforms, the effects of packaging, season, and province were significant, but not the interactions. In the case of EB, packaging, season, and province emerged as significant factors, whereas year, packaging x season, and packaging x year were not significant.

The Vitek MS (identification) analyses on EB and *E. coli* positive samples in pasteurised and antibiotic susceptibility testing on succeeding positive Vitek MS identifications have been completed. Of the 84 different organisms in pasteurised milk, 22 species were of the EB group. Microbial criteria for EB have not been included in the R1555 regulation yet, but this comprehensive study already suggests that *Enterobacteriaceae* should not be overlooked.

The data analyses and interpretation of identifications and subsequent arguments related to risk management will continue in 2024.

PRJ-0358: Impact of good agricultural practice interventions on the SA Dairy Industry.

Project leader: Tania Blignaut (DSA).

Progress:

- A literature review was conducted and continues. Overall, the literature review serves as a foundation for understanding the current landscape of dairy production systems, identifying key challenges, and exploring potential solutions through the implementation of good agricultural practice (GAP) interventions. Additionally, ongoing research aims to benchmark these interventions against international standards, ensuring alignment with global sustainability goals and incorporate best

practices into the DSA Guide for GAP for producers as well as verification thereof by means of the DSA Producer audit program.

- The current audit criteria of the DSA have been revised after it was benchmarked against sustainability evaluation models to incorporate additional indicators for measuring agricultural sustainability. These amendments aim to align the audit criteria with international standards and benchmarks, particularly against the Response-Inducing Sustainability Evaluation (RISE) model. RISE provides a comprehensive assessment of farming operations across economic, social, and environmental dimensions.

- Data from 138 farm audits have been collected, processed, and finalised. The DSA GAP Assessment Audits criterion was completed and eight sustainability evaluations utilising the RISE framework.

- The evaluation of the sustainability performance of four farms by applying information gathered from GAP audits to the RISE system has been completed. This integration has provided valuable insights into the context of information required during farm audits and has facilitated a more holistic assessment of sustainability.

- Several enhancements have been identified to improve the measurement of compliance with good sustainability practices at the farm level and to assess risks effectively. Four out of the 16 themes have been successfully measured, and scores between the DSA audit criteria and the RISE indicator system have demonstrated correlation. Quantitative questions were added to the DSA audit criteria to measure sustainability more effective across all 16 themes.

- The compliance of raw milk to regulatory requirements, along with the measurement of compliance trends over a 3-5year period, has been identified as a crucial criterion. This longitudinal analysis will provide insights into the sustainability trajectory of dairy production systems and inform future policy decisions.

- Raw milk sampling is a critical component of the study, aimed at assessing the quality and safety of dairy products in South Africa. However, several challenges have been encountered throughout the process. Due to logistical constraints and difficulties in obtaining permissions to collect raw milk samples during farm audits, along with logistical hurdles, the testing of raw milk samples in 2023 could not be done. Efforts were made to address this issue by communicating with audit clients and requesting permission to collect samples. By the end of 2023, permission for sampling was obtained from one client. However, approvals from three remaining clients are still pending and will be pursued early in 2024.

PRJ-0342: A feasibility analysis of low cost biological wastewater treatment options for dairy farms in South Africa.

Project leader: Jon McCosh (INR, in collaboration with DUT).

Background: Dairy wastewater treatment has been applied in a variety of ways in South Africa, which include physico-chemical and biological methods, but there are no published studies that provide a comprehensive catalogue and understanding of the biological methods used and the applicability of low cost technologies. As such, the broad aim of the project is to conduct a physico-chemical analysis of wastewater produced by commercial dairy farms and assess the feasibility of using low cost biological wastewater treatment methods for mitigating the environmental effects thereof in the South African context.

Progress: An audit of the waste water found that the participating farmers use similar systems and ingredients for cleaning and sanitising dairy milking equipment and the volumes of wastewater generated from the parlour and the holding pens are now better understood. Further, the volume of the slurry ponds could be approximated, which will assist in understanding the residence time, frequency of abstraction and volumes applied to the pastures where waste water is irrigated.

Emerging from a literature review, a process to audit dairy waste water was developed, with farmers self-reporting on a series of questions relating to on-farm practices and dairy waste water which have been collated in tabular format. Notably, all farmers indicated that wastewater quality is not monitored and neither did any of the farmers indicate that there were water quality issues associated with the dairy waste water. However, the characterisation of the dairy waste water and a comparison of the water quality standards required for irrigation with wastewater with high organic content found that all four farms that were sampled were not compliant with a number of water quality standards, highlighting the need to introduce measures to enhance dairy waste water quality, prior to disposal of waste water onto pastures.

The results from the phycoremediation laboratory experiments suggest that algal consortia have potential in diluted dairy waste water and that further enrichment and adaptation is required for the consortia to be effective in higher concentrations of dairy waste water. The micro-algal consortia used in phycoremediation out-competed native microbes and native microbes failed to grow after 22 days of incubation as part of the enrichment process. However, this is based on a controlled environment laboratory experimental setting. Further, additional adaptation experiments need to be carried out to enhance the removal efficiency of COD. Furthermore, the COD removal was less than the COD removal observed in experiments where the batch reactor was inoculated with activated sludge. More research is required to develop strategies to improve COD removal.

On the negative side, the laboratory based phycoremediation experiments indicated that the high turbidity of undiluted waste water inhibits the establishment of algal consortia. Native microorganisms in the slurry performed well in ammonia removal and co-culturing with algae

further improved ammonia removal. The batches inoculated with algae furthermore performed well in the removal of nitrates. There was no significant difference in COD removal between the treatments and control. Further adaptation of the algal consortia is required to improve performance.

Next phase: Co-culturing of native bacteria and algal consortia suggest that this approach should be investigated further and soil samples should be analysed to determine if the irrigation with waste water has an impact on soil physico-chemical properties.

PRJ-0360: Use of NIR to detect and quantify mastitic bacteria in cow's milk.

Project leader: Mark Laing (UKZN)

Background: Recent advances in portable NIR (Near-Infrared Spectroscopy) technology and cloud-based Machine Learning application development have made the NIR technology affordable and accessible. The InnoSpectra range of portable devices, along with the Frequai software will allow dairy farmers, processors and consultants to analyse their products for as many parameters as required on-site and if necessary in real time. Whereas the present project is to develop NIR calibration equations for the major mastitis pathogens, the usual quality parameters can also be monitored regularly with the equipment as can be seen below.

Aim 1: Optimizing NIR models of milk quality parameters.

Progress: This was for the development of the software models for the analysis of major milk components, i.e., protein, fat and sugar, on an inexpensive InnoSpectra T-11 device. To that effect in order to produce the necessary range of fat, sugar and protein composition, mixtures of low fat milk, full cream milk and cream were created. The prediction models created showed exceptional accuracy with R^2s in excess of 0.9 [Y = predicted value; X = tested value]:

Fat: $Y = 0.812X + 1.51$; $R^2 = 0.953$

Sugar: $Y = 0.923X + 0.370$; $R^2 = 0.980$

Protein: $Y = 0.749X + 0.725$; $R^2 = 0.931$

The models were developed rapidly and easily. Therefore, the performance indicates that the InnoSpectra T-11 is a suitable device, coupled with the Frequai software, for rapid and inexpensive milk analysis.

Further developments are that the Frequai software is implemented to make the processing of scans an online App on a cellphone, because the T-11 links to a cellphone to capture the scans. The App will then upload the scans to the Frequai site on the Cloud, and then download the results to the cellphone.

Conclusions and recommendations with respect to milk composition predictions: These calibration models were developed rapidly and easily. Therefore, the performance indicates

that the InnoSpectra T-11 is a suitable device, coupled with the Frequai software, for rapid and inexpensive milk analysis. If more samples are added in model development, then the accuracy of the calibration models can be enhanced. The scanning of 100 milk samples took less than one minute.

This technology will be able to be used by farmers and dairy workers to provide on-site, real-time information about their product properties. Frequai is working to make these calibration models readily available to the dairy industry as an easy-to-access online system so that anyone with an InnoSpectra T-11 NIR device can scan a milk sample, upload the scan to the Frequai site, where it will be computer-analysed and then a simple spreadsheet of the results will be sent to the user. Development of the App is a further step.

Aim 2: Use of NIR to detect mastitis bacteria: A similar approach is being used to develop calibration models to develop NIR detection of mastitis organisms. Other researchers have shown that NIR is an effective tool for the detection of these bacteria. NIR will be able to discriminate between the major bacterial species that cause mastitis (*Staphylococcus aureus*, *Streptococcus* spp and *E. coli*) and also provide an estimate of the population of the bacteria. Initial results are positive but further experiments are required to develop robust, accurate calibration models for the five primary bacteria that cause mastitis. To that effect a new spectrophotometer was bought which should fast track analyses.

An unexpected delay was because the incubations were run for too long, and too warm. The result was that the bacterial populations grew too fast and when the cell numbers get high, then clotting occurs and then transmission NIR ceases to work. So, the focus will now be on the initial growth cycle of the bacterium in milk, and to slow down the growth cycle by using a cool incubation temperature. The goal is to detect low levels of the mastitis bacteria and therefore the conditions of the experiment will be changed to start with only 100 cells / ml, and to incubate at 4-6 ^{0}C for 24 hours, sampling every hour.

PRJ-0345: Estimation of the on-farm carbon capture and storage capacity within different dairy production systems: A system dynamics approach.

Project Leader: Riana Reinecke (in collaboration with James Blignaut of Asset Research)

Objective: To develop a tool based on a system dynamics model to assess greenhouse gas emissions (GHGE) and carbon capture and storage on farms, by analysing critical nutrient flows in order to determine whether farms are net emitters of carbon (i.e. sources) or sequestrators thereof (i.e. sinks).

Progress: The model has been developed which will assist dairy farmers and the industry in general with estimating carbon emissions, and carbon capture and storage capacity (including sequestration) of different production systems. In support, (1) an online tool has been developed to estimate the carbon footprint (emissions only) of a dairy farm, which can be accessed from: https://assetresearch.org.za/environmental-indicators-dairy-production-

systems-phase1/ and (2) a comprehensive web-based DESTiny tool (Dairy Environment Sustainability Tool) which estimates the net on-farm nutrient and net carbon flows (inclusive of both sources and sinks) for dairy production, which can be accessed from: https://assetresearch.org.za/on-farm-carbon-capture-and-storage-capacity/, with a user-interface which allows remote users, researchers, practitioners, farmers, and technicians ease of access while integrating the system dynamics models with on-farm realities. DESTiny can help dairy farmers adopt sustainable practices, improve competitiveness and reduce environmental risks while aligning environmental impact with profitability and building consumer trust.

Briefly, by analysing nutrient availability, pasture production and animal-related factors, DESTiny estimates emissions and sinks for carbon to gain a better understanding of the net carbon flux on a farm. The results of the model are disaggregated in such a manner that it provides a systems-view of the entire farm as a production unit while considering all the major factors needed to accurately calculate emissions and carbon storage. By doing so, producers, consumers and the industry stakeholders can understand how carbon flows through their farms, calculate the net GHGE, and measure the economic stability of the operations. The different sub-models within this tool are illustrated in Figure 1.

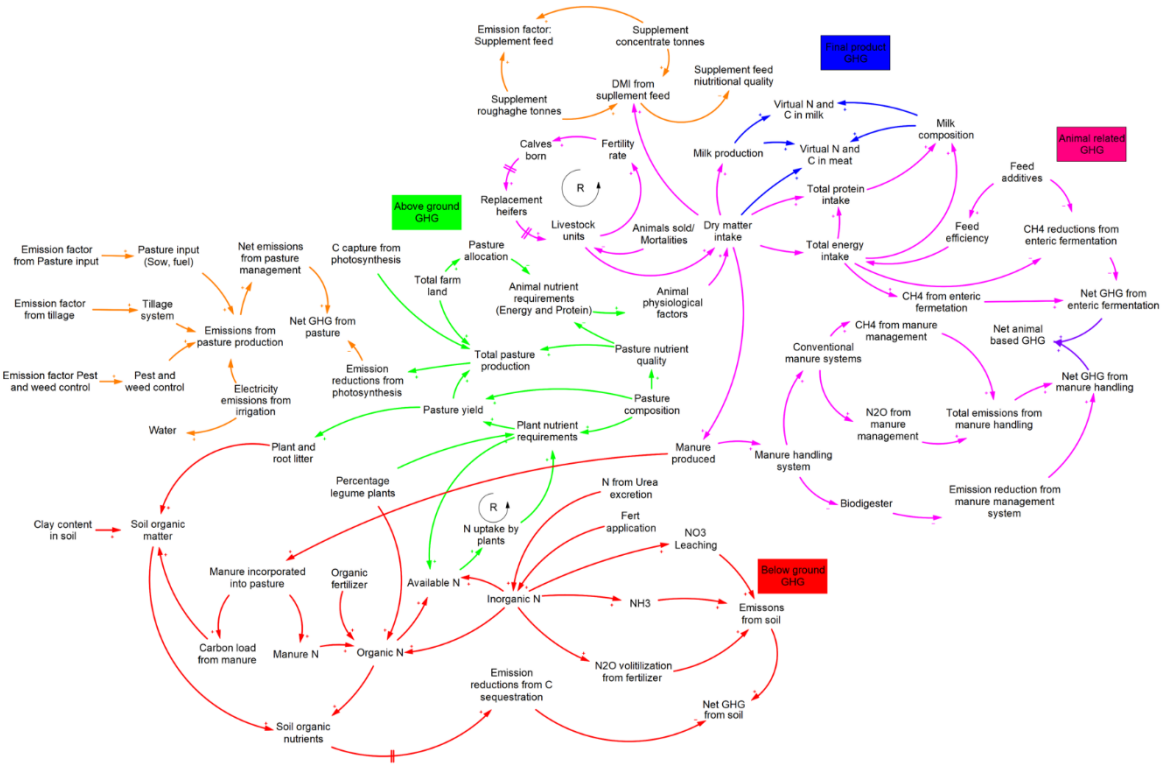

Figure 1: Causal loop diagram showing the flow of sources and sinks within a dairy farm system

Notes:

- Red sub-model: belowground

- Green sub-model: aboveground
- Purple sub-model: animal model
- Blue sub-model: within-product
- Orange sub-model: external sources

Next phase: This is aimed towards providing ongoing aftercare and monitoring of the use of the models and the updating thereof as and when new information becomes available. This includes the marketing of the tools and the development of capacity in the use and application thereof. This is to ensure that the tools are utilised to the benefit of the entire industry, in particular dairy farmers, processors, consultants, decision-makers and other stakeholders, such as consumers. Methods include: Ongoing revision and updating of the models and model parameters as new information arises; Marketing of the models by means of academic and popular papers, as well as participation in farmer days and conferences, and training on use of the tools for different users.

PRJ-0346: Application of a systems dynamic model to estimate the relative environmental footprint of milk and plant-based beverages.

Project leader: Enrike Maree (in collaboration with James Blignaut of Asset Research)

Aim: The primary aim of the project is to develop a comprehensive sustainability model tailored to milk and plant-based beverages, focusing on environmental, economic and nutritional dimensions.

Approach and application: A sustainability index providing a score to milk and plant-based beverages within South Africa has been developed. The so-called Nutrient-Rich Food Index (NRFi), which incorporates factors like nutrient bioavailability, food matrix effects, age and sex-specific dietary needs, demographic strata, global nutrient contributions, and associations with diseases or protective effects, has been used. Additionally, protein quality has been evaluated and included. The approach taken also leveraged life-cycle analysis (LCA) principles with parameters within farming and production systems, including carbon emissions and storage, water usage, fertiliser application, land use, energy consumption, recyclable materials, and waste management. To comprehensively gauge sustainability, the approach furthermore employs consumer and producer indicators and self-reported inquiries on aspects such as employee numbers, production efficiencies, profitability and others, which are considered along with product pricing in relation to country-specific poverty levels.

A summary of the results is shown in the table in index format.

Sustainability indicator scores in general, and specific to the carbon footprint.

Item & units	Bovine milk	Almond drink	Soy drink	Oat drink
Environmental	0.161	0.137	0.193	0.165

Economic	1.543	1.103	1.277	1.083
Nutritional	3.67	1.55	2.17	1.20
NRFPi^/CO_2 eq*	12.5 (6.66 – 30.7)	7.68 (5.24 – 20.5)	7.06 (3.85 – 25.2)	9.13 (5.12 – 9.24)
CO_2 eq/NRFPi**	0.08 (0.03 – 0.15)	0.13 (0.05 – 0.19)	0.14 (0.04 – 0.26)	0.11 (0.08 – 0.20)

^NRFPi: Nutrient Rich Food Price Index = Nutrient density score per Rand spent

**NRFPi/CO_2 eq = Nutrient density score achieved per Rand for each kg of carbon dioxide emitted*

***CO_2 eq/NRFPi = kg carbon dioxide emitted per Rand spent to achieve nutrient density score*

For the individual sustainability components, the results in the table show that bovine milk expressed the most favourable nutritional and economic profile, while the environmental score was within the ranges of the plant-based beverages. The nutritional score is based on chemical analyses, nutritional requirements and malnutrition parameters which are specific, and will therefore have little variation. The environmental score was obtained as an index including water use, land use, energy and nitrogen use, greenhouse gas emissions (GHGE) and others. These are all cite (farm) specific and depends on the production system followed. The same applies to the economic score. For the development of the model a specific scenario and production process were chosen, but the reader should realize that due to considerable variation in the elements included in the environmental and economic scores, the outcomes may vary substantially. This variation is illustrated where GHGE is expressed relative to NRFPi (to express emission justification in relation to food security) and per monetary unit spent. For the average scenario though, bovine milk achieved the highest nutrient density score per Rand for each kg of carbon dioxide emitted, or reciprocally, the least carbon dioxide emitted per Rand spent to achieve the required nutrient density score.

Next phase: Carbon emissions were calculated according to standard IDF/IPCC methodology to allow international comparison. The LCA for milk from cow to packaging will be determined using DESTiny instead, to allow for carbon sequestration and production system differences. The outcomes should be useful for milk buyers, processors and retailers.

B. Supporting Programmes:

PRJ-0355: Environmental sustainability

Responsible for Programme: Colin Ohlhoff (Fair Cape)

Also SA representative and vice-chair of the IDF's Scientific Committee for the Environment

Report: Over the past few years, what initially began as conversations around the connection between environmental sustainability and nutrition in the dairy sector, has developed into a prominent agenda item for all international dairy organisations. This intricate connection could be regarded as central in shaping current global commitments towards achieving the UN sustainable development goals. Attendance of a recent symposium hosted by the Consumer Education Project proved that dairy in South Africa is at the forefront of forging the link between the value of nutritious dairy products to human health, and the associated environmental footprint reduction efforts related to its production. We can confidently demonstrate to consumers, the benefits of incorporating dairy into a healthy diet where its nutritional complexity makes it beneficial for children, adults, and the elderly, while simultaneously ensuring that dairy is produced in harmony with the environment.

Milk SA and its Research Program has over the past 12 months again been immensely proactive and supportive of ensuring that our industry is aligned with international best practices and relevant research areas in the field of 'environment'. We are regularly exposed to the ambitions of Europe and the USA to progress GHG measurement, where we have seen that emission reduction targets and the associated pressures of implementing practices which will advance reducing emissions from dairy farms, has become a key driver of policy making within some of these countries. From a dairy perspective, the focus on methane reduction specifically, was again a notable focus area at the recent International Dairy Federations World Dairy Summit held in Chicago (October 2023). The United States, in particular, seems to be rapidly developing their Carbon marketplace, where verified credits can be sold outside of the dairy sector, to commercial entities in so doing, offsetting the emissions from their operations. This point was highlighted in a previous quarterly report and is certainly a development that will be keenly followed during 2024.

In South Africa, enabling our farmers to understand the environmental impact of their operations through modelling, is a positive step on our own sustainability journey. To this extent, the work conducted by the Asset Research Group in collaboration with the R&D program of Milk SA to develop a web-based tool which can be used by farmers to analyse nutrient and carbon flows on their farms, must be recognised. This serves as a potentially valuable guide, enabling users to evaluate their on-farm management strategies while allowing them to trial various sustainability scenarios. This can provide insight into how changes in practices could impact both environmental and economic outcomes. We look forward to uptake in the use of this tool and will continue to promote it through our communication channels.

The issue of food waste and loss, which is both a nutrition and environmental concern, received further attention this past year on a National level where Government published a draft strategy for reducing food waste and loss in terms of section 72 and 73 of the National Environmental Management: Waste Act 2008 (Act 59 of 2008). The dairy industry has been active in its engagement with the Consumer Goods Council of South Africa on this topic prior to this strategy being published. The goal is to establish a food loss/waste baseline for the dairy industry in South Africa and this is largely reliant on individual dairies reporting the required figures. While progress has been limited in 2023, a concerted effort will be made to add some momentum to the process in the upcoming months.

The concept of 'circular economy' and the opportunity for farmers to efficiently harness waste streams, potentially converting these into economic benefits, was referenced on occasion during the past year. Our focus must be on minimizing the use of finite resources as far as possible, while encouraging the use of regenerative ones. In this regard, the Milk SA R&D Program has identified that our understanding of waste and nutrient management systems on-farm could be further enhanced through looking into the flows of Nitrogen, Phosphorus and Potassium specifically. Where do these nutrients emanate from on-farm? How do they move through the system? Are we treating and re-using them effectively? Just some interesting food for thought at this stage as this project is currently being scoped and developed.

PRJ-0357: Veterinary consultancy – Animal Health and Welfare.

Responsible for Programme: Mark Chimes (Private and DSA)

Meetings attended: Amongst the most prominent Meetings in relation to Animal Health and Welfare include: 4 of the National Animal Health Forum (NAHF); 4 of the Livestock Welfare Coordinating Committee (LWCC); 1 of the National Animal Health Forum & Technology & Innovation Agency; 2 of the SPCA in transport and housing of dairy calves; 1 on the International Dairy Federation's (IDF) Sub-Committee on Animal Health & Welfare; the IDF World Congress – IDF Welfare Forum and Joint Scientific Committee on Farm Management.

Webinars presented for the DSA: rBST – Friend or Foe? and Increase your profits with dairy farm animal welfare.

Webinars attended: DSA – Sharpen your pencil on dairy legislation, and The fear factor in automated microbiological test methods; IDF – Discussion on dairy calf rearing, Nutrition matrix of dairy, and Understanding methane.

Lectures presented: Ruminant Veterinary Association of South Africa (RuVASA) Congress 2023 – Welfare aspects of Lameness in dairy cattle; RuVASA Congress 2023 – Welfare of dairy calves; Onderstepoort final year veterinary student dairy elective – Welfare aspects of lameness in dairy cattle, and Welfare of dairy calves; IDF World Congress – Measures to

improve the welfare of dairy calves in South Africa; Consumer Group of South Africa (CGSA) – Monitoring of animal health and welfare on dairy farms.

Congresses attended: RuVASA 2023; IDF World Congress, Chicago; SA Veterinary Association Southern Cape Branch mini-congress.

Articles and guidelines published: Milk SA guidelines: Brucellosis-A dairy farmers'guide; Assisted calving; Paired calf housing; Calf buyer and seller agreement; Protocol for dairy farms in case of Foot and Mouth disease; Selective dry cow treatment, and Disbudding of calves. For the Review magazine – lameness in dairy cows as a welfare issue.

Reports compiled: IDF reports: Animal welfare effects on the 4 pillars of sustainability from a South African perspective; Report on Control of Foot and Mouth Disease outbreak in SA; Implementing measures to improve the welfare of dairy calves in South Africa. Milk SA – Draft press release regarding a calf welfare incident in Albertinia; Milk SA's position on calf hutch sizes.

Appointments: IDF: Registered as an expert on Animal health and welfare; Appointment as the SANCIDF SA representative on animal health and welfare. NAHF – Appointed by SAVA to represent them as a committee member. LWCC – Appointed as the representative of Milk SA. SABS – applied to be appointed to the technical committees for SANS 1694 and 1488 revision. Committee member of the SAVA Southern Cape branch and co-opted member on animal welfare of RuVASA.

Miscellaneous activities: 79 x Dairy farm audits for the DSA; helped to revise the dairy farm audit questionnaire; 5 x ''Ruminant Health and Production'' magazines published as editor; Revised SANS 1694 – The welfare of dairy cattle – with a view to have it updated; revised SANS 1488 – Transport of livestock by road – with a view to have it updated; MPO – Acted as one of the judges for the MPO/Nedbank Stewardship competition.