A review of dairy production performance on different methane reducing dietary treatments:

3-NOP, nitrate, linseed and rapeseed

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Introduction

Farmers fear that methane-reducing dietary treatments might reduce production...

- In Flanders, Belgium, dairy farmers can take several measures to **reduce the methane emissions** on their farm, evaluated and approved under the Convenant Enterische Emissies Rundvee (CEER).
- Five of these feed measures are currently **subsidized**: **3-NOP** (60ppm), **extruded linseed** (2%), **nitrate** (1%) (both for dairy and beef cattle), combination **nitrate** (1%) **+ rapeseed** (1,75%), and combination **nitrate** (1%) **+ linseed** (2%).
- The **implementation of these measures is lagging**. Some farmers believe that these feed measures might reduce their cattle's production performance.

In this research, we wanted to tackle the fears of farmers by investigating if these **methane-reducing dietary treatments** have **any positive or negative effects** on animal production performance, based on a **literature review**.

Material & Methods

We reviewed the effects of four dietary treatments on dairy production performance in literature

- Literature review of a total of **57 peer-reviewed papers**, reduced to 48 papers after selection (Table 1)
- Calculation of a **reduction percentage** compared to the control treatment for each parameter (Table 2)
- **Pearson correlation** to determine if the dose-response effect is significant
- Calculation of a **predicted reduction percentage** at the doses currently subsidized in Flanders: 2% for linseed, 1,75% for rapeseed, 1% for nitrate, 60ppm for 3-NOP (all on DM)

Table 1. Number of treatments (and papers) included in the literature review for each dietary treatment, before and after selection.

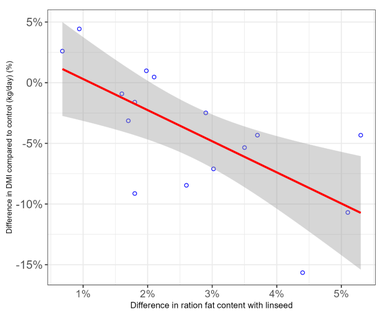
Linseed	Rapeseed	Nitrate	3-NOP
27 (13)	30 (18)	25 (14)	33 (16)
↓ ~~Oil Seeds~~	↓ ~~Oil Seeds~~	↓	↓ ~~>100 ppm~~
16 (8)	21 (13)	25 (14)	29 (15)

Results

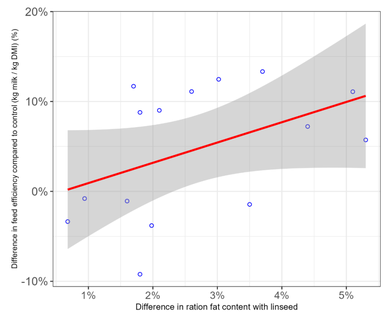
Some significant correlations could be found, but FPCM production was never significantly affected

Table 2. Effects of four dietary treatments on production performance and methane production. P = p-value for a Pearson correlation test with dose ~ reduction compared to control. R^2 = R squared of a linear model with dose ~ reduction compared to control.. DMI = Dry Matter intake. FPCM = Fat- and Protein-Corrected Milk. ▲ = significant positive trend, ▼ = significant negative trend.

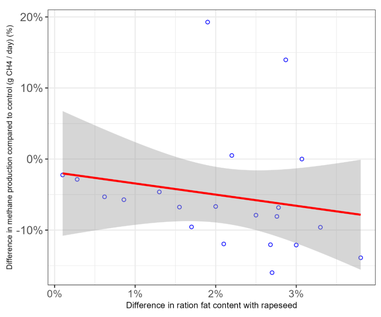
	Linseed			Rapeseed			Nitrate			3-NOP		
	p	R^2	Predicted reduction at 2% dose	p	R^2	Predicted reduction at 1,75% dose	p	R^2	Predicted reduction at 1% dose	p	R^2	Predicted reduction at 60ppm dose
DMI (kg/day)	<0,01 ▼	0,46	-2,3 %	<0,01 ▼	0,40	1,7 %	0,40	0,03	-0,7 %	<0,01 ▼	0,47	-1,7 %
Milk production (kg/day)	0,75	0,01	0,2 %	0,51	0,02	4,2 %	0,77	0,00	0,2 %	0,02 ▼	0,19	-1,3 %
Milk fat content (%)	0,35	0,18	-7,1 %	0,28	0,07	-1,5 %	0,12	0,11	-1,9 %	0,89	0,00	4,2 %
Milk protein content (%)	0,04 ▼	0,61	-5,3 %	0,02 ▼	0,31	-1,3 %	0,02 ▼	0,23	-1,1 %	0,15	0,08	1,4 %
FPCM production (kg/day)	0,22	0,11	0,9 %	1,00	0,00	2,8 %	0,90	0,00	-1,1 %	0,18	0,07	0,1 %
Feed efficiency (kg milk / kg DMI)	0,09	0,20	3,2 %	0,03 ▲	0,23	2,6 %	0,35	0,04	0,8 %	0,37	0,03	0,4 %
Feed efficiency (kg FPCM / kg DMI)	0,53	0,03	1,9 %	0,08	0,17	1,3 %	0,43	0,03	-0,4 %	0,27	0,05	1,9 %
Methane production (g CH_4 / day)	<0,01 ▼	0,83	-10,2 %	0,41	0,04	-4,6 %	<0,01 ▼	0,35	-13,9 %	<0,01 ▼	0,38	-27,6 %
Methane yield (g CH_4 / kg DMI)	<0,01 ▼	0,71	-8,6 %	0,82	0,00	-4,7 %	<0,01 ▼	0,40	-12,7 %	0,11	0,09	-26,1 %
Methane intensity (g CH_4 / kg milk)	<0,01 ▼	0,65	-9,9 %	0,23	0,09	-6,4 %	0,05 ▼	0,21	-12,6 %	0,01 ▼	0,24	-26,1 %
Methane intensity (g CH_4 / kg FPCM)	<0,01 ▼	0,46	-8,2 %	0,11	0,14	-7,0 %	0,01 ▼	0,32	-11,8 %	<0,01 ▼	0,28	-27,6 %



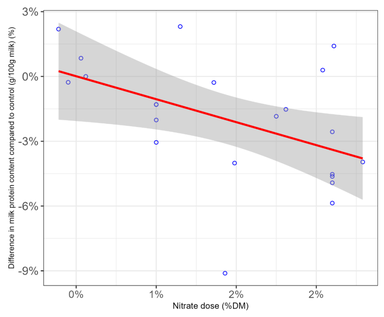
1 Both **linseed** and rapeseed show clear negative trends on **DMI**, but milk and FPCM production are not affected



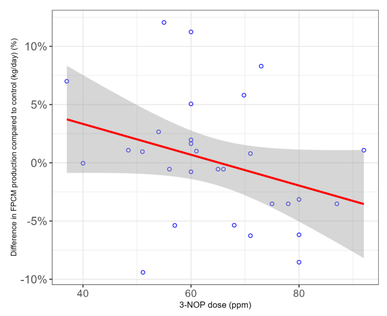
2 **Feed efficiency** significantly increases with higher levels of **rapeseed** inclusion, although datapoints are quite scattered



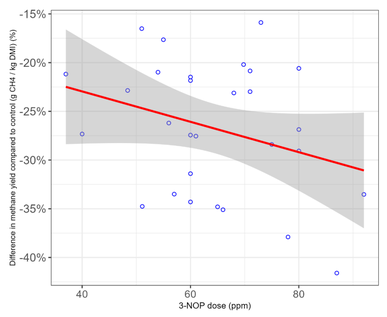
3 No significant trend on **methane production** with **rapeseed.** However, 17 out of 21 datapoints show a reduction



4 **Milk protein content** decreases with higher levels of **nitrate** inclusion, but milk or FPCM production is not influenced



5 DMI and milk production show significant negative trends with higher **3-NOP** doses, but **FPCM production** is not significantly influenced and often even increased at lower doses



6 No significant trend for **methane yield** with **3-NOP**, but all datapoints show reductions of 15% or more

Conclusions & Future perspectives

The doses applied in Flanders do not seem to be harmful for dairy production performance

- **DMI, milk production** and **milk protein content** often show **negative trends** at increasing doses of methane-reducing dietary treatments. **FPCM production** however shows **no significant trend** for neither of the four investigated treatments.
- At the **subsidized doses** in Flanders (2% linseed, 1,75% rapeseed, 1% nitrate, 60ppm 3-NOP), the predicted effects on production performance are often **negligible**. However, there is a **high inter-study variation in experimental results**. For instance, the same dose of 3-NOP (± 55 ppm) could lead to a FPCM production change of -10% or +12% according to different studies.
- Effects of **fat inclusion** (linseed and rapeseed) on production parameters might be influenced by the **total diet characteristics**. In some cases, the inclusion of linseed or rapeseed in the experimental diets led to > 6% crude fat, with negative effects on milk production.
- This literature review will be further refined in a more detailed **meta-analysis**, taking into account study size and length, study design, total diet characteristics, methane measuring techniques,...

Questions?

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