Evaluation of different biochar sources added at two inclusion levels in a grass hay-based diet on dry matter disappearance and ruminal fermentation parameters *in vitro*

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Background

- Enteric CH_4 represents 6% of global anthropogenic GHG emissions, and losses of up to 6-12% of gross energy intake in ruminants (Beauchemin et al. 2020)
- Biochar, a carbon-rich biogenic biomass arising from pyrolysis may offer potential to mitigate CH_4. However biochar effects differ with source and there is scarcity of data on optimal inclusion levels
- The study evaluated the impact of adding biochar at two inclusion levels to a grass hay-based diet on total gas and CH_4 production, feed disappearance, and other fermentation parameters

Methodology

Experimental design and treatments

- Treatments: control (C: grass hay only), and hay with one of 7 biochar products at 2 inclusion levels (2.25%; 4.5% of DM), arranged in a RCBD
- Biochar products:
  - Coconut-based: P001 and P014
  - Pine-based: P002, P015, P016, P023 and P024

In vitro incubation and measurements

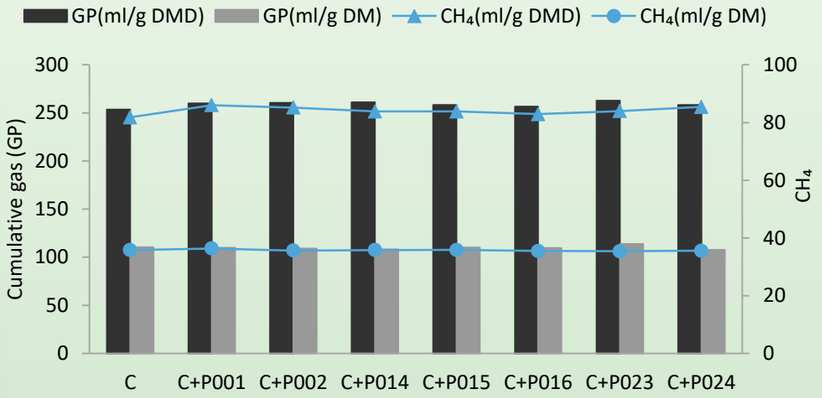
- 0.5g grass hay weighed into ANKOM bags and incubated in a 120 ml serum bottles for 48 hr using rumen fluid:buffer (1:2, v/v) (Menke et al. 1979)
- Gas pressure was recorded at 3, 6, 9, 12, 18, 24, 36 and 48h and samples obtained to determine cumulative gas (GP) and CH_4 production
- Other measurements: DM disappearance (DMD), VFA, NH_3-N and pH

Data analysis

- Data were analysed using the PROC MIXED procedure of SAS, with the fixed effects of biochar product and inclusion level, and run and replicate within run as random effects

Results and discussion

Fig. 1 Cumulative gas and CH_4 production of control (C) and with 7 biochar products



- Biochar did not affect GP or CH_4 relative to the control (Fig. 1)
- Increased biochar inclusion level decreased (P<0.05) GP in ml/g DM (Fig. 2)

Fig. 2 Cumulative gas (GP) and CH_4 production of control and biochar at 2 inclusion levels (2.25%; 4.5% of DM) averaged over biochar treatments

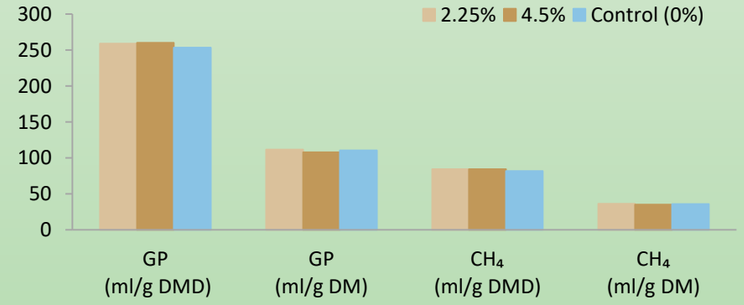


Table 1. DM disappearance (DMD) coefficient, volatile fatty acids (VFA; mmol/L), ammonia nitrogen (NH_3-N; mg/dL) and pH of control (C) and with 7 biochar products at 2 inclusion levels (2.25%; 4.5% of DM)

	Treatments														
	C	C+P001		C+P002		C+P014		C+P015		C+P016		C+P023		C+P024	
Inclusion		2.25	4.5	2.25	4.5	2.25	4.5	2.25	4.5	2.25	4.5	2.25	4.5	2.25	4.5
Parameters															
DMD	0.44	0.43	0.41	0.43	0.41	0.43	0.41	0.44	0.42	0.43	0.42	0.42	0.43	0.42	0.41
Acetic	23.4	26.6	24.3	25.5	23.5	26.1	22.7	28.8	24.6	25.7	27.6	22.1	23.4	26.2	22.9
Propionic	9.2	10.2	10.9	9.8	9.4	10.0	8.3	10.3	9.7	10.0	9.9	8.8	9.3	9.4	8.6
Butyric	4.8	5.6	5.8	5.1	4.8	5.3	4.3	5.4	5.2	5.1	5.2	4.5	5.0	4.9	4.3
Total VFA	39.2	44.1	39.2	42.0	39.7	43.1	37.1	46.2	41.1	42.2	44.1	37.5	39.4	42.1	37.3
NH_3-N	5.24	4.95	4.97	4.48	4.94	5.31	5.30	4.77	4.69	5.01	5.15	5.47	5.13	5.57	4.31
pH	6.72	6.71	6.70	6.71	6.70	6.70	6.69	6.69	6.70	6.71	6.69	6.70	6.71	6.70	6.71

- DMD decreased (P=0.034) with higher biochar inclusion level
- Biochar product and inclusion level did not affect VFA or other fermentation parameters
- A significant (P=0.040) interaction was observed between biochar product and inclusion level for NH_3-N

Conclusions

Biochar product and inclusion level had little or no effect on *in vitro* DMD or fermentation; and did not mitigate CH_4 from a grass hay-based diet

References

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Acknowledgements

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