Til Fødevarestyrelsen

Følgebrev

Dato 15. september 2020

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Levering af bestillingen "Indsamling af eksisterende dokumentation om effekt af metanreducerende fodertilsætningsstoffer – case med Bovaer".

Fødevarestyrelsen har i en bestilling sendt den 13. august 2020 bedt DCA – Nationalt Center for Fødevarer og Jordbrug – om "*at vurdere, hvornår dokumentationen for effekt er tilstrækkelig i forhold til at få metanreducerende fodertilsætningsstoffer (som f.eks. Bovaer) til at indgå i emissionsopgørelserne, ved at anvende 3-NOP / Bovaer som en case*".

Nedenfor følger besvarelsen, der er udarbejdet af Professor Peter Lund fra Institut for Husdyrvidenskab ved Aarhus Universitet. Seniorrådgiver Christian Friis Børsting fra samme institut, har været fagfællebedømmer og notatet er revideret med afsæt i hans kommentarer.

Besvarelsen er udarbejdet som led i "Rammeaftale om forskningsbaseret myndighedsbetjening mellem Miljø- og Fødevareministeriet og Aarhus Universitet" med relation til "Ydelsesaftale Husdyrproduktion 2020-2023".

Venlig hilsen

Klaus Horsted
Specialkonsulent, Kvalitetssikrer for DCA-centerenheden

DCA - Nationalt Center for Fødevarer og Jordbrug
Aarhus Universitet
Blichers Allé 20
8830 Tjele

Tlf.: +45 8715 6000
E-mail: dca@au.dk
http:// dca.au.dk

Besvarelse: "Indsamling af dokumentation om effekt af metanreducerende fodertilsætningsstoffer – case med Bovaer"

Forfatter: Peter Lund, professor, Inst. for Husdyrvidenskab, AU, Peter.Lund@anis.au.dk, 40157673

Fagfællebedømmer: Christian F. Børsting, seniorrådgiver, Inst. for Husdyrvidenskab, AU

Bestilling:

Titel

Indsamling af dokumentation om effekt af metanreducerende fodertilsætningsstoffer – case med Bovaer

Baggrund

I 2021 forventes det første fodertilsætningsstof med metanreducerende effekt hos kvæg, Bovaer, at blive godkendt i EU.

Effekterne af virkemidlerne i klimahandlingsplanen, fx brugen af metanreducerende fodertilsætningsstoffer som Bovaer, skal indgå i den danske emissionsopgørelse, hvis de skal tælle med i klimalovens mål om en 70 pct. reduktion af drivhusgasserne i 2030. FN's klimapanel har strenge krav til dokumentation af effekter for nye teknologier, hvis de skal medtages i emissionsopgørelsen.

Det er blevet diskuteret, hvorvidt den eksisterende dokumentation – primært baseret på hollandsk forskning - er tilstrækkelig for at Bovaer kan indgå i emissionsopgørelserne (løsningsmodel a), eller om nye forsøg med Bovaer bør udføres under danske forhold, før dokumentationen er tilstrækkelig (løsningsmodel b).

På basis af DCA's (Peter Lund) svar på bestillingen (Bestilling omkring vurdering af effekt af 3-NOP/Bovaer) fra 3. marts 2020 og på basis af input fra et møde den 9. marts 2020, hvor blandt andre også en repræsentant (Ole-Kenneth Nielsen) fra Nationalt Center for Miljø og Energi (DCE) var til stede, er ovenstående to løsningsmodeller blev beskrevet. Det er nu blevet besluttet at gå videre med løsningsmodel a (indsamle eksisterende dokumentation, funderet i primært hollandsk forskning for at få en vurdering af, om denne er tilstrækkelig for at få Bovaer inkluderet i emissionsopgørelserne.

Formålet med opgaven

Formålet med bestillingen er at anvende Bovaer som en case, der kan give erfaringer med at vurdere, hvornår dokumentationen er tilstrækkelig i forhold til at få metanreducerende fodertilsætningsstoffer (som f.eks. Bovaer) til at indgå i emissionsopgørelserne.

Formålet er i udgangspunktet ikke møntet på kun at indsamle dokumentation om Bovaer, men da dette produkt pt. er det eneste relevante i denne sammenhæng, er fokus på Bovaer i bestillingen.

KORT beskrivelse af opgaven

Opgaven består i at indsamle dokumentation fra den eksisterende relevante litteratur, der menes at være valid og hvis resultater menes at kunne overføres nogenlunde til danske forhold. Den indsamlede dokumentation skal samles i et notat eller rapport, som efterfølgende skal anvendes af DCE til dialog med FN's klimapanel om, hvorvidt denne dokumentation er tilstrækkelig til at indgå i emissionsopgørelserne.

Dokumentationen skal udover at præsentere de tilgængelige data også beskrive rationalet for, hvorfor resultaterne kan overføres til danske forhold. Der bør også være en beskrivelse af hvorvidt det samlede datagrundlag er tilstrækkeligt til at udlede en generel reduktionsfaktor. Endeligt, vil det være vigtigt med en beskrivelse af usikkerheden på en afledt reduktionsfaktor herunder hvilken tilsætningsgrad (eller interval) denne faktor gælder for.

Rapporten/notatet skal skrives på engelsk.

I er velkomne til at kontakte virksomheden og fx de hollandske forskere i forbindelse med besvarelse af bestillingen for at få indsigt i eventuel nyere forskning, som kan indgå i den samlede dokumentation for effekt.

Tidsfrist for levering af leverancen

15. september 2020

Response:

GHG mitigation strategies in National Inventories.

Two prerequisites have to be fulfilled if a given GHG mitigation strategy is to be included in the National Danish Inventories for Agriculture and thereby fulfil the Danish obligations under EU Directives and the United Nations Framework Convention on Climate Change (Albrektsen et al. 2017):

1) The effect of the mitigation strategy should be well documented and consistent under conditions similar to Danish conditions and be based on peer-reviewed scientific reports where sound methods have been used.
2) Activity data for use of the strategy should be available and of sufficient quality.

This report only addresses the first prerequisite; addressing the potential effect of a new feed additive, Bovaer (3-nitrooxy-propanol, 3-NOP) on enteric methane production in dairy cows under Danish conditions. The second prerequisite will depend upon setting up the sufficient and trustworthy system for collecting these data. This can either be driven by reporting to national authorities or by collecting data from the Feed evaluation system and data platforms managed by the industry. It is essential that these data are scientifically validated in some way before entering the national inventory system.

The Danish production system

Danish dairy cow production is characterized by a high level of milk production (11.178 kg of ECM/cow/y for Holstein; 9901 kg ECM/cow/y for Jersey; Lund et al., 2020a), a high proportion of highly digestible forage in the diet (50-60%) and that grassclover-silage and maize silage constitutes the predominant part of the forage fraction, but in different proportions ranging from very low proportion of maize silage in organic diets to diets with very high proportion of maize silage in specific parts of the country. On average the ratio between grass and maize is estimated to 40:60. The production systems used in NW-Europe (UK, BEL, NED GER, SWE) resembles the Danish dairy production systems, and with only minor differences in production level and composition of the diet, whereas data from the US and S-Europe often are based on diets that varies significantly from Danish diets both with respect to type of concentrate used, type of forage, and production level.

Interactions with diet composition

The work by Dijkstra et al. (2018) showed that the effect of Bovaer (3-NOP) was doses dependent and dependent on NDF content in the diet, and these relationships are illustrated in Fig. 1 and Fig. 2. At expected inclusion level of 3-NOP (70-90 mg/kg) the response in production of enteric methane varies from 21-39%

depending upon the NDF content of the diet (Fig. 1), and as the typical concentration of NDF in Danish rations for dairy cows is 320-340 g/kg DM (Hellwing et al., 2016) this would be equivalent to a reduction of 24-32% in typical Danish diets for dairy cows. This example illustrates that the effect of 3-NOP is dose dependent and interacts with NDF concentration. Recent data suggests that the response of 3-NOP also interacts with other diet characteristic than merely NDF content. This calls for the development of models where these interactions are taken into account as well as high quality activity data for the potential diet characteristics that interacts with doses-level before 3-NOP can be used in national inventories.

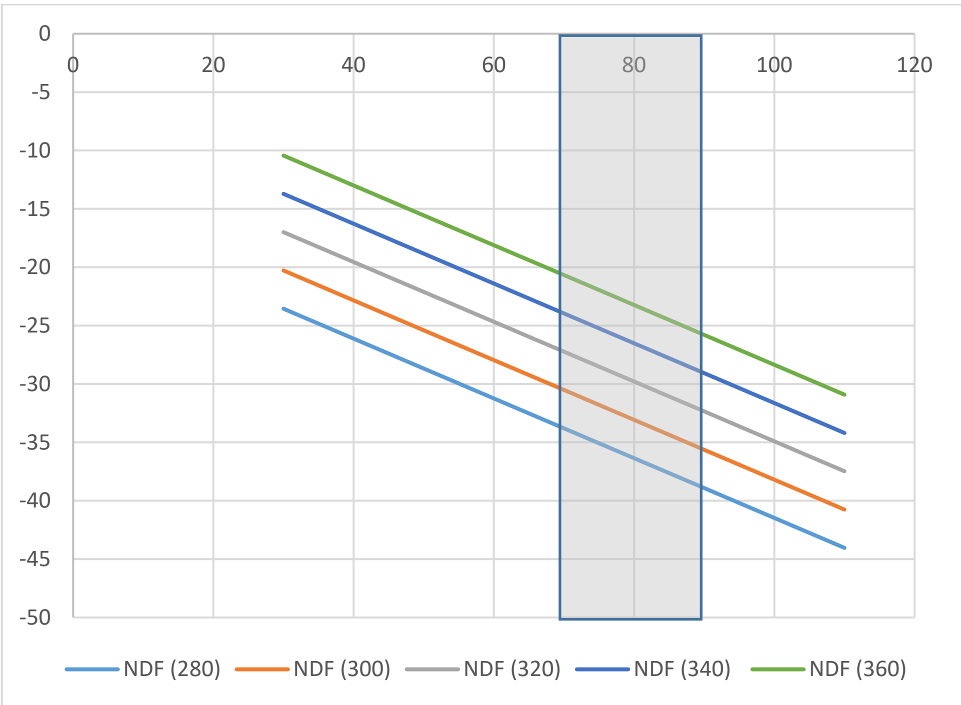

Fig. 1: Relationship between doses of 3-NOP (mg/kg DM) and reduction in enteric methane from dairy cows (%) at 5 different levels of NDF in the diet (g/kg DM) (mod e. Dijkstra et al. (2018)). Gray area indicates the expected concentration of 3-NOP (70-90 mg/kg DM).

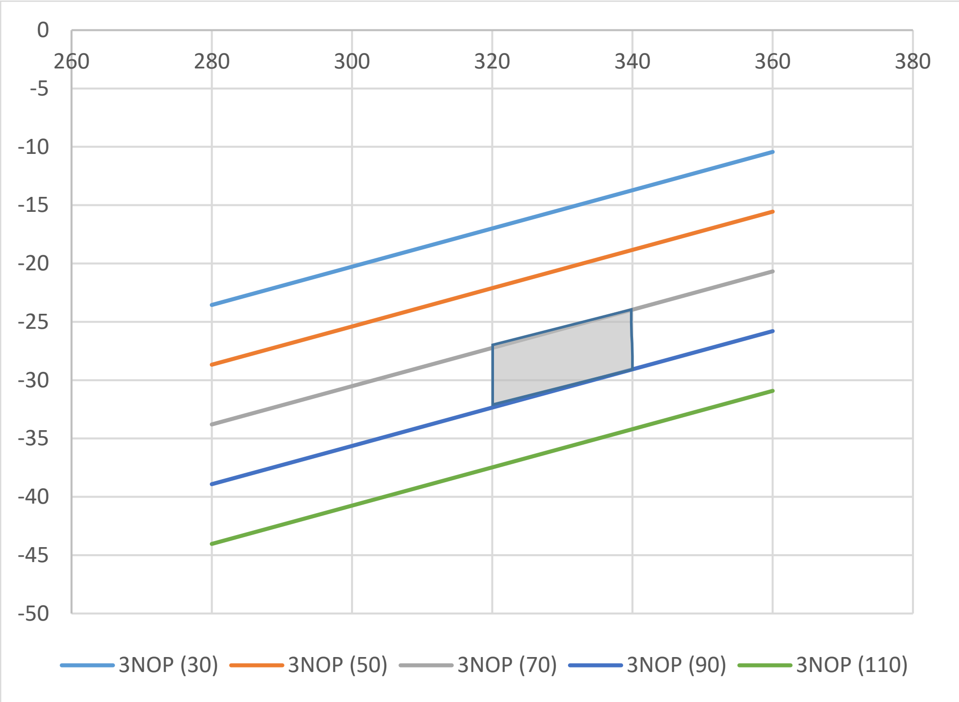

Fig. 2: Relationship between level of NDF in the diet (g/kg DM) and reduction in enteric methane from dairy cows (%) at 5 different levels of 3-NOP in the diet (mg/kg DM) (mod e. Dijkstra et al. (2018)). Gray area indicates the typical concentration of NDF in Danish rations for dairy cows (320-340 g/kg DM) and the expected concentration of 3-NOP (70-90 mg/kg DM).

Effect of Bovaer in production systems similar to dairy production in Denmark

The general effect of Bovaer on enteric methane in dairy cattle has already been addressed in a previous note from DCA (Lund, 2020), primarily based on a meta-analysis by Dijkstra et al. (2018) on dairy cattle and beef cattle, and this meta-analysis included data from 9 papers, 11 experiments and 38 different treatments covering a wide range of different diets and different animals. It was concluded by Lund (2020) that the general methane mitigating effect of Bovaer is well-documented in the peer-reviewed literature, but origin of data and chemical composition of the diets used besides NDF-content was not taken into account. The 9 papers in the Dijkstra paper varies in origin, diets composition and type of animal, which is ideal when the scope is to justify a general effect.

Based on the above description of the Danish dairy cattle production system and potential interactions between response of addition of 3-NOP and diets characteristics was it decided only to include studies from NW-Europe published in well-known peer-reviewed journals, where forage constitutes at least 50% of the diet, where maize silage and grass silage (preferably with addition of clover) constitutes the predominant part of the forage in the diet, and where only concentrate commonly used in Denmark is included. In total 3 studies fulfills these prerequisites:

A study from Belgium (Van Wesemael et al., 2019) fed 1,6 g of 3-NOP/cow/d (**73 mg/kg DM**) to cows as part of the basal roughage diet, based on grass silage and maize silage, or as part of the separate concentrate. NDF content of the diet was **346 g/kg DM**. Daily enteric methane production was reduced with **23-28%** and methane yield (g/kg DM intake) was reduced with **21-23%**

In a Dutch study, van Gastelen et al. (2020) fed 3-NOP (**51 mg/kg DM**) to cows in early lactation. The diet was based on 35% grass silage, 25% maize silage and 40% concentrate (diet: **358 g NDF/kg DM**). Enteric methane was measured at 27, 55, 83 and 111 DIM (days in milk) and feeding 3-NOP did not affect methane production at 27 and 83 DIM, but decreased daily methane production at 55 and 111 DIM with on average 19%. Across the experiment addition of 3-NOP reduced methane production with **15%**. Methane yield was reduced by **16%** on average.

3-NOP is degraded in the rumen, and a UK study by Reynolds et al. (2014) should therefore be interpreted with care as 3-NOP was pulse dosed into the rumen twice daily (500 or 2500 mg/d, equivalent to **25 and 124 mg/kg DM**). Maize silage and grass silage were the primary forage sources, and the NDF content of the diet was **398 g NDF/kg DM**. Daily methane production was reduced with **7-10 %**. Methane yield was reduced by **4-7%**. A lower effect of addition of 3-NOP directly into the rumen compared to the other studies where 3-NOP was added to the diet was as expected as 3-NOP is metabolized in then rumen and therefore should be supplied continuously in the diet to obtain the maximal effect.

3-NOP has also been tested in production systems different from the Danish system and with effect that in general are higher than what can be expected in NW-European diets:

A recent US dose-response study by Melgar et al. (2020) using a diet (318 g NDF/kg DM) very different from Danish conditions (no grass silage, inclusion of alfalfa haylage, soybean seeds and cottonseeds) showed that inclusion of 40, 60, 80, 100, 150, an 200 mg 3-NOP/kg DM resulted in a reduction in methane production of 22-44% and in methane emission yield of 16-36%. Lopes et al (2016) found a reduction of 31% in daily methane production and 34% in methane yield at a dose of 60 mg 3-NOP/kg DM in comparable US diets (309 g NDF/kg DM) very different in composition compared to Danish diets for dairy cows.

Canadian experiments (Haisan et al., 2014; 2017) with diets (NDF: 265-338 g/kg DM), where barley silage is the only forage source, and thereby very different in composition compared to Danish diets for dairy cows have shown reductions in daily methane production and methane yield of 39-65% and 37-60%, respectively (doses: 130-132 mg/kg DM).

These differences between regions indicates that the effect of 3-NOP is highly dependent upon the composition of especially the forage part of the diet, and the supplier (DSM) is currently in the process of developing regional meta-analyses in order to overcome these challenges.

Experiments at Aarhus University

Preliminary results from a recent study at Aarhus University with 4 rumen and intestinally cannulated dairy cows showed that addition of 3-NOP (**80 mg/kg DM**) to a typical Danish diet (**300 g NDF/kg DM**) reduced methane yield by **21-28%** (Kjeldsen, 2020).

At Aarhus University a production study with 48 lactating cows is planned for 2020/2021. This study includes 3 well-known methane mitigation strategies (3-NOP, nitrate and fat) and addresses the potential interactions between the 3 additives regarding enteric methane mitigation. The composition of the diet will reflect a typical Danish diet with inclusion of around 50% forage, and grass- and maize silage as the forage types used.

Conclusion

It is concluded that the overall effect of 3-NOP (Bovaer) on enteric methane emission in dairy cows is well-documented, but that the effect seems to be dependent on diet composition, especially related to the forage part of the diet. The effect in rations based on combining grass- and maize silage and thereby typical for Danish milk production, at doses of 50-70 mg 3-NOP/kg DM seems lower than the overall average reduction of 39% previously reported by Dijkstra et al. (2018). This calls for further data obtained under productions systems similar to the Danish system where diet composition varies, and models that can account for these interactions between doses and diet composition.

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