Effects of dietary fat on mitigation of methane from dairy cows

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Background

The Danish authorities wants to reduce methane emission from dairy production. Therefore, the authors have supplied the authorities with an estimate of the mitigation effect of adding fat to dairy cow diets, as well as the potential effects on emissions from barn and storage and on biogas potential

Objective

To estimate the effects of adding dietary fat to dairy cow diets combined with various feeding strategies

Materials and methods

- The effect of fat on enteric methane emission was estimated with the Norfor diet planner software from the equation:
  CH_4 (MJ/cow/day) = 1.39*DMI (kg/cow/day) – 0,091*FA (g/kg DM)
  Daily methane emission was estimated from predicted DMI and methane emission/kg DMI.
  The relative change was based on daily methane emissions
- Effect of fat on the potential biogas yield after 90 days/kg Volatile Substance (VS) was estimated by an empirical model
- A diet with 28 g fatty acids/kg DM was used as the standard diet, which was equivalent to average diets used across 1,422 Danish dairy herds in 2018
- Rape seed oil was used as fat supplement to increase fatty acid content to approximately 47 g/kg DM
- 6 different feeding strategies were compared to the standard diet

Conclusions

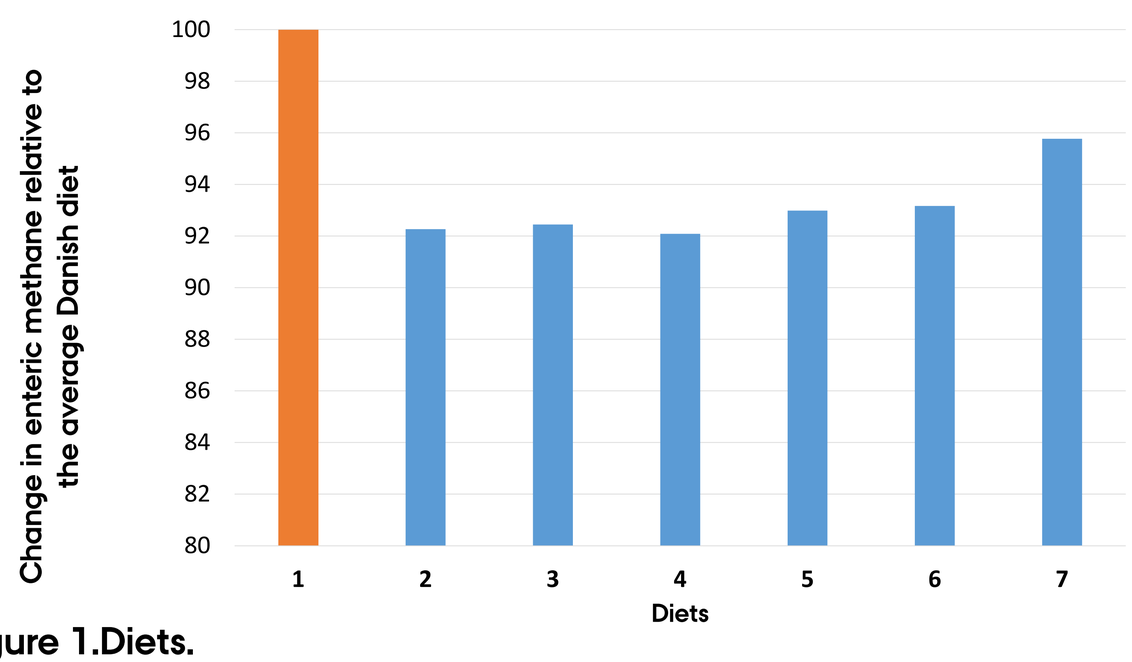
Addition of 20 g fatty acids/kg DM can decrease enteric methane from dairy cows by approx. 8%.
This can reduce the GHG emission from Danish dairy cows by 0.17 Mio ton $CO_{2eq.}$ per year
Addition of 20 g fatty acids/kg DM can increase biogas potential of manure by about 8 % per kg VS

Results

- Across several diets, which can realistically be used under Danish conditions, there was an **average decrease of 3,8% in enteric methane per day for each increase of 10 g FA/kg DM**, when FA/kg DM was increased up to 47 g
- In a meta-analysis, Niu et al., 2018 found a decrease in enteric methane of 3.4 - 4.1 % per 10 g increase in FA/kg DM
- It was estimated with a preliminary model, that there was no change in methane emission from barn and storage when dietary fat was increased
- **Biogas potential of manure showed an increase of about 4 % per kg VS for each increase of 10 g FA/kg DM** in the diet
- The Ministry of Environment estimated that the **GHG emission** from Danish dairy cows can be **reduced by 0.17 Mio. tons $CO_{2eq.}$ per year**, if cows are fed 50 g FA/kg DM (Jersey 55) from 8 weeks after calving until dry off
- This is equivalent to 14% of the demanded 1.2 Mio. tons CO_{2eq} reduction from Danish agriculture by 2025

Reference: Niu et al., 2018. Prediction of enteric methane production, yield, and intensity in dairy cattle using an intercontinental database. Glob. Change Biol.. 1 -22.

a: Change in enteric methane relative to feeding the average Danish diet



b: Change in biogas potential relative to feeding the average Danish diet

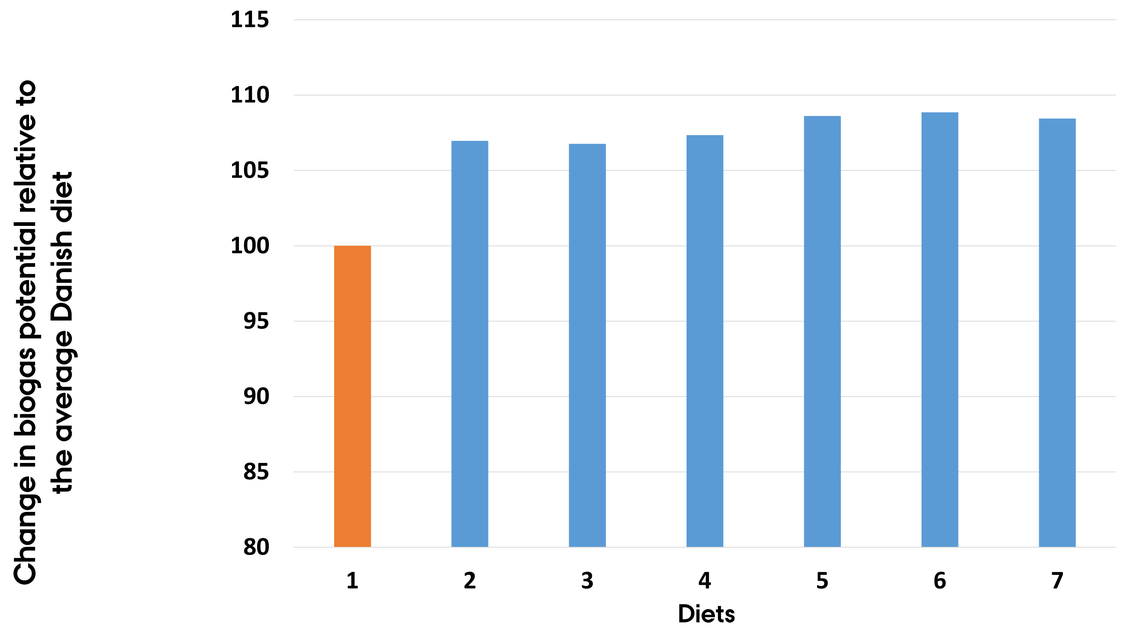
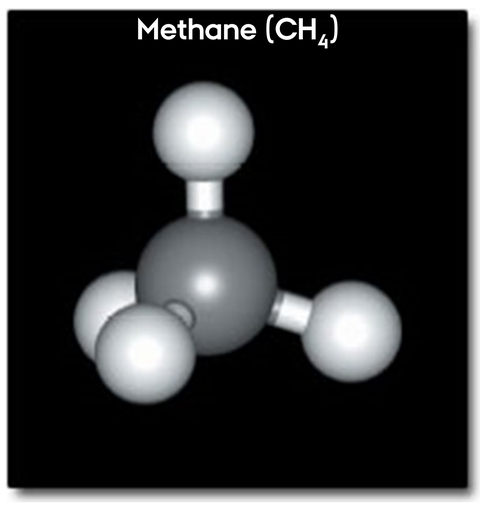


Figure 1.Diets.

All diets were planned to meet 100% of NE requirement. Changes below are in % of DM

1. Standard diet, equivalent to the average Danish Dairy diet with 28 g fatty acids/kg DM
2. Barley decreased, 2.5 % rape seed oil added
3. 0,6% PFAD fat out, 2.5% rape seed oil added
4. 8,7 % soybean meal out, and barley reduced, 16.9% faba beans and 2.9% rape seed oil added
5. Same as No 4, but 20% of DM from maize silage was replaced by grass-clover silage
6. Soy bean meal reduced by 4,5%, no faba beans, high grass-clover, and low maize silage
7. +22% milk; grass and maize reduced, more concentrate and 1,8% rape seed oil added



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