SRUC

Economic Advice & Related Services to Support Development of a New Rural Support Scheme for Scotland

RESAS/005/21

Methane mitigation by feed supplements

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An output to RESAS as part of commissioned project on Economic Advice & Related Services to Support Development of a New Rural Support Scheme for Scotland

Output Ref: RESAS/005/21 – W7

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June 2022

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Key Points

- This summary draws on Duthie et al's (2022) report to Defra on *Methane Inhibiting Livestock Feed Supplements: Review of Net Impacts, Barriers to Success and Consumer Acceptance*.[1]
- The potential of feed supplements[2] to reduce emissions intensity by inhibiting enteric methane production from ruminant livestock has attracted considerable attention. A variety of potential supplements have been investigated, varying in their origins and composition. For example, 3-nitrooxypropanol (3-NOP), Essential Oils, Probiotics, Nitrate, and Seaweed.
- Widespread adoption of such methane inhibitors will be dependent upon their availability, efficacy, and acceptance by farmers. However, none currently have the necessary regulatory approval, supply-chain infrastructure and appropriate incentives in place for widespread commercial release and adoption.
- One (Agolin Ruminant, an existing but rebranded essential oils product) is currently available in the UK – but its regulatory approval does not as yet relate explicitly to its potential for reducing enteric methane.
- One other (Bovaer 10, a branded 3-NOP product) is authorised for use to reduce methane emissions from dairy cows in the EU, but is not yet authorised in the UK.
- Reported emission reductions vary widely from c.5% to over 50%, reflecting challenges in measurement but also variation across different supplements and farming systems.
- Practical difficulties in ensuring individual animals receive correct daily dosages are likely to result in lower emission savings than those achieved under experimental conditions. Inclusion of supplements in pre-mixed concentrate-based feed rations may be feasible for some farming systems, but alternative delivery mechanisms (e.g., boluses, feed blocks/tubs/licks) may be required for (especially) forage-based systems.
- Most feed supplements designed to reduce methane have little or no beneficial effect on animal performance (and therefore farm revenue). Some may have negative effects on perceived product quality (e.g., taste). Regulation, direct payment and/or subsidy (as well as advice and training) will be required to incentivise adoption.
- Cost data are scarce but suggest £0.02 to £0.20 per animal per day. For comparison, typical daily feed costs for dairy cows are currently about £4.00 and for finishing beef cattle the currently range from £2.80 - £4.00 depending on the intensity of finishing system.
- Further research is needed into efficacy, to establish robust verification of emission savings to inform both on-farm and policy decisions, and to counter general scepticism about the accuracy and consistency with which farming's net emissions are portrayed.
- Technical, market and regulatory developments in this field are rapidly evolving and hence briefing notes would benefit from regular (e.g., quarterly) updates.

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[1] Duthie, C-A., Vigors, B., Akaichi, F., Miller, G., Newbold, J. and Eory, V. (2022) Methane Inhibiting Livestock Feed Supplements: Review of Net Impacts, Barriers to Success and Consumer Acceptance. A report to Defra.

[2] 'Feed Supplement' is used here as a generic term including products regulated as either Feed Materials or Feed Additives.

Introduction

1. Enteric methane is essentially wasted energy, accounting for 2% to 12% of the total energy gained from feed. Improving feed efficiency so that less energy is lost as enteric methane will result in more sustainable ruminant production.

2. Nutritional strategies are a key element in reducing enteric methane and are the subject of ongoing research and commercial development. In particular, the potential of feed supplements to reduce emissions intensity by inhibiting methane production in the rumen has attracted considerable interest.

3. However, widespread adoption of such methane inhibitors will be dependent upon their availability, efficacy and acceptance by farmers. This paper summarises current evidence[3] for these, recognising that technical, market and regulatory developments in this field are rapidly evolving and hence briefing notes would benefit from regular (e.g., quarterly) updating.

4. 'Feed Supplement' is used here as a generic term including products regulated as either Feed Materials (previously under EC Regulation 767/2009) or Feed Additives (previously under EC Regulation 1831/2003). It is worth noting that if a company has Feed Materials with some efficacy they can refer to it can provide an easier route to market than for a new Feed Additive that needs a full dossier of efficacy and safety data.

Market availability

5. A variety of potential feed supplements have been the subject of research and development. For example, 3-nitrooxypropanol (3-NOP), Bromochloromethane, Essential Oils, Monensin, Nitrate, Probiotics, Saponins, and Seaweed.

6. Bovaer 10 (brand name for 3-NOP) is authorised as a feed additive to reduce enteric methane emissions from dairy cows in the EU (with approval for other ruminants likely to follow). It is not yet authorised for use in the UK.

7. Agolin Ruminant (an existing but rebranded essential oils product) has been commercially available in the UK for several years. It contains ingredients authorised as sensory Feed Additives, but not (yet) as zootechnical Feed Additives for the purpose of methane mitigation.

[3] More detail is presented by Duthie, C-A., Vigors, B., Akaichi, F., Miller, G., Newbold, J. & Eory, V. (2022) Methane Inhibiting Livestock Feed Supplements: Review of Net Impacts, Barriers to Success and Consumer Acceptance. SRUC report to Defra.

8. Mootral (a mix of Feed Additives and Feed Materials) is commercially available. Like Agolin Ruminant, the Feed Additives it contains are approved as sensory Feed Additives but not as zootechnical Feed Additives for the purpose of methane mitigation.

9. SilvAir (a branded nitrate product) can be used as a Feed Material and test marketing in Netherlands and Belgium may commence during 2022.

10. Asparagopsis (a red seaweed) can currently be marketed as a Feed Material, although if further processing is required (e.g., to lower iodine content), it may be regulated as a Feed Additive. Supply chains to Europe have not yet been developed.

11. Table 1 presents some information on these five example products.

12. Foreign Direct Investment has supported a facility to produce Bovaer 10 in Scotland, but supply-chains for most methane inhibitors are likely to be based outwith the UK. None currently have the necessary regulatory approval, supply-chain infrastructure and appropriate incentives in place for widespread commercial release and adoption.

Table 1 Summary description of five products closest to commercial availability

Product name (supplier)	Active principal	Effect (CH_4/kg dry matter intake)	Regulatory status	Supply chain	Commentary
Bovaer 10 (DSM)	3-nitrooxy propanol	-25.1%[1]	Authorised in EU as zootechnical feed additive for dairy cows Not yet authorised in UK	In place	Effects are short-lived, so requires continual consumption. Slow-release forms, more applicable to grazing livestock, are in development.
SilvAir (Cargill)	Nitrate	-15.5% (dose-dependent)[2]	Listed as Feed Material (source of NPN and Ca)	In place (pilot)	Likely to be test marketed in NL and BE, exclusively as an ingredient in compound feeds (to manage risk of over-consumption)
Agolin Ruminant (Agolin SA)	Plant extracts (eugenol, linalool)	-14.7%[1]	Authorised in EU and UK as sensory additive Under review by EFSA as zootechnical feed additive	In place	Already widely used in UK under a different brand name, likely resulting in unrecognised and unrewarded reductions in methane.
Mootral (Mootral GmbH)	Garlic, citrus oil	-13.3[3]	Components listed as Feed Material or authorised as sensory additive	In place (small scale)	Currently used on a small number of dairy farms (in England?), generating voluntary carbon credits sold through Verra.
Asparagopsis seaweed (Future Feed pty)	Bromoform	-22% (dairy), -56% (beef), variable responses reported[4]	Seaweed listed as Feed Material May be regulated as Feed Additive	To be developed	EU (and UK?) may decide to regulate as Feed Additive, implying significant time needed to develop safety and efficacy dossier.

1. SRUC Rapid Evidence Assessment, 2021 (unpublished)
2. Feng et al. (2020) J. Dairy Sci. 103: 11375–11385
3. Roque et al. (2019) Transl. Anim. Sci. 3: 1383–1388
4. SRUC Rapid Evidence Assessment, 2022 (unpublished)

Composition and Efficacy

13. Potential feed supplements differ in their composition. For example, 3-NOP and Nitrates are synthetic in nature whereas seaweed and essential oils are natural ingredients. This may influence acceptability to consumers and farmers.

14. Products also differ in their reported average effect on headline emissions. For example, from around 5% for some probiotics to around 15% for essential oils to around 25% for 3-NOP and over 50% for Asparagopsis.

15. However, such averages are based on relatively few reported studies and mask considerable variation between studies. Such variation may reflect that measuring changes in methane emissions under even controlled experimental conditions is challenging.

16. It may also reflect differences in whether effects are expressed, for example, per unit of feed intake (as in Table 1 above) or per unit of livestock output, and indeed which type of ruminant species is being considered (e.g., dairy cow vs. beef cow vs. sheep). Hence, whilst mitigation effects are to be expected, precise quantification of real-world efficacy is subject to some uncertainty. Efficacy is also likely to vary depending on cattle diet and more research is needed on this (it is notable that DSM are undertaking work to better predict the magnitude of responses to Bovaer).

Farmer acceptance

17. The acceptance by farmers of methane inhibitors for on-farm use will be influenced by a range of factors. These include the cost of adoption in terms of not only the price of feed supplements but also their ease of use and any effects on the quantity and/or quality of livestock products.

18. In principle, lower methane emissions should translate into productivity improvements through lower feed requirements and/or higher output. In practice, evidence of this remains scarce, although has been shown for dairy cattle in some cases. This implies little or no beneficial effect on animal performance (and therefore farm revenue).

19. Consideration also needs to be given to possibilities for product taint (e.g., essential oils can affect product taste) and other negative consumer perceptions of quality (although low emissions may generate positive perceptions).

20. Equally, effects on animal health and welfare need to be considered. For example, the potential for some supplements (e.g., Nitrate) to have adverse health effects at high dosage, and that the long-term effects of inhibitors on rumen health are not yet known.

21. Similarly, it is possible that some feed supplements may have adverse environmental effects, either in their extraction/production and/or usage. For example, in terms of energy usage, land use (habitat) change and air or water pollution.

22. The general lack of commercial availability of supplements means that information on costs per daily dose is generally unavailable. Agolin Ruminant costs approximately £0.04/animal/day for dairy cattle, £0.02/animal/day for beef cattle.

23. Other supplements are estimated to cost perhaps £0.20/animal/day, although possibilities for substitution with other feed inputs mean that net costs may be less than gross costs. For comparison, typical daily feed costs for dairy cows are currently about £4.00 and for finishing beef cattle the currently range from £2.80 - £4.00 depending on the intensity of finishing system.

24. In practical terms, ensuring that each animal receives the correct dosage of a feed supplement is challenging and will affect both cost per animal and achieved efficacy. This applies to concentrate-based feed rations within housed production systems but also more obviously to forage-based and/or extensive grazing systems.

25. That is, pre-mixed or on-farm mixed feed rations may be feasible in some cases, but even then optimising doses for individual animals is unlikely to be achieved. Where offering feed rations is not feasible, alternative delivery systems such as slow-release boluses or feed blocks/tubs/licks may be possible for some (but not all) supplements and would be even less likely to guarantee optimal dosages.

Verification and incentivisation

26. All of the points noted under farmer acceptance highlight a need for further research into efficacy, practicalities, costs and side-effects. Particular attention is needed in relation to verification of emission savings and the incentivisation of uptake.

27. For example, without a better understanding of the efficacy of different feed supplements under both experimental but more importantly real-world conditions it is difficult for informed decisions to be made about the merits of adoption.

28. This applies at the individual farm-level, but also to policy and supply-chain initiatives that will need to endorse particular mitigation tactics and have confidence in the measurement and monitoring of emission savings.

29. General scepticism amongst farmers about the accuracy and consistency with which farming's net emissions are measured and reported is already apparent (e.g., the basis for the National Inventory and different farm carbon calculators, plus inconsistencies between them).

30. This may hinder adoption by at least some farmers, as may mistrust in sources of advice and information and perceptions that methane inhibitors are a lazy technical fix ('a sticking plaster') that distracts from other mitigation options.

31. This suggests that adoption is likely to be contingent upon additional incentives being made available. For example, beyond regulatory approval for feed supplements, it will be necessary for policy to offer support payments conditional on the use of approved feed supplements and/or to simply oblige their use, plus to offer appropriate advice and training.

32. Equally, supply-chains may need to offer price premia for livestock products created using approved feed supplements (or price penalties for those not using them). Quality Assurance (QA) schemes may have a role to play here but will be reliant upon prior agreement on verification issues.

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