Effects of feeding supplemental amino acid complexed zinc for mitigation of liver abscesses in feedlot cattle

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Introduction

Liver abscesses (LA) in feedlot cattle continue to be an issue compromising beef productivity, health and food safety. Ruminal acidosis resulting from the feeding of highgrain finishing diets may compromise ruminal epithelial integrity and predispose cattle to liver abscesses. Dietary zinc (Zn) is known to promote epithelial integrity and may provide an alternative method for reducing LA. Two research projects were conducted to evaluate the effect of dietary Zn supplementation on biomarkers of inflammation and metabolism and LA prevalence and formation in response to a mild acidosis challenge (Study 1). In a second study (Study 2), effects of dietary Zn source and concentration on LA prevalence were evaluated in a longitudinal, retrospective pooled study analysis.

Materials and Methods

Study 1: Forty-two steers (417 ± 1.5 kg) were individually fed diets containing either 0 (CON; n = 18) or 90 mg Zn/kg DM from a Zn-amino acid complex (Zn-AA; n = 18; Availa-Zn®; Eden Prairies, MN). Six additional steers were fed the CON diet and did not undergo the acidosis challenge (NON; n = 6). Ruminal pH was monitored continuously with an intra-ruminal pH bolus. Blood samples were collected throughout the study and ruminal epithelial and liver tissue collected at slaughter. Steer was the experimental unit for statistical analysis.

Study 2: Liver abscess scores were combined from four retrospective, commercial feedlot research studies (total number >10,000 animals) evaluated the main effects of feeding Zn-AA (+) in the finishing diet or CON (no Zn-AA) in the finishing diet. Linear (L), quadratic (Q) and cubic (C) effects of dietary Zn-AA concentration (0 = < 30 mg Zn-AA·kg-1 DM; 1 = 30 – 59 mg Zn-AA·kg-1 DM; 2 = 60 – 89 mg Zn-AA·kg-1 DM; 3 = ≥ 90 mg Zn-AA ·kg-1 DM inclusion) were determined. Pen was the experimental unit.

Results

Study 1: Liver abscess incidence tended (P=0.12) to be lesser in Zn-AA (6%) steers compared to CON (24%); though the study did not have adequate statistical power to differentiate effects in LA severity. Dietary treatment did not affect ruminal papillae width, keratinized layer, or total epithelial layer (P ≥ 0.45). There were no differences between treatments (P ≥ 0.67) for white blood cell, fibrinogen, neutrophil, or lymphocytes. Serum aspartate aminotransferase (SAA) and gamma-glutamyl transferase (GGT) concentrations were greater in NON vs. CON (P ≤ 0.02), and serum alkaline phosphatase (AP) concentration was decreased in CON vs. Zn-AA (P < 0.01). Creatine concentrations were greater (P = 0.02) in Zn-AA compared to CON. Ruminal pH, as determined by area under the curve (AUC), set at a threshold of a rumen pH below 5.8, as well as minimum and maximum rumen pH during the challenge and post-challenge period was similar between NON and CON steers. Liver Cu and Zn were not different (P ≥ 0.20) among treatments. Liver Fe was greater (P = 0.04) in NON compared to CON; although, Fe concentrations between CON and Zn-AA-fed steers were not different (P = 0.15).

Study 2. Percentages of total LA were reduced (P< 0.03) in Zn-AA(+) compared to Zn-AA(-) by 19% (10.5 vs 8.5%, respectively). Incidence of and A+ LA were reduced by dietary Zn-AA from 3.4 to 2.4% of total livers scored (P<0.01). Total and A+ LA were quadratically reduced (P<0.01) with 60-89 ppm supplemental dietary Zn-AA.

Significance

Dietary Zn supplementation with Zn-AA decreased incidence and severity of LA. The acidosis challenge model was adequate to induce the formation of a measurable incidence of liver abscesses that could be differentiated between CON and Zn-AA treatments. Observed shifts in liver enzymes may represent viable biomarkers with application to identify cattle with liver abscesses earlier in the feeding period or which may be at higher risk for developing liver abscesses later in the finishing period. Results from commercial feedlots, where tylosin was fed, indicated further mitigation of LA maybe achieved from feeding Zn-AA.