Reducing rumen emissions

Enteric methane interventions, such as feed additives

Fact sheet 2 of 6

Methane is a harmful greenhouse gas which can be generated in a variety of ways, including by the digestive process of ruminants, like dairy cows.

Enteric methane interventions are actions that reduce the methane produced by microbes in the rumen of livestock.

Methane production is highly influenced by dry matter intake and diet quality. Increased dry matter intake leads to an increase in methane emissions, but higher digestibility results in less methane emissions because feed spends less time in the rumen.

Dietary reformulation, including feed additives, can reduce methane emissions, but not all formulations are suitable for all dairying systems and some products are still in development.

The research analysed the following enteric methane interventions. Many of these interventions are available now – others are not far away.

- Agolin®
- Bovaer® (3-NOP)
- *Asparagopsis* (red marine algae)
- Breeding
- Early life programming

Agolin®

Agolin® is a feed additive based on an essential oil that is already commercially available in Australia and overseas. It is a low-cost feed option, applicable to many farming systems with potential productivity gains.

KEY POINTS

Enteric methane is a greenhouse gas produced in the rumen of livestock, accounting for more than half the emissions from dairy farms

Dietary additives, breeding, early life programming are all forms of enteric methane interventions

Agolin® (an essential oil feed supplement), can profitably reduce enteric methane emissions for dairy farms

Asparagopsis and Bovaer® (3-NOP) work well in total mixed ration (TMR) farm systems, but delivery methods must be investigated for grazing systems

Research found Agolin® was the best feed additive of its type supported by scientific literature. Not all studies found Agolin® reduced methane or increased milk production. Methane reductions reported range from 8.8 per cent to 12.9 per cent. More research is needed to better understand the productivity co-benefits of Agolin® and the sources of the variation in productivity and methane reduction benefits between studies.

Bovaer® (3-NOP)

Available now, Bovaer® (3-NOP) is a feed additive that inhibits methane production in ruminants. It is most effective when mixed with every bite of food consumed by livestock so works best in a Total Mixed Ration (TMR) system. Its application in grazing systems will be limited until alternative delivery mechanisms are available.

Studies have demonstrated methane reductions from 3-NOP fed to dairy cows ranging from 6.5 per cent to 38 per cent. A life cycle assessment of 3-NOP use in dairies in California, USA recorded an overall reduction in emissions, even with the inclusion of emissions associated with manufacturing and transport.

3-NOP was more effective at reducing emissions in a TMR farming system with report authors noting that 'less intensive' systems should allow for 'lower, but still substantial methane reductions.'

The challenge for Bovaer® (3-NOP) is finding delivery mechanisms for pasture-based dairy farming systems.

Asparagopsis

Asparagopsis (red marine algae) is a seaweed that is still in development as an option to reduce methane production. It has greater emissions mitigation potential than Bovaer® (3-NOP).

Large reductions in methane emissions – even at a lower feed inclusion rate – have been reported for *Asparagopsis*. But, like other feed additive interventions, studies have indicated variability in the results, with forage quality likely to be one cause of this variability. Studies have shown potential reductions in methane of 26.4 per cent to 67.2 per cent from feeding *Asparagopsis*.

Asparagopsis could become a more attractive option in the coming years if its cost fell, which may occur with improvements in production processes and increase in supply. However, availability could be held up by regulations and supply.

Further research is needed to better understand the production and environmental impact of growing *Asparagopsis*. More information is needed about the optimal doses of *Asparagopsis* for dairy cows as well as potential productivity effects.

Genetics/breeding

Some cows naturally produce less methane than others. By breeding for this trait, it is possible to lower the amount of methane emitted per kilogram of protein equivalent produced for each animal.

Farmers who breed with genetics from the industry's Balanced Performance Index (BPI) – the most widely used economic index for breeding dairy cattle in Australia – receive small emissions reductions anyway. DataGene's **Sustainability Index** was released in 2022 as a tool for those wishing to more aggressively reduce emissions intensity via genetics.

Calculating the value of emission reduction strategies

- A review commissioned by Dairy Australia has estimated the costs and effectiveness of different greenhouse gas emission reduction strategies across the Australian dairy farm industry as a whole, based on the most recent information available.
- Each strategy was analysed for its ability to reduce the total greenhouse gas emissions (mitigation potential). The cost of this action was calculated per tonne of carbon dioxide equivalent or CO_2e.
- Combining the mitigation potential and the cost of the reduction paints a picture of the value for money that each strategy could deliver.
- This information will be used to guide research and investment decisions.
- This fact sheet and others in the series provide a summary of the information from research most relevant to individual farmers. They provide a useful starting point for farm businesses looking to understand their options. Farm businesses will need to do further analysis to figure out which option(s) are appropriate for their own business.

Breeding achieves low to moderate reduction in methane emissions without any productivity sacrifices and this strategy complements other emissions reduction actions. While the benefits are incremental, they are permanent and compound each generation.

Breeding for reduced emissions intensity is considered a low cost option because breeding is already a routine cost of production. The cost is largely an 'opportunity cost' – the potential gain lost when choosing one investment opportunity rather than another. Breeding for reduced emissions intensity is more costly if a farmer chooses to aggressively chase emissions reductions through breeding as this choice was assumed to incur an opportunity cost associated with lower gains in milk production than if they selected genetics based on the BPI. The mitigation effectiveness of this option is in addition to the historic reduction in methane emissions associated with breeding for increased efficiency of production.

There are no specific on-farm studies that have demonstrated the level of methane emissions mitigated as a result of breeding, however, breeding has been suggested as a timely strategy to start with, because of the low cost and minimal changes to on-farm practices.

Early life programming

Methane inhibitors – such as Bovaer® (3-NOP) – fed to calves can alter the development of rumen microbes so, as cows, these animals emit less emissions.

Referred to as early life programming, this approach shows promise – but more research is needed. Research has shown 8.7 per cent to 17.5 per cent reduction of methane emissions from cows 56–60 weeks of age that were treated as calves.

Due to the early stage of research on this method, there is high uncertainty about many things including the costs and availability. While early life programming uses a product already available – Bovaer® (3-NOP) – the timeline for adoption will depend on developing a method of applying it to commercial farming operations and longer-term research studies.

If proven, early life programming will be suitable to all farming systems and won't require daily feeding of Bovaer® (3-NOP) during lactation – reducing the cost of the strategy.

The early life programming strategy requires verification of how long emissions reductions will last while there's also research gaps regarding the impact of management, farm characteristics and cow traits on the effectiveness of this mitigation option.

FURTHER INFORMATION

This fact sheet is one of a series:

1 Reducing dairy's greenhouse gas emissions
2 **Reducing rumen emissions**
3 Reducing manure emissions
4 Reducing nitrous oxide emissions
5 Reducing fossil fuel emissions
6 Storing more carbon.

You can find these on the Dairy Australia **website**.

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