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OPTAFLEXX[1] AFFECTS RUMEN FERMENTATION

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Summary

Three experiments were conducted to determine effects of ractopamine-HCl, sold under the trade name Optaflexx, on rumen fermentation. In experiment 1, fermentative gas production was measured *in vitro* to determine the impact of increasing amounts of ractopamine-HCl added to rumen fluid. Ractopamine-HCl increased gas production when added to rumen fluid up to 10 times the assumed physiological dosage of 200 mg per head/day, but depressed gas production at 100 times the physiological dose. Experiment 2 and 3 evaluated the effects of ractopamine-HCl on production of volatile fatty acids (VFAs) by ruminal microbes. *In vitro* experiments revealed no effect of ractopamine on volatile fatty acid production, but VFA levels in rumen fluid of cattle 23 hours after feeding were lower for cattle fed Optaflexx then for controls (P = 0.01). Results of these studies indicate that ractopamine-HCl has a direct influence on fermentation by rumen microflora.

Introduction

Ractopamine-HCl is a beta-agonist similar in structure to catecholamines and is marketed commercially under the trade name Optaflexx. Feeding Optaflexx accelerates gain and improves efficiency when administered to cattle during the final 4 to 6 weeks of feedlot finishing. Naturally occurring catecholamines have been noted to affect certain types of microorganisms. Consequently, researchers were interested in determining if ractopamine-HCl could impact ruminal microorganisms in a similar manner.

Materials and Methods

Experiment 1. Concentrations of ractopamine-HCl were 0, 0.0339, 0.3339, 3.339, or 33.39 mg RAC per gram of corn dry matter were compared in an *in vitro* experiment with rumen microorganisms. Ground corn was added to each flask as a source of substrate for the microorganisms. Rumen fluid was mixed with McDougall's artificial saliva to a final ratio of 2:1 and added to the culture flasks. Flasks were incubated at body temperature, and gas production was measured at hourly intervals for 6 hours.

Experiment 2. *In vitro* VFA profiles were determined with five concentrations of ractopamine-HCl (0, 0.0339, 0.3339, 3.339, or 33.39 mg RAC per gram of corn dry matter) added to flasks. Flasks were incubated 6 hours, and VFA concentrations were determined using gas chromatography.

Experiment 3. Rumen fluid samples used to determine *in vivo* VFA profiles were obtained from 60 cross-bred heifers fed a 94% concentrate ration formulated to provide 0 or 200 mg/day Optaflexx. Samples were taken 23 hours after feeding. Heifers were sampled on two separate occasions. Samples were analyzed for VFA concentrations.

[1]Optaflexx is a registered trademark of Elanco Animal Health, Indianapolis, IN.

Results and Discussion

Experiment 1. Optaflexx concentration had a quadratic effect on in vitro gas production. Gas production increased significantly from the control with addition of Optaflexx at the concentration of .3339 mg of RAC per gram of corn dry matter and 3.339 mg RAC per gram of corn dry matter ($P<0.05$). The highest concentration resulted in the lowest gas production. The increase in gas production in response to increased concentration of ractopamine-HCl provides evidence that changes are occurring in the rumen of cattle fed Optaflexx. The decline in gas production at 33.39 mg RAC per gram of corn dry matter indicates that the rumen can be exhausted by an excessive amount of ractopamine-HCl, negatively impacting the rumen microflora.

Experiment 2 and 3. The VFA profiles from *in vitro* fermentations are not different among increasing levels of Optaflexx (Table 1). Optaflexx decreased total VFA production *in vivo* ($P = 0.014$, Table 2). The contradiction between *in vitro* and *in vivo* VFA profiles may be a result of the sampling technique. The *in vitro* samples were obtained sis hours after the substrate was added to the batch fermentation system. Heifers were sampled 23 hours after feeding for the *in vivo* analysis. The decline in total VFA production may be a result of more extensive digestion of the ration rather than from a decline in VFA production. Sampling rumen fluid from cattle ruminally cannulated at several time points after feeding of Optaflexx may better illustrate the effects on fermentation and the rumen.

Conclusion/ Implication

Supplementing cattle with Optaflexx changes the rumen environment. Developing a greater understanding of these changes may make it possible to further improve responses to Optaflexx supplementation.

Table 1. Effects of Ractopamine-HCl on *In Vitro* VFA Profiles

	Volatile Fatty Acid Concentration, mM						
	Acetate	Propionate	Butyrate	Isobutyrate	Isovalerate	Valerate	Total
Control	28.41	13.21	7.07	0.63	1.62	1.04	51.96
Ractopamine-HCL	28.85	13.12	7.49	0.65	1.68	1.08	52.86

Control and ractopamine are not different, $P>0.50$

Table 2. Effects of Optaflexx Supplementation on *In Vivo* VFA Profiles

	Volatile Fatty Acid Concentration, mM						
	Acetate[a]	Propionate[a]	Butyrate[b]	Isobutyrate[b]	Isovalerate	Valerate[a]	Total[a]
Control	27.65	31.08	6.48	0.34	0.65	2.48	68.62
Optaflexx	25.33	28.37	5.7	0.37	0.68	2.08	62.52

[a]Control and Optaflexx groups are different, $P<0.05$.
[b]Control and Optaflexx groups are different, $P<0.10$.

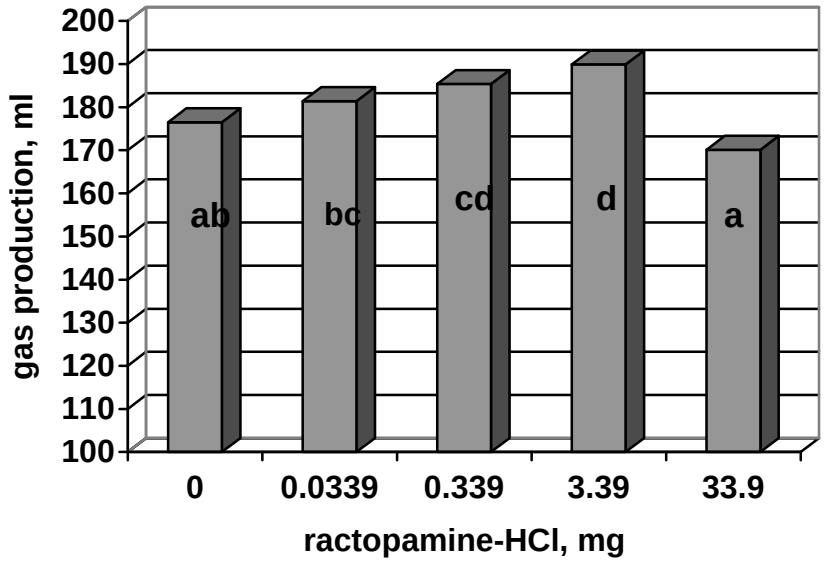

Figure 1. The Amount of Fermentative Gas Produced by Rumen Microbes During a 6 Hour *In Vitro* Fermentation with 5 Concentrations of Ractopamine-HCl. Gas production was measured as ml of water displaced during the six hour fermentation. [a,b,c,d]Means without a common superscript are different (P<0.10).