Effect of the feed additive 3-nitrooxypropanol on the CH_4/ CO_2 ratio in an on-farm trial

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Introduction

Livestock is accounted as one of the most important sources of anthropogenic methane emissions. Especially ruminants are responsible for significant amounts of this potent greenhouse gas. In their rumen, micro-organisms breakdown the nutrients, like carbohydrates, of the feed. Methane is produced as a by-product of this process, called enteric fermentation, and is exhaled by the animals (Gerber et al., 2013). Because of the global (warming) importance of enteric methane (GWP_{100}: 34) (Myhre et al., 2013), various mitigation practices are widely investigated (Knapp et al., 2014). Nutritional intervention like the use of feed additives, is one of the main routes that can be followed for lowering methane emissions from ruminants (Gerber et al., 2013; Knapp et al., 2014). To assess the effectiveness of mitigation strategies different methane measurement techniques are available. Next to the respiration chambers, which are accepted as the golden standard of the experimental methods, other techniques like the SF_6-technique and the on-farm GreenFeed system (C-lock inc.) are widely used. The GreenFeed system is built as a concentrate feeder that measures the methane and carbon dioxide emissions of an individual animal when it visits the feeder. Typically short-term (3-7 min) measurements, several times per day, over several days are needed to obtain a 24h individual methane emission profile (Hammond et al., 2015). An on-farm evaluation of a feed additive was made using the GreenFeed system in a free stall with cubicles.

Material and methods

In an *in vivo* trial conducted at ILVO during Spring 2015, eight highly productive Holstein cows were treated with the methane inhibitor 3-nitrooxypropanol (3-NOP) to study the effectiveness of this feed additive in a Flemish ration. Two other high-producing Holstein cows were assigned as reference cows and received a placebo additive. Previous research showed a great potential of 3-NOP for reducing methane emissions in lactating dairy cows. When providing 40 to 80 mg/kg feed dry matter, methane emissions from high-producing dairy cows decreased with 30% (Hristov et al., 2015). In the current trial cows were supplemented 1,7g 3-NOP/day mixed in soybean meal via a standard concentrate feeder in the free stall with cubicles. The ration consisted of 50% maize silage, 40% pre-wilted grass silage and 10% pressed beet pulp, on a dry matter basis. The amount of concentrates (balanced concentrate, soybean meal and protected soybean meal) was calculated on an individual cow basis, to meet the needs of VEM and protein digestible in the small intestine. Methane and carbon dioxide emissions were measured with a GreenFeed system. A control of 18 days followed a two-week adaptation period. No feed additive or placebo substance was administered during both periods. During the treatment period eight animals received the feed additive and the two reference cows received the placebo. For both periods, emission data from 12 until 18 days were considered.

Results and discussion

To evaluate methane reduction due to the addition of 3-NOP the individual CH_4/CO_2 ratio was calculated for the control and the treatment period. This ratio is of particular interest for expressing the efficiency of the rumen micro-organisms fermenting the feed. Methane production is a loss of energy and this ratio describes the proportion of carbon that is not metabolized into CO_2 and in this way is lost as CH_4. The CH_4/CO_2 ratio can be used to identify the rations and/or the cows which give rise to a more efficient feed energy conversion or in other words which produce the least methane (Madsen et al., 2010). Figure 1 shows the CH_4/CO_2 ratio of all cows (n=10) during control period (CTRL - circles) and treatment period (TRTM - triangles). The ratio for the reference cows, which received a placebo additive, did not change in the treatment period compared to the control period ($p=0.92$). On the contrary, seven out of the eight treated cows showed a reduced ratio during the treatment period ($p<0.01$, N=8). Besides this it can be seen that the variation between the treated cows is larger in the treatment period (average ± stdev, 0.033± 0.0034, N=8) than it is for the control period (average ± stdev, 0.039± 0.0017, N=8). Variation between animals can be considerable and needs to be taken into account when testing mitigation strategies (Garnsworthy et al., 2012).

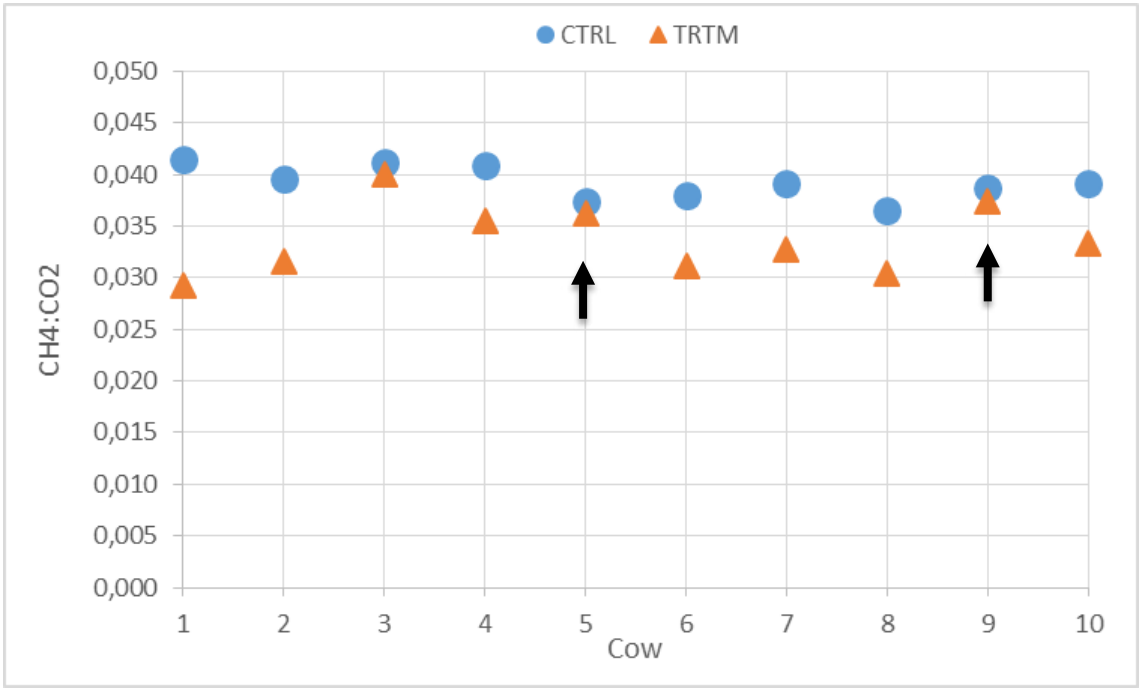

Figure 1: CH_4/CO_2 ratio of all cows (n=10) during control (CTRL) and treatment (TRTM) period, reference cows are indicated with an arrow.

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