Investigating the effect of 3-nitrooxypropanol (3-NOP) on enteric methane emissions in Irish Winter-Milk cows

[1]Michael Dineen, [1]Neil Maher, [2]Aidan Lawless, [1]Hazel Costigan and [1]Ben Lahart.
[1]Teagasc, Animal and Grassland Research and Innovation Centre, Moorepark, Fermoy Co. Cork, Ireland P61 P302.
[2]Teagasc, Johnstown Castle, Co. Wexford, Ireland.

Enteric methane is responsible for 62.5% of Irish agricultural emissions; hence, the reduction of methane will play a critical role in achieving agriculture's green-house-gas emissions reduction target of 25% by 2030. Furthermore, the Global Methane Pledge, which was initiated by the European Union and the USA, aims to collectively reduce methane emissions by 30% by 2030. If such reductions can be achieved, a 0.2 °C increase in average global temperature could be eliminated by 2050, due to the relatively short life of methane in the atmosphere.

There are currently a number of mitigation solutions available to achieve these targets such as animal genetics, pasture quality and methane reducing feed additives. Notably, there is a methane reducing feed additive, 3-nitrooxypropanol (3-NOP), which has performed robustly when investigated internationally. This 3-NOP molecule selectively binds into the active site of methyl coenzyme-M reductase while also being cleaved into nitrite and 1, 3-propanediol and thus inhibits the enzyme from catalysing the last step of methanogenesis, ultimately reducing methane production.

Over the winter of 2022-2023, at the Johnstown Castle Dairy Unit, the effect of 3-NOP on enteric methane emissions in Irish Winter-Milk cows was investigated. Two experimental diets were designed containing grass-silage, maize-silage and concentrate, fed either without (control) or with the 3-NOP molecule. The feed additive was simply added to the diet feeder with the other dietary ingredients each morning and fed to the corresponding treatment group.
The experiment consisted of a 2-wk covariate period and a 7-wk data collection period where the enteric methane emissions of the cows was measured daily using Greenfeed machines.

In terms of milk production, cows fed 3-NOP produced slightly higher milk protein concentration when compared with cows fed the control diet (3.57 vs. 3.51%, respectively). In addition, cows fed 3-NOP produced slightly higher milk solids (MS) yield when compared with cows fed the control diet (2.50 vs. 2.45 kg MS/day, respectively).

Cows fed the 3-NOP treatment produced less absolute (g of methane per cow per day) methane (330 g/day) when compared to cows fed the control diet that did not contain the feed additive (447 g/day), a 26% reduction. The intensity of methane emissions (g of methane per kg of MS) was also reduced with 3-NOP fed cows producing 132 g of methane/kg of MS, whereas cows fed the control diet produced 182 g of methane/kg of MS, a 27% reduction.

While the outcomes of this experiment investigating the effect of 3-NOP on enteric methane emissions in Irish Winter-Milk cows are promising, an array of mitigation technologies will be required to ensure that agriculture can meet its climate targets while also being mindful of economic and social sustainability. Additionally, due to 3-NOP’s molecular structure, it is highly soluble and rapidly metabolized in the rumen, hence when fed only twice a day within pasture-based systems its effectiveness of inhibiting methane production is reduced. Altogether, it is critical that further investigations into methane emissions mitigation technologies are performed.