Combined effects of 3-nitrooxypropanol (3-NOP, Bovaer®10) and whole cottonseed on production and enteric methane emissions of dairy cows

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Introduction

- 3-nitrooxyproponal (3-NOP) is a proven inhibitor for enteric methane (CH_4) mitigation.
- Dietary inclusion of whole cottonseed (WCS) decreased protozoa count and relative abundance of archaea (Castro Veloz, 2023).
- Gossypol, derived from WCS, have shown antimicrobial effects on some bacteria and yeasts (Wang et al., 2009), but unclear on its effect on rumen methanogens.
- **Objective**: to evaluate the effects of WCS and 3-NOP combined on dry matter intake, production, total-tract digestibility and enteric CH_4 emissions in dairy cows.

GreenFeed

Total collection of excreta

Material and Methods

- Sixteen dairy cows were arranged in a split-plot design, where the main plot was the breed of cows [8 Holstein Friesian (HF), 8 Brown Swiss (BS)]. Within each block, cows were used in a 4 × 4 Latin Square design with 2 × 2 factorial arrangement of treatments with 4, 24-d periods.
- Treatments were: CON (basal diet); 3-NOP (Bovaer®10, 600 mg/kg DM); WCS (50 g/kg DM); 3-NOP + WCS.
- The diets were balanced for ether extract and NDF content (4.0 and 43% of DM, respectively) and fed 2x/day at 0800 and 1800 h.
- Data were analyzed using mixed models in R.

Results

Table 1. Dry matter intake, ECM, and enteric gas emissions of lactating dairy cows from two breeds receiving dietary treatments.

	3-NOP			WCS			Breed			*P*-value						
Items	No	Yes	SE[3]	No	Yes	SE	BS	HF	SE	3-NOP	WCS	Breed	3-NOP × WCS	3-NOP × Breed	WCS × Breed	3-NOP × WCS × Breed
DMI, kg/d	24.6	24.8	0.51	24.7	24.7	0.51	23.6	25.8	0.68	0.42	0.89	0.03	0.03	0.10	0.77	0.65
ECM, kg/d	28.2	28.5	1.43	27.7	28.9	1.43	28.0	28.6	1.99	0.60	0.03	0.83	0.60	0.93	0.07	0.23
CH_4 production, g/d	460	400	9.1	422	438	9.1	437	422	11.8	<0.01	0.20	0.39	0.11	**0.05**	0.82	0.30
CH_4 yield, g/kg DMI	18.9	16.3	0.39	17.2	17.9	0.35	18.7	16.4	0.39	<0.01	0.26	<0.01	0.54	0.24	0.75	0.22
CH_4 intensity, g/kg ECM	16.3	14.1	0.60	14.9	15.6	0.61	15.4	15.1	0.77	<0.01	0.34	0.99	0.39	**<0.01**	0.97	0.79
H_2 production, g/d	1.26	3.75	0.236	2.70	2.32	0.236	2.17	2.85	0.268	<0.01	0.01	0.01	0.03	**<0.01**	0.16	0.11

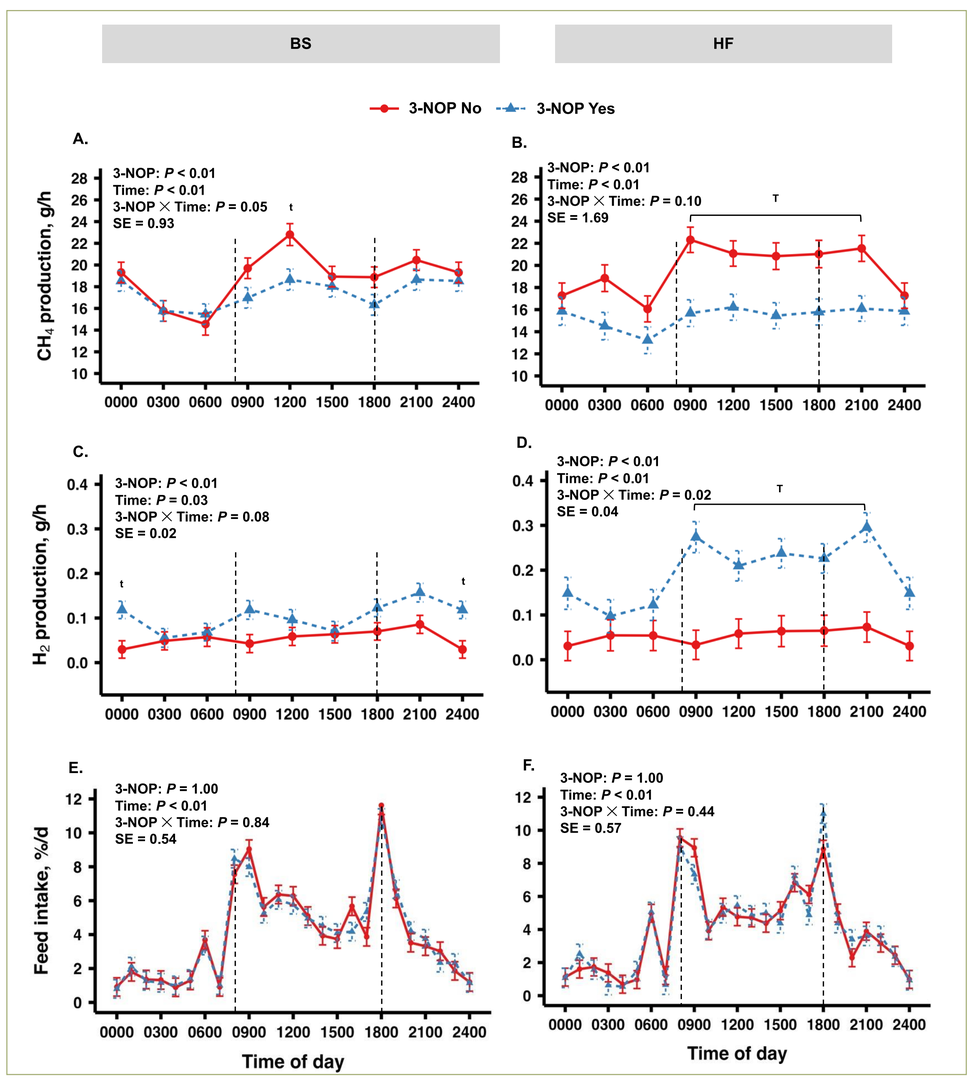

Figure 2. Effect of supplementing 3-NOP to Brown Swiss cows (Left: BS) and Holstein Friesian cows (Right: HF) on the intraday pattern of CH_4 production (A, B), H_2 production (C, D), and feed intake (E, F). Dashed line: morning and afternoon feeding.

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- There was WCS × breed interaction for milk fat yield ($P = 0.04$) and ECM ($P = 0.07$): WCS increased milk fat yield by 12.2% and ECM by 8.2% in BS.
- There was 3-NOP × breed interaction in CH_4 production ($P = 0.05$), CH_4 intensity ($P < 0.01$), H_2 production ($P < 0.01$).
- Brown Swiss had lower intake than HF; apparent total-tract digestibility of all nutrients, expect for CP and starch, were decreased ($P < 0.01$) in cows fed WCS.

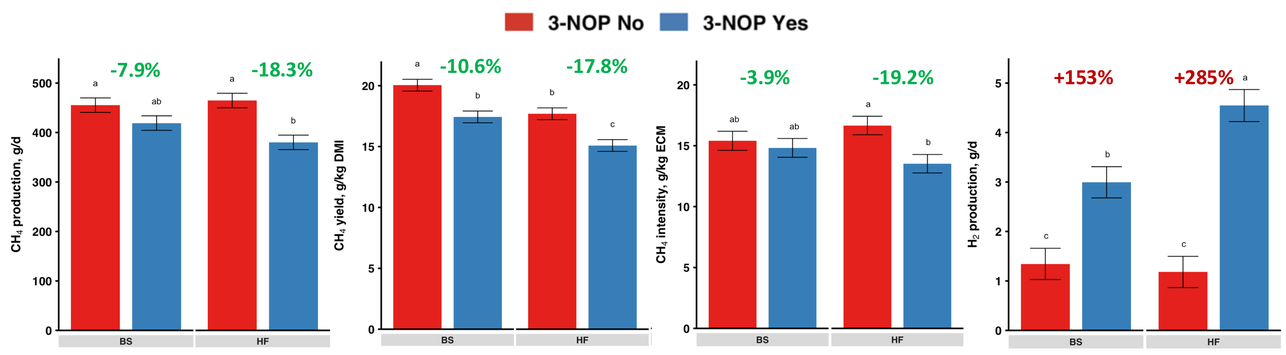

Figure 1. Effect of supplementing 3-NOP to Brown Swiss cows (BS) and Holstein Friesian cows (HF) on enteric gas emissions.

Conclusions

- Combining WCS with 3-NOP improved ECM and milk fat yield but did not have additional enteric CH_4 emission inhibition in dairy cows.
- Further investigations are necessary to effectively assess dietary CH_4 mitigation strategies related to various animal breeds.

Reference

Castro Veloz, C. (2023). Effect of Increasing Levels of Gossypol and Fatty Acids Coming From Whole Cottonseed on Rumen Fermentation, Nutrient Digestibility and Microbial Community Composition in Continuous Culture Fermenters.

Wang, X., Howell, C. P., Chen, F., Yin, J., & Jiang, Y. (2009). Gossypol-a polyphenolic compound from cotton plant. Advances in food and nutrition research, 58, 215-263.