Managing Heat Stress Can Improve the Milk Environmental Footprint

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Heat stress takes a heavy toll on dairy cows, not only reducing farm profitability but also raising the environmental impact of every litre produced. New data brings a fresh perspective on rumen-specific live yeast, showing that it can influence both dairy performance and the environmental footprint of milk production under hot temperatures.

As climate changes, managing heat stress is both a farm performance and animal welfare issue. Heat-stressed cows eat less, ruminate less and divert energy from dairy production to thermoregulation. The consequences are well documented: reduced milk yield, lower feed efficiency, increased acidosis risk, higher somatic cell counts and, in the long term, drops in fertility. The real economic toll of heat stress is staggering — global annual losses have recently been estimated to exceed $US10 billion (IDF, 2025). In addition to the financial impact, it also appears that heat stress has an environmental cost, as recent research demonstrates an increase in the environmental footprint of milk production.

The environmental cost of heat stress

Agriculture is responsible for approximately one quarter of global greenhouse gas (GHG) emissions, with ruminant production contributing around 40% of this share.



Enhancing feed efficiency represents a key lever to reduce emission intensity per kilogram of milk produced.

However, heat stress exerts opposite effects on animal performance: when the Temperature–Humidity Index (THI) exceeds 68–70, dairy cows typically exhibit:

- Reduced dry matter intake (DMI)
- Decreased rumination activity
- Increased risk of rumen pH drop
- Lower fibre degradation
- Reduced milk yield, often accompanied by a decline in milk fat content

A recent publication highlights heat stress as a significant driver of the environmental footprint of milk production. The study demonstrates that elevated thermal load (THI≈ 73) disrupts rumen function (decreased rumination time, rumen pH, and motility), altering fermentation efficiency and nutrient utilisation. These physiological effects translate into reduced animal productivity, particularly lower milk yield and feed efficiency.

As a consequence, under heat stress, methane emissions increased, both per kilogram of feed intake (methane yield) and per kilogram of milk produced (methane intensity). Methane yield increased by ~17% (17.0 vs. 14.5g/kg DMI), while methane intensity rose by ~18% (11.3 vs. 9.6g/kg ECM). Thus, heat stress exacerbates the milk environmental footprint by depressing performance while compromising digestive efficiency, reinforcing the link between animal resilience, productivity, and environmental impact.

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Managing heat stress - managing the rumen

Among the various nutritional approaches available to help alleviate heat stress impact in dairy cows, live yeast appears as the most robust one.

A recent meta-analysis conducted a systematic evaluation of dietary interventions tested in lactating dairy cows under heat stress conditions, including various feed additives or supplements such as live yeast, yeast-based products, phytochemicals, vitamins, minerals, betaine, amino acids and lipids.

Drawing on a large body of peer-reviewed studies (53 studies included in the analysis), the authors quantify the effects of these different approaches on cow performance, physiology, and thermoregulatory responses.

They concluded that live yeasts (Saccharomyces cerevisiae) showed the most consistent outcomes, increasing milk yield by +5.70%, exceeding the average response observed for other yeast derivatives or supplement types. In addition, live yeast supplementation was associated with reductions in milk urea nitrogen, plasma haptoglobin, and respiration rate, suggesting improved metabolic and physiological resilience during heat stress.

The meta-analysis included one controlled study conducted at the University of Florida with Saccharomyces cerevisiae CNCM I-1077 (LEVUCELL SC , Lallemand Animal Nutrition) under heat stress conditions (THI ≈ 80). This publication (Fig. 1) showed a 5.7% increase in energy-corrected milk yield and a 7.6% improvement in feed efficiency (+130g of milk/kg DMI), without nutrient dilution effect. This benefit is explained by the well-documented effects of S. cerevisiae CNCM I-1077 on rumen function, in particular under stressors.

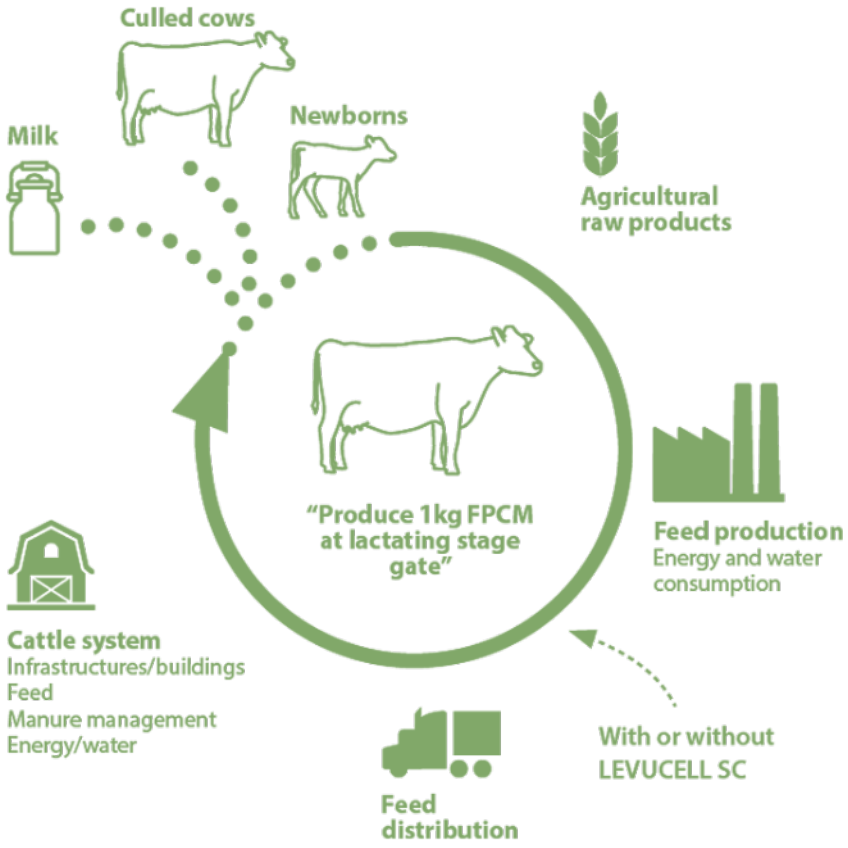
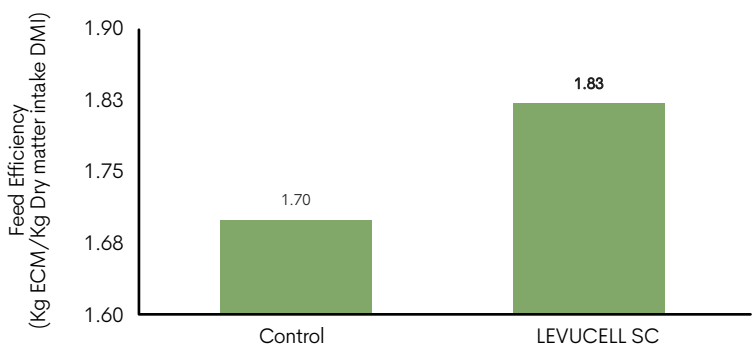


Fig. 2. Scope of S. cerevisiae CNCM I-1077 Life Cycle Assessment study, from cradle to farm gate.

Fig. 1. Effect of S. cerevisiae CNCM I-1077 supplementation on dairy cows' feed efficiency (Kg ECM/Kg dry matter intake) under heat stress conditions.



Link to environmental footprint

The Florida heat stress trial has been further analysed in terms of environmental footprint. Indeed, the dataset from this study was included in a Life Cycle Assessment* (LCA) to evaluate the environmental footprint of 1kg of fat and protein corrected milk (FPCM) from cradle (including upstream feed production and transport) to the farm gate, with and without S. cerevisiae CNCM I-1077 (Fig. 2).

The LCA report was critically reviewed by Greg Thoma, PhD, independent expert and Director of Agricultural Modelling and Life Cycle Assessment at AgNext, Colorado State University.

In LCAs applied to dairy production systems, a total of 16 environmental impact categories are recommended at the European level, which were fully evaluated in this study.

Among those, seven key indicators have been identified by the Product Environmental Footprint Category Rules for Dairy (PEFCR Dairy) as the most relevant for assessing the environmental performance of milk production (Fig. 3).

The study showed that the carbon footprint of milk (per 1kg FPCM) decreased by 6.1% when cows were fed the live yeast while under heat stress.

Moreover, across the seven indicators selected by PEFCR Dairy, all showed reductions (from 4.9% to 8.3%, Fig. 4). These reductions are linked to higher feed efficiency and improved milk yield, as **fewer resources and emissions were needed per unit of milk produced.**

Building dairy resilience

Beyond the challenges of agricultural raw material production, heat stress is becoming a major constraint of global dairy production. Traditional mitigation strategies, shade, cooling, ventilation, etc., are essential. However, nutritional strategies should also be considered for a more holistic approach. New evidence-based research indicates that live yeast could be considered the most robust solution. Our results confirm that rumen-specific live yeast documented to improve rumen stability and feed efficiency during heat stress can also bring additional sustainability benefits by:

- Mitigating productivity losses without increasing resource use
- Reducing milk production environmental footprint, especially GHG emissions intensity at a time when dairy producers face increasing demands from the dairy industry and consumers
- Contributing to animal welfare, which is also an increasing demand from the dairy market

Conclusion

Feeding rumen-specific live yeast in a period of higher heat stress risk can help maintain dairy cows' rumen efficiency, fibre digestion and feed conversion. New LCA data indicates that these improvements translate into lower environmental impacts per kilogram of milk produced, in particular a 6.1% reduction in carbon footprint.

In a context of rising temperatures, such insights highlight the potential role of rumen microbial management as one of several levers to improve feed efficiency and reduce emissions intensity in dairy production.

** ISO conformant LCA (ISO 14040 / 14044), following the Product Environmental Footprint Category Rules for Feed (PEFCR Feed) and the PEFCR Dairy methodology.*

References are available from the author on request

Indicator (Unit)	What it means	Why it matters in dairy production
Acidification (mol H^+eq)	Emissions that make soil and water more acidic (e.g., ammonia, NOx).	Animal emissions, particularly ammonia from manure and urine, contribute to soil and water acidification.
Climate change (kg CO_2 eq)	Total greenhouse gases contributing to global warming: CO_2, CH_4, NO_2, It is expressed in equivalent CO_2, as each gas has a different global warming power: **1kg CH_4 = equivalent to 27kg CO_2** **1kg NO_2 = equivalent to 273kg CO_2 in terms of warming potential**	Enteric methane from cows and nitrous oxide from manure and fertilisers make climate change the largest impact for dairy production.
Freshwater ecotoxicity (CTUe)	Chemicals that can damage freshwater ecosystems.	Fertilisers or pesticides, used for feed production can pollute rivers and lakes.
Particulate matter (disease incidences)	Fine particles that affect human health.	Dust from feed, manure drying/ spreading and machinery emissions can impact respiratory health
Marine eutrophication (kg N eq)	Nitrogen that reaches the sea, causing algae blooms, leading to oxygen deprivation, impacting marine ecosystems.	Nitrogen losses from fertilised soils or manure runoff can pollute marine water.
Terrestrial eutrophication (mol N eq)	Excess nitrogen deposited onto land ecosystems.	Ammonia from manure contributes to nutrient imbalance, reducing plant species diversity.
Water Use (m^3 deprivation)	Water consumption adjusted for local scarcity.	Water is needed for cow consumption, cleaning and culture irrigation for feed production.

Fig. 3. Significance of environmental indicators for dairy production (based on the 7 indicators prioritised by PEF CR Dairy for milk production (for the production of 1kg FPCM).

Fig. 4. Effect of S. cerevisiae CNCM I1077.supplementation on 7 PEFCR Dairy environmental factors of milk production under heat stress conditions.

