# Effect of Alga Bio 1.0 on Reducing Enteric Methane Emissions from Cattle

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## Summary with Implications

*An experiment was conducted to determine the effect of Alga Bio 1.0 inclusion on methane and carbon dioxide emissions along with diet digestibility. Three treatments were evaluated with 0, 69, and 103 grams per day Alga Bio 1.0 fed as a top dress in a corn-based diet. Indirect calorimetry headboxes were utilized to evaluate gas production with 12 cows in 4 replicated 3x3 Latin squares. There was a 39% reduction in methane per lb of dry matter intake for cattle fed 69 g of Alga Bio 1.0 and 63% reduction when cattle were fed 103 g of Alga Bio 1.0 daily compared to the control treatment. Both dry matter intake and organic matter intake were reduced by 13% with Alga Bio 1.0 inclusion, but the treatments did not affect the digestibility of dry matter or organic matter. Gross and digestible energy were not affected by Alga Bio 1.0 inclusion. Although this strain of algae is not FDA approved for feeding to cattle, the research shows great potential of Alga Bio 1.0 as a methane mitigation strategy.*

## Introduction

Greenhouse gas emissions are a concern related to future climate and global warming potential. Methane ($CH_4$) emissions are one gas that the agricultural industry will target, and beef cattle are implicated due to enteric fermentation. Because methane has a short life span (10 to 12 years in the atmosphere), reductions will have an immediate impact on the climate. Cattle also experience an energetic loss, 2 to 12% of dietary energy, when producing methane during ruminal fermentation.

Some types of algae have been proposed as a feed additive to reduce methane production in the rumen. Algae is a broad category of aquatic plants, one of which is seaweed. The active ingredient bromoform is concentrated in some species of red seaweed (Asparagopsis taxiformis is perhaps the most widely researched), and blocks the pathway for methane production during ruminal fermentation. Although the product used in this experiment is not Asparagopsis taxiformis, it was inspired by the seaweed and acts in a similar way. The objective of this experiment was to evaluate the effects of Alga Bio 1.0 on diet digestibility and impacts on methane production in cattle.

## Procedure

An experiment using indirect calorimetry (headboxes) was conducted at the University of Nebraska-Lincoln Animal Science metabolism area in Lincoln, NE. Twelve non-lactating, open Jersey cows (previously trained for the headboxes) were used in a 3-period replicated design. Cows were blocked by intake and assigned randomly within 4 blocks to 1 of 3 treatments (4 cows per treatment). Each block was replicated three times with each cow receiving each of the treatments. Treatments included 0, 69 and 103 g (DM basis) of Alga Bio 1.0 daily provided as a top-dress. This was equal to approximately 0, 0.4, and 0.6% of diet DM. Modified distillers grains plus solubles
(MDGS) was used as a carrier and was displaced with the Alga Bio 1.0 to equal one-pound DM of top-dress. Because this product is not FDA approved for feeding to cattle, no milk or meat from these animals entered the food supply chain.

Cattle were housed in individual stalls and fed once daily in the morning with ad libitum access to feed and water. Feed refusals were collected each day before feeding. Diet consisted of 60% dry-rolled corn, 20% corn silage, 15% MDGS, and 5% supplement (DM basis; Table 1). Cows were adapted to high-grain diets prior to start of the experiment. Each period was 21 days with diet samples, orts, and total feces collected for the last 4 days of each period. Samples were dried for 48 hr at 60˚C in a forced-air oven and ground through a 1-mm screen. Samples were analyzed for DM, organic matter (OM), and energy using a bomb calorimeter.

Gas emissions (methane and carbon dioxide) were collected using indirect headbox style calorimeter and emissions were calculated using a gas analyzer. Cows were in headboxes for two, non-consecutive 23-hr periods (adjusted to 24-hr) and gas samples were collected in foil bags that filled evenly throughout the time frame. Gas measurements were averaged per cow for one value per period. Dry matter intake (DMI) of the cows during the 4 days of

**Table 1. Diet composition.**

| Ingredient, % of DM[1] | |
|---|---|
| Dry-rolled corn | 60 |
| Corn Silage | 20 |
| Modified distillers grains plus solubles | 15 |
| Supplement | 5 |
| Fine ground corn | 2.2025 |
| Limestone | 1.68 |
| Tallow | 0.125 |
| Urea | 0.60 |
| Salt | 0.30 |
| Trace mineral premix | 0.05 |
| Vitamin ADE | 0.015 |
| Rumensin-90[2] | 0.0165 |
| Tylan-40[3] | 0.011 |

[1]All treatments received the same basal diet with the addition of Alga Bio 1.0 as a top dress (0, 69, or 103 g/d) mixed with modified distillers grains plus solubles at 1 lb DM/cow daily

[2]Supplement formulated to provide 30 g/ton of Rumensin® (Elanco Animal Health, DM basis)

[3]Supplement formulated to provide 8.8 g/ton of Tylan® (Elanco Animal Health, DM basis)

**Table 2. Effect of Alga Bio 1.0 inclusion on greenhouse gas emissions**

| | Treatment[1] | | | | |
|---|---|---|---|---|---|
| | Control | 69 g/d | 103 g/d | SEM | *P*-value |
| $CH_4$, g/day | 164.9[a] | 88.2[b] | 44.4[c] | 15.6 | < 0.01 |
| $CH_4$, g/lb of DMI | 7.94[a] | 4.84[b] | 2.91[c] | 0.8 | < 0.01 |
| $CO_2$, g/day | 8420[a] | 7844[a] | 7728[b] | 424.1 | 0.08 |
| $CO_2$, g/lb of DMI | 407.6 | 416.6 | 428.4 | 20.4 | 0.39 |
| $O_2$ consumption, g/day | 5729 | 5065 | 5430 | 362.4 | 0.26 |
| $O_2$ consumption, g/lb of DMI | 281.8 | 265.2 | 296.5 | 22.6 | 0.39 |
| RQ[2] | 1.04 | 1.02 | 1.02 | 0.02 | 0.32 |

[1]All treatments received the same basal diet with the addition of Alga Bio 1.0 as a top dress (0, 69, or 103 g/d) mixed with modified distillers grains plus solubles at 1 lb DM/cow daily. The Alga Bio 1.0 inclusion was approximately 0.4 and 0.6% of diet DM.

[2]RQ = respiratory quotient, Liters per day of $CO_2$ production / Liters per day of $O_2$ consumption

[a,b,c] Means in row with unique superscripts are different ($P \leq 0.05$)

**Table 3. Effect of Alga Bio 1.0 inclusion on intake, digestibility, and energy**

| | Treatment[1] | | | | |
|---|---|---|---|---|---|
| | Control | 69 g/d | 103 g/d | SEM | *P*-value |
| Performance | | | | | |
| BW, lb | 1086 | 1077 | 1081 | 42.1 | 0.66 |
| BCS[2] | 3.9 | 3.8 | 3.8 | 0.2 | 0.32 |
| Intake and Digestibility | | | | | |
| Dry Matter Intake, lb/d | 21.4[a] | 19.2[b] | 18.5[b] | 1.4 | 0.01 |
| Digestibility, % | 70.6 | 68.9 | 68.6 | 2.4 | 0.51 |
| Organic Matter Intake, lb/d | 20.5[a] | 18.3[b] | 17.9[b] | 1.4 | 0.01 |
| Digestibility, % | 75.2 | 74.7 | 74.7 | 1.8 | 0.89 |
| Energy | | | | | |
| Gross Energy, Mcal/lb | 1.99 | 2.00 | 1.99 | 0.01 | 0.44 |
| Digestible Energy, Mcal/lb | 1.44 | 1.42 | 1.43 | 0.03 | 0.67 |
| DE/GE | 0.72 | 0.71 | 0.71 | 0.02 | 0.66 |

[1]All treatments received the same basal diet with the addition of Alga Bio 1.0 as a top dress (0, 69, or 103 g/d) mixed with modified distillers grains plus solubles at 1 lb DM/cow daily. The Alga Bio 1.0 inclusion was approximately 0.4 and 0.6% of diet DM.

[2] Body Condition Score was performed using a 5-point scale common in the dairy industry.

[a,b,c] Means in row with unique superscripts are different ($P \leq 0.05$)

collections was used for reporting gas emissions on a per lb DMI basis.

Digestibility and gas emissions were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). Cow within period was the experimental unit. Cow and period were random effects and treatment was a fixed effect. Differences were considered significant if $P \leq 0.05$.

## Results

The inclusion of Alga Bio 1.0 in the diet decreased methane production measured as g/d ($P < 0.01$; Table 2) and g/lb DMI ($P < 0.01$). There was a 39% reduction in methane emissions expressed as g/lb of DMI with 69 g Alga Bio 1.0 inclusion and 63% reduction (g/lb of DMI) with 103 g of Alga Bio 1.0 inclusion compared to the control diet. Methane emissions reported as g/d were reduced 46% with 63 g Alga Bio 1.0 and 73% with 103 g Alga Bio 1.0. Emissions of carbon dioxide ($CO_2$; g/d) tended ($P = 0.08$) to be lower for cattle receiving 103 g of Alga Bio 1.0, but did not differ when calculated as g/lb DMI ($P = 0.39$). Oxygen consumption ($O_2$) amounts did not differ between treatments for g/day ($P = 0.26$) and g/lb DMI ($P = 0.39$). Respiratory quotient (RQ; a measure of basal metabolic rate) was not significantly impacted ($P = 0.32$) by the treatments.

Alga Bio 1.0 inclusion did influence DMI ($P = 0.01$; Table 3) with the Alga Bio 1.0 treatments having lower DMI compared to the control. There was no difference in DM digestibility among the treatments ($P = 0.51$). Similar to DM, OMI was affected by the inclusion of Alga Bio 1.0 ($P = 0.01$), but OM digestibility was not influenced by the treatments ($P = 0.89$). Gross energy expressed as Mcal/lb was not affected by the inclusion of Alga Bio 1.0 ($P = 0.44$). Digestible energy (Mcal/lb) was not significantly different ($P = 0.67$) between treatments.

## Conclusion

Cattle supplemented with Alga Bio 1.0 at 69 or 103 g/d had lower methane emissions compared to a dry rolled corn control diet. There was no significant impact on carbon dioxide emissions (g/lb of DMI). Intake was significantly decreased with the addition of Alga Bio 1.0, but digestibility and dietary energy were not impacted. Alga Bio 1.0 shows promise as a feasible methane mitigation tool when included in cattle diets as a feed additive; however, FDA approval is needed prior to use by producers.

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