Research Now

Availa®Zn Improved Ruminant Gut Health in Heat-Stressed Holstein Steers

Introduction:

This study was designed to assess the effect of Availa®Zn on ameliorating the negative impacts of heat stress on intestinal integrity and villi morphology in Holstein steers.

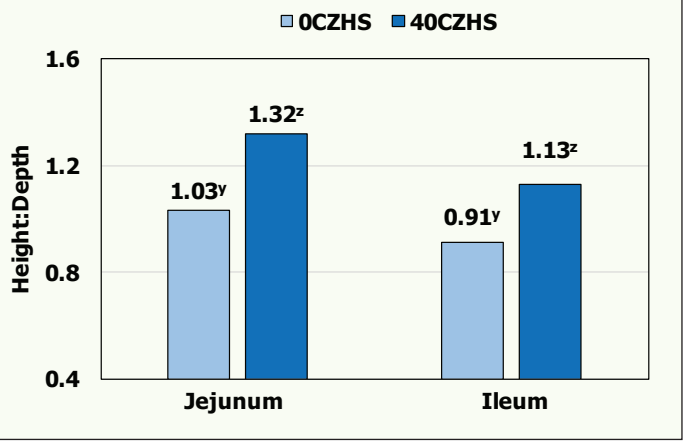
Experimental Design:

Forty Holstein steers were fed *ad libitum* 1 of 2 Zn treatment diets for 21 days: 75 ppm Zn from $ZnSO_4$ (0AvZn) or 35 ppm Zn from $ZnSO_4$ and 40 ppm Zn from Availa-Zn (40AvZn). On d 22 steers were moved to environmental chambers and continued to receive treatment diets *ad libitum* (AL) under thermal neutral conditions (TN) for 5 days (Period 1). Steers were then assigned to 1 of 5 diets and environment combinations for 6 days (Period 2). Steers continued to receive either 0AvZn or 40AvZn and were housed under TN or heat stress (HS) conditions. Pair-fed (PF) steers were fed similar amounts of dry matter as their *ad libitum* fed HS counterparts.

Period 2 treatments:

T1: TN, AL, 0AvZn (CON)
T2: TN, PF to T3, 0AvZn (0CZPF)
T3: HS, AL, 0AvZn (0CZHS)
T4: TN, PF to T5, 40AvZn (40CZPF)
T5: HS, AL, 40AvZn (40CZHS)

Effect of Zn Source on Villi Height:Crypt Depth



yz Within a tissue, means lacking a common superscript letter differ, $P < 0.01$

Results:

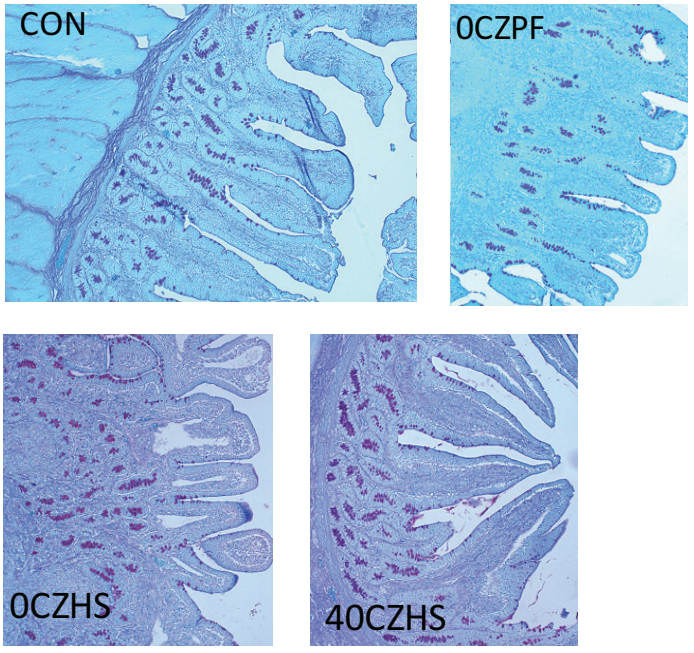
Feeding 40AvZn tended to increase dry matter intake (DMI) regardless of environment, $P = 0.09$

Compared to HS steers fed 0AvZn, HS steers receiving 40AvZn were observed to have ($P < 0.01$):
- Reduced rectal temperatures
- Decreased duodenum villi width
- Increased jejunum villi height and villi height:crypt depth

Compared to TN, HS steers were observed to have ($P < 0.01$):
- Decreased NEFA and serum amyloid A
- Increased BUN, insulin:DMI, and L-lactate

Compared to PF, HS steers had ($P < 0.01$):
- Increased numbers of goblet cells in the duodenum, jejunum, ileum and colon

Feeding Availa-Zn improved DMI, reduced rectal temperature, and altered intestinal morphology resulting in improved ruminant gut health of heat-stressed steers.



Intestinal Morphology: Villi height, width, and crypt depth

Abstract

The Effects of Zinc Amino Acid Complex on Biomarkers of Gut Integrity and Metabolism in Heat-Stressed Steers. M. Abuajamieh[1], S.K. Kvidera[1], E.A. Horst[1], E.J. Mayorga[1], J.T. Seibert[1], J.S. Johnson[1], J. W. Ross[1], M. Al-Qaisi[1], P.J. Gordon[1], J.M. DeFrain[3], R.P. Rhoads[2], and L.H. Baumgard[1] [1]Iowa State University, [2]Virginia Tech University, [3]Zinpro Corporation, Eden Prairie, MN, USA.

Supplemental Zn improves monogastric intestinal integrity during heat stress (HS), but its ability to improve ruminant gut health is unknown. Forty Holstein steers (173.6 ± 4.9 kg) were used in a replicated, incomplete 2x3 factorial design to determine the effect of Zn source ($ZnSO_4$ vs. Zn amino acid complex [CZ; Availa®Zn, Zinpro Corporation]) and environment (thermal neutral [TN] conditions or cyclical HS) on biomarkers of intestinal integrity and villi morphology. Steers were fed *ad libitum* (AL) one of two diets for 21 d: 1) 75 mg/kg of Zn from $ZnSO_4$ or 2) 35 mg/kg Zn from $ZnSO_4$ and 40 mg/kg Zn from of CZ. Steers remained on assigned diets and were then housed in environmental chambers. The experiment consisted of two periods (P): P1) 5 d of baseline in TN-AL conditions (20.2±1.4°C, 30.4±4.3% RH) and P2) 6 d of environment implementation followed by euthanasia. During P2, steers received one of five diet by environment combinations: 1) TN fed AL 75 mg/kg of Zn from $ZnSO_4$ (Ctrl; n=8), 2) TN pair-fed (PF) 75 mg/kg of Zn from $ZnSO_4$ (0CZPF, n=8), 3) HS (27.1±1.5 to 35.0±2.9°C, 19.3±3.5% RH) and fed AL 75 mg/kg of Zn from $ZnSO_4$ (0CZHS; n=8), 4) TN and PF 35 mg/kg of Zn from $ZnSO_4$ and 40 mg/kg of Zn from CZ (40CZPF, n=8), and 5) HS and fed AL 35 mg/kg of Zn from $ZnSO_4$ and 40 mg/kg of Zn from CZ (40CZHS; n=8). The Ctrl, 0CZPF, and 40CZPF steers remained in TN continuously. The 0CZPF and 40CZPF steers were fed to their 0CZHS and 40CZHS counterparts, respectively. Data were analyzed with repeated measures using PROC MIXED in SAS and P1 data used as a covariate. Preplanned contrasts evaluated Zn source and environment. Regardless of environment, 40CZ tended to increase DMI (10%; $P = 0.09$) relative to 0CZ ($P < 0.01$). Compared to TN, HS decreased NEFA, serum amyloid A and increased BUN, insulin:DMI, and L-lactate ($P < 0.01$). 40CZHS calves had reduced rectal temperature compared to 0CZHS (0.24°C; $P < 0.01$). Compared to PF, HS calves had increased ($P < 0.01$) goblet cell numbers in the duodenum, jejunum, ileum, and colon. 40CZHS decreased duodenum villi width and increased both jejunum villi height and villi height:crypt depth relative to 0CZHS ($P < 0.01$). Feeding CZ improved DMI, reduced rectal temperature, and altered intestinal morphology; changes indicative of improved intestinal barrier function during HS.

Key words: gut health, heat stress, intestine, zinc

2016 JAM, July 19-23, 2016, Salt Lake City, UT, USA