# Changing from a grass silage based diet to a maize silage based diet does not alter enteric methane emission in dairy cattle

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## Introduction

Worldwide, livestock is accounted for 14,5% of total greenhouse gas (GHG) emissions, mainly because of the enteric fermentation of ruminants. In the rumen, micro-organisms break down carbohydrates of the feed into nutrients for the animals. Methane is produced as a by-product of this process and is exhaled by the animals (Gerber et al., 2013). Because of the role of enteric $CH_4$ in global warming, various mitigation practices are widely investigated. Nutritional intervention, e.g. diet manipulation and/or the use of feed additives, is one of the main routes that is studied (Hristov et al., 2013). It is often stated that replacing grass silage (GS) by maize silage (MS) in dairy rations is a promising nutritional strategy to reduce $CH_4$ emissions, as MS is rich in starch (Van Middelaar et al., 2013) and GS is rich in fiber. In practice, however, it is not feasible to simply replace one forage component by another without affecting the nutritional value of the dairy diet. In order to have a sufficiently high starch supply in the total diet (± 20%), diets rich in GS are accompanied by high starch concentrates (HSC). Accordingly, we assessed the impact on enteric $CH_4$ emission when replacing a diet rich in GS (GSD) by a diet rich in MS (MSD) under Flemish conditions.

## Material and methods

For an *in vivo* feeding trial, conducted at ILVO during winter 2015-2016, 12 high-producing (31±3 kg milk/day) Holstein Friesian cows were divided into a control and treatment group based on milk production, days in milk and parity. The control group received GSD during the whole trial (12 weeks), while the treatment group shifted from the GSD to the MSD after six weeks. The GSD and MSD consisted of 35% MS/65% GS and 65% MS/35% GS, on a dry matter (DM) basis respectively. In both diets (protected) soybean meal was used as protein-rich concentrate and in GSD the balanced concentrate had a 14% higher starch content than in MSD. The amount of concentrates was calculated on an individual basis to meet the requirements of VEM (Van Es, 1978), DVE and OEB (Tamminga et al., 1994). $CH_4$ emissions were measured from open-circuit chambers (OCC) during five days (De Campeneere & Peiren, 2012). The emissions were measured during week 6 and 12 in the OCC. Data from three cows were omitted due to technical (n=2) and health problems (n=1). Data were analyzed by using a linear mixed model in R 3.3.1 for Windows with group (control and treatment), period (P1 and P2) and their interaction as fixed effects and cow as random effect. A significant interaction effect equals a significant treatment effect.

## Results and discussion

Even when using HSC in GSD, the average starch content of this diet was 56 g/kg DM lower and the average crude fiber content was 13 g/kg DM higher than for the MSD diet (Table 1). Despite these differences, changing from a GSD to a MSD did not affect the $CH_4$ emissions/day, nor $CH_4$/kg DMI or $CH_4$/per kg milk as no interaction was found between group and period (Table 2). Also, milk production and composition were not affected.
Although it is often stated that replacing GS by MS is a promising strategy to reduce enteric $CH_4$ emissions no differences were observed in $CH_4$ emissions between the two diets. Hatew et al. (2015) too, did not find any difference in $CH_4$ production per kg DMI or milk, even with a

100 g/kg DM higher starch content in the diet. Van Middelaar et al. (2013) on the other hand, simulated a reduction of 3.2% by increasing the amount of MS by 1 kg DM/cow/day at the expense of grass (silage), but it was stressed that when changing diets in favor of more MS total GHG emissions at farm or chain level should also be considered, as this can lead to a different overall outcome. In the future the experiment discussed here, will be analyzed in a more system oriented way too.

**Table 1**: Mean nutrient content (g/kg DM) in the GSD and MSD diet in both periods (P1 & 2).

| | **Control group** | | **Treatment group** | |
|---|---|---|---|---|
| | GSD – P1 | GSD – P2 | GSD – P1 | MSD – P2 |
| **Crude protein** | 164 | 163 | 164 | 163 |
| **Crude fiber** | 183 | 185 | 178 | 165 |
| **Starch** | 189 | 189 | 196 | 252 |
| **Sugars** | 54 | 61 | 56 | 48 |
| **VEM (/kg DM)** | 970 | 952 | 978 | 979 |
| **DVE** | 92 | 88 | 93 | 89 |
| **OEB** | 15 | 17 | 15 | 17 |

**Table 2**: Least square means of dry matter intake (DMI), milk production (MP), milk composition and methane ($CH_4$) emissions at the end of period 1 (P1) and period 2 (P2) for the control (GSD in P1 and P2) and treatment (GSD in P1 and MSD in P2) group.

| | **Control group** | | **Treatment group** | | **p-value group*period** |
|---|---|---|---|---|---|
| | GSD – P1 | GSD – P2 | GSD – P1 | MSD – P2 | |
| **DMI (kg/d)** | 20.6 | 21.8 | 20.3 | 21.4 | 0.38 |
| **MP (kg/d)** | 28.8 | 27.9 | 26.5 | 26.1 | 0.69 |
| **Milk fat (%)** | 4.16 | 4.32 | 4.37 | 4.27 | 0.10 |
| **Milk protein (%)** | 3.41 | 3.43 | 3.41 | 3.46 | 0.75 |
| **MUC (mg/dl)** | 20.8 | 20.5 | 24.4 | 21.1 | 0.18 |
| **$CH_4$ (g/dag)** | 435 | 437 | 423 | 439 | 0.53 |
| **g $CH_4$/kg DMI** | 21.2 | 20.0 | 20.9 | 20.5 | 0.43 |
| **g $CH_4$/kg MP** | 15.3 | 16.0 | 16.0 | 16.9 | 0.87 |

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