Effect of biochar inclusion in finishing beef cattle diets on enteric methane production and performance

Hanna K. Cronk, Holly A. Heil, Rebecca L. Sjostrand, Mitch M. Norman, Galen E. Erickson, Andrea K. Watson*

University of Nebraska- Lincoln, Animal Science

Introduction

- Methane (CH_4) and carbon dioxide (CO_2) are greenhouse gases and emissions from cattle are part of the biogenic cycle.
- CH_4 has a high global warming potential but a relatively short life in the atmosphere.
- The agriculture industry has been exploring methods to mitigate emissions, especially CH_4 emissions made from enteric fermentation in ruminants.
- Diet quality, intake, age, and class of the ruminant influences how much methane is produced.
- One potential mitigation strategy is Biochar supplementation.
- Theories on how biochar impacts methane emissions include adsorbing CH_4 in the rumen, increasing inert surface area for microbial attachment, or altering the rumen microbiota.

Objectives

- 1) Determine if feeding biochar impacts finishing beef cattle performance.
- 2) Evaluate the impact of biochar in the diet on methane emissions from beef cattle.

Materials and Methods

- A food use authorization (FDA) was granted as biochar is not approved to feed to cattle
- Randomized Design
- Two treatments
  - Control (CON)
  - Biochar (BIO)
    - Biochar was 0.5% of diet DM and replaced DRC in diet
- 128 crossbred beef steers
  - 8 replicates, 16 pens with 8 head/pen
- Replicates assigned randomly for pen scale methane barn rotation
- Animals were weighed on two consecutive days to equalize gut fill and to establish initial BW
- Fed for 169 days before slaughter at Greater Omaha Packing Plant (Omaha, NE)

Table 1. Diet Table

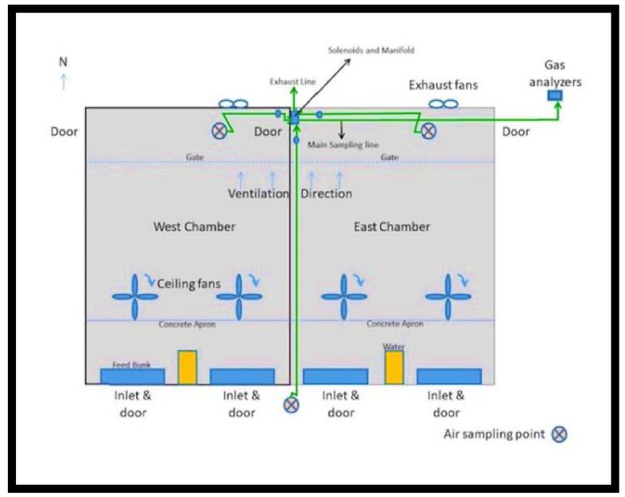
	CON	BIO
Ingredient, % DM		
Dried Rolled Corn	61	60.5
Sweet Bran	30	30
Wheat Straw	5	5
Supplement[1]	4	4
Biochar[2]	0	0.5

[1]Supplement contained limestone, salt, urea, tallow, trace mineral premix, Vitamin ADE, Rumensin (33 mg/kg, Elanco Animal Health), and Tylan (9.68 mg/kg, Elanco Animal Health) in fine ground corn carrier

[2]Biochar inclusion 0.5% of diet DM and replaced DRC in the diet

Pen Scale Methane Barn

- Open-circuit indirect calorimeters
- Two pens noted as East or West chamber
- Four replicates were monitored in two cycles, on either side of chamber
- 1 week rotation
  - Cattle in the barn for 5-day continuous monitoring
  - 1 day manure contribution
  - 1 day baseline
- Each chamber is equipped with a negative pressure system
- Air sampling taken on a timed system: 2-minute ambient air, 6 minutes sampling West chamber, 6 minutes ambient air, and 6 minutes sampling East chamber
- Air sampled was analyzed using a LI-COR 7700 CH_4 and LI-COR 7500 sensor measuring methane and carbon dioxide



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Results

Table 2. Effect of Biochar on Emissions

	CON	BIO	SEM	*P*-Value
Pens	4	4		
DMI, kg/d	12.5	12.2	1.218	0.77
CH_4, g/d	176	194	5.970	0.09
CH_4, g/kg DMI	14.2	16.3	0.563	0.28
CO_2, g/d	10691	10854	383.7	0.78
CO_2, g/kg DMI	904.0	860.6	13.34	0.34

Table 3. Effect of Biochar on Final Cattle Performance and Carcass Characteristics

	CON	BIO	SEM	*P*-Value
Pens	8	8		
Performance				
Initial BW, kg	347	347	0.93	0.78
Carc. Adj. BW, kg	703	695	14.69	0.40
DMI, kg/d	13.2	13.2	0.29	0.76
Carc. Adj. ADG, kg	2.10	2.06	0.08	0.39
Carc. Adj. Gain: Feed	0.157	0.156	0.002	0.71
Carcass Characteristics				
HCW , kg	443	438	9.25	0.39
LM area, cm^2	93.9	94.9	0.15	0.82
Yield Grade	3.80	3.68	0.04	0.06
12th Rib Fat, cm	1.83	1.73	0.01	0.07
Marbling	575	590	16.22	0.51
# Liver Abscess	24	24		

Conclusion

- Supplementing biochar at 0.5% of the diet DM did not decrease eructed CH_4 or impact respired CO_2.
- Final animal performance was not impacted by feeding biochar.
- Yield Grade and 12th Rib Fat tended to be decreased in the biochar group.

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