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Introduction

Hops (*Humulus lupulus*) have played an integral role in beer manufacturing and are widely known for their antimicrobial and preservative properties. Alpha-acids of hops are extracted and utilized to enhance beer flavor, leaving residues largely composed of β -acids. Beta-acid extracts of hops are structurally similar to ionophores and may express ionophore-like traits. Ionophores, including Rumensin (Elanco Animal Health, Greenfield, IN), are used to improve feed efficiency and to decrease the incidence of digestive disturbances in feedlot cattle. A large portion of *in vitro* studies show benefits from feeding hops or hop acids with results similar to ionophores; however, live animal experiments are needed to confirm these observations. The objectives of this study were to assess the effects of β -acid extracts of hops on feedlot performance in cattle fed high-concentrate diets and determine a response to varied doses of β -acid extracts of hops.

Experimental Procedures

Yearling crossbred heifers ($n = 80$; initial body weight 855 lb) were randomly allotted to five treatments consisting of a control (no additive); Rumensin fed at 33 ppm of diet dry matter; and β -acid extracts of hops fed at 10, 25, or 50 ppm of diet dry matter. Heifers were housed individually in partially covered concrete pens equipped with individual feed bunks and fed a basal diet presented in Table 1. Feed additives (Rumensin or β -acid beadlet) were preblended into a carrier consisting of finely ground corn and mixed daily prior to feeding. The negative control premix consisted of ground corn only. Heifers were weighed after 23 days on feed, and subsequent weights were captured in 21-day intervals. Average daily gain, dry matter intake, and feed efficiency were determined for each period. Ruminal digesta samples (4 to 8 ml) were collected via rumenocentesis on days 44 and 86 to analyze ruminal concentrations of volatile fatty acids and ammonia.

Results and Discussion

One heifer was removed from the study due to lameness. Live performance parameters such as average daily gain (Figure 1), dry matter intake (Figure 2), and feed efficiency (Figure 3) did not differ among treatments ($P = 0.31$; $P = 0.85$; $P = 0.26$, respectively). When comparing two separate sampling days, no significant differences were observed between treatments for any ruminal volatile fatty acid acetate:propionate or ammonia

concentrations ($P = 0.67$; $P = 0.30$; $P = 0.91$, respectively; Figures 4 and 5). This study consisted of a small population size, which may warrant further investigation of *in vivo* studies with larger population sizes to further elucidate response and mode of action of β -acid extracts of hops in ruminant diets.

Implications

Hops β -acid extract showed feedlot performance similar to Rumensin and could be fed as an alternative to this ionophore.

Acknowledgements

We would like to thank DSM Nutritional Products for providing the hops β -acid beadlet product.

Table 1. Diet composition

Ingredient	Dry matter, %
Corn gluten feed	30.21
Alfalfa hay	7.99
Steam-flaked corn	57.85
Feed additive premix ¹	2.03
Trace mineral/vitamin premix ²	1.92

¹Diets including feed additives (Rumensin, Elanco Animal Health, Greenfield, IN) or (β -acid beadlet, DSM Nutrition Products, Village-Neuf, France) were blended into ground corn and are included in the percentage. The final diet (dry matter) provided either no additive, 33 ppm Rumensin, or 10, 20, or 50 ppm β -acid. The negative control consisted of ground corn only. Optaflexx (Elanco Animal Health, Greenfield, IN) was combined with a ground corn carrier and fed at a rate of 40 ppm throughout days 118–147.

²Formulated to provide at least 14% crude protein, 1000 IU/lb vitamin A, 0.1% added sodium, 0.15% added chlorine, 0.7% calcium, 0.7% potassium, 10 ppm copper, 60 ppm zinc, 60 ppm manganese, 0.5 ppm iodine, 0.15 ppm cobalt, and 0.3 ppm selenium.

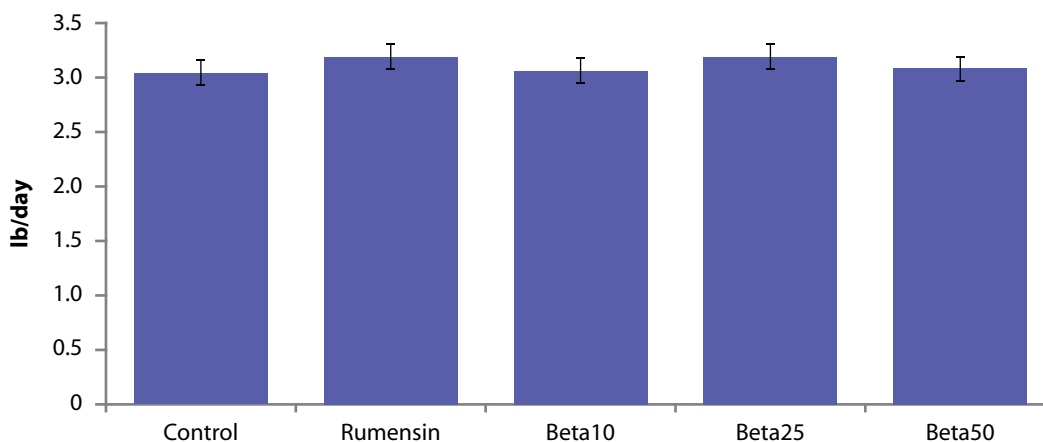


Figure 1. Average daily gain of heifers fed for 147 days ($P = 0.31$).

The control diet contained no additive, Rumensin provided 33 ppm Rumensin in the final diet (dry matter), Beta10 provided 10 ppm β -acid in the final diet (dry matter), Beta25 provided 25 ppm β -acid in the final diet (dry matter), and Beta50 provided 50 ppm β -acid in the final diet (dry matter).

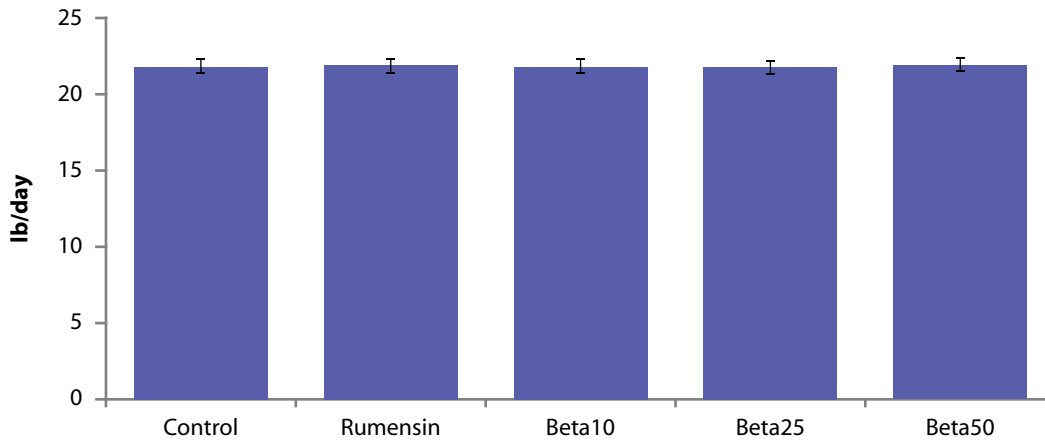


Figure 2. Feed intake (dry basis) of heifers fed for 147 days ($P = 0.85$).

The control diet contained no additive, Rumensin provided 33 ppm Rumensin in the final diet (dry matter), Beta10 provided 10 ppm β -acid in the final diet (dry matter), Beta25 provided 25 ppm β -acid in the final diet (dry matter), and Beta50 provided 50 ppm β -acid in the final diet (dry matter).

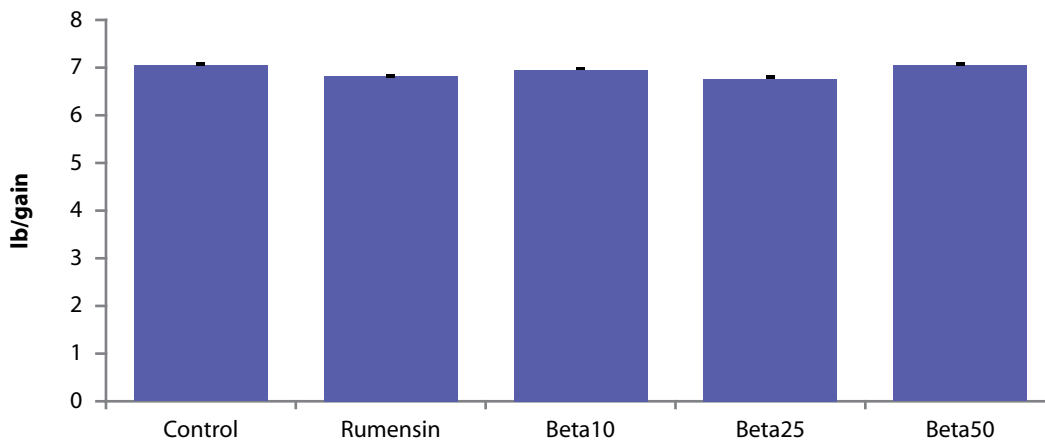


Figure 3. Feed:gain of heifers fed for 147 days ($P = 0.26$).

The control diet contained no additive, Rumensin provided 33 ppm Rumensin in the final diet (dry matter), Beta10 provided 10 ppm β -acid in the final diet (dry matter), Beta25 provided 25 ppm β -acid in the final diet (dry matter), and Beta50 provided 50 ppm β -acid in the final diet (dry matter).

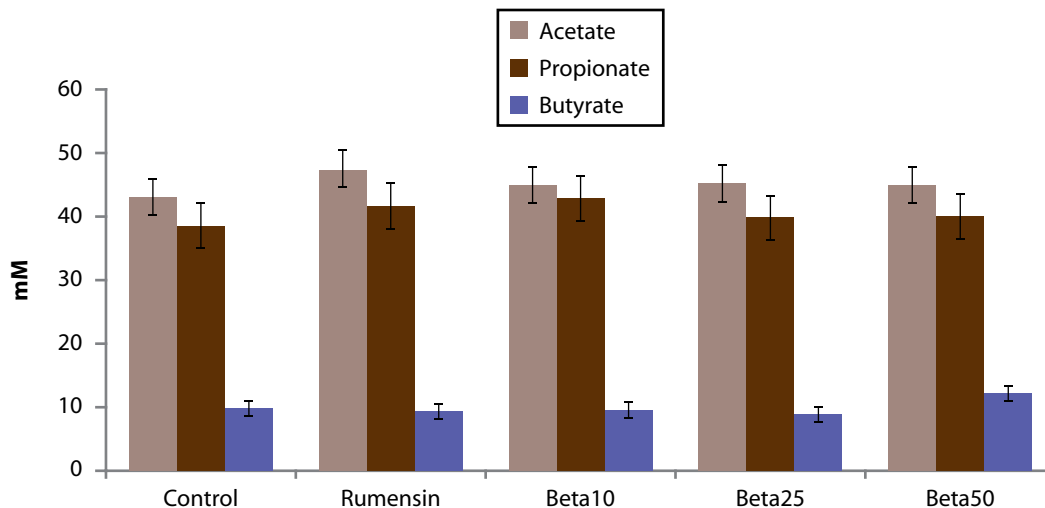


Figure 4. Ruminal volatile fatty acid concentrations of heifers on day 86, ($P = 0.67$).

The control diet contained no additive, Rumensin provided 33 ppm Rumensin in the final diet (dry matter), Beta10 provided 10 ppm β -acid in the final diet (dry matter), Beta25 provided 25 ppm β -acid in the final diet (dry matter), and Beta50 provided 50 ppm β -acid in the final diet (dry matter).

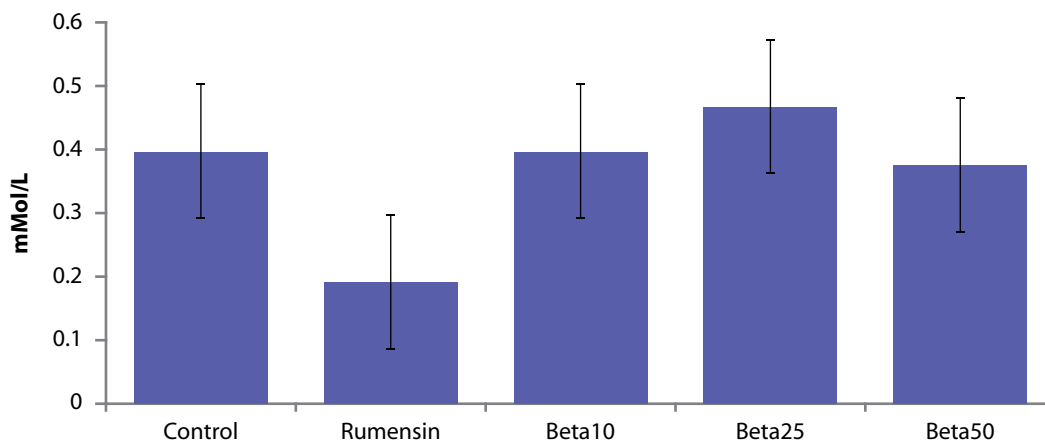


Figure 5. Ruminal ammonia concentrations of heifers on day 86, ($P = 0.91$).

The control diet contained no additive, Rumensin provided 33 ppm Rumensin in the final diet (dry matter), Beta10 provided 10 ppm β -acid in the final diet (dry matter), Beta25 provided 25 ppm β -acid in the final diet (dry matter), and Beta50 provided 50 ppm β -acid in the final diet (dry matter).