Research Now

Supplementing Availa®Zn Impacts Gut Integrity and Metabolism In Heat-Stressed Pigs

Introduction:

Heat stress (HS) jeopardizes the health of both animals and humans. It is instigated in part by decreased integrity of the intestine, a condition known as "leaky gut." The objective of this study was to determine if the assault on intestinal integrity, brought on by acute HS, could be mitigated by the supplementation of zinc amino acid complex (ZnAA; Availa®Zn).

Experiment Design:

- 32 cross-bred gilts (64 ± 3 kg initial BW) randomly assigned to 1 of 4 treatments
- All gilts subject to thermoneutral (TN) conditions and allowed *ad libitum* access to feed during diet acclimation period. One of two Zn supplements included in diet:
  1. CON: 120 ppm Zn from $ZnSO_4$
  2. ZnAA: 60 ppm Zn from $ZnSO_4$ + 60 ppm Zn from Availa-Zn
- Environmental challenge initiated on d 17 for 12 h period. Gilts underwent one of two conditions:
  1. TN: Thermoneutral (21 °C, 70% humidity)
  2. HS: Heat stress (37 °C, 40% humidity)

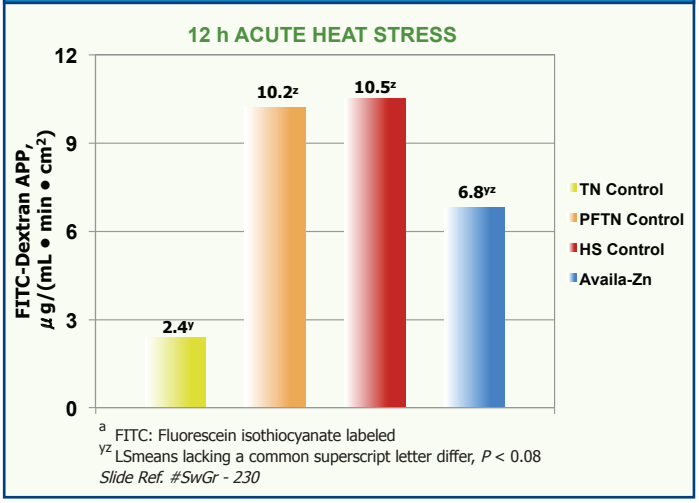
Treatments:

1. **TN Control:** Control diet + TN condition (*ad libitum* intake; n = 8)
2. **PFTN Control:** Control diet + TN condition (pair-fed intake; n = 8)
3. **HS Control:** Control diet + HS condition (*ad libitum* intake; n = 8)
4. HS ZnAA; ZnAA: (labeled as Availa-Zn in charts below) diet + HS condition (*ad libitum* intake; n = 8)

Results:

- Heat-stressed gilts had lower body temperatures when fed Zn from Availa-Zn compared to $ZnSO_4$
- Feeding Zn from Availa-Zn maintained ileal integrity of pigs in heat stress conditions
- Markers of muscle catabolism in blood were decreased when heat-stressed pigs were supplemented with Zn from Availa-Zn compared to $ZnSO_4$

Ileal FITC[a]-Dextran Apparent Permeability Coefficient (APP)



[a] FITC: Fluorescein isothiocyanate labeled
[yz] LSmeans lacking a common superscript letter differ, $P < 0.08$
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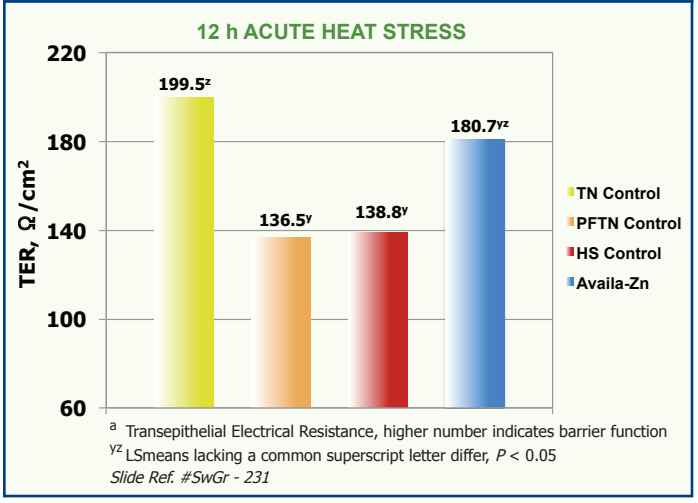
Ileal Transepithelial Electrical Resistance[a] (TER)



[a] Transepithelial Electrical Resistance, higher number indicates barrier function
[yz] LSmeans lacking a common superscript letter differ, $P < 0.05$
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Abstract

Effects of Zinc Amino Acid Complex on Gut Integrity and Metabolism in Acutely Heat-Stressed Pigs. Sarah C. Pearce[1]*, Maria V. Sanz-Fernandez[1], Jerry Torrison[2], Mark E. Wilson[2], Nicholas Gabler[1], Lance H. Baumgard[1]; [1]Animal Science, Iowa State University, Ames, Iowa, USA, [2]Zinpro Corporation, Eden Prairie, MN, USA.

Heat stress (HS) negatively affects intestinal integrity and livestock function. Therefore, our objective was to determine whether zinc amino acid complex (ZnAA) supplementation would mitigate acute HS-induced changes in intestinal integrity. Crossbred gilts (n = 32; 64 ± 3 kg BW) were individually penned and fed *ad libitum* 1 of 2 diets for 17 d: 1) 120 ppm of Zn from $ZnSO_4$ (CON); or 2) 60 ppm from $ZnSO_4$ + 60 ppm from ZnAA (ZnAA). After 17 d, CON pigs were exposed to either TN conditions (21 °C; 70% humidity) with *ad libitum* intake (TN-CON; n = 8); HS conditions (37 °C; 40% humidity) with *ad libitum* intake (HS-CON, n = 8), or pair-fed in thermal-neutral conditions (PFTN; n = 8); while ZnAA pigs were only exposed to HS conditions (HS-ZnAA, n = 8). Pigs were sacrificed after 12 h of environmental exposure and blood markers of stress, and ileum and colon permeability were assessed by Ussing chamber transepithelial resistance (TER) and FITC-dextran permeability (PaPP). As expected, HS-CON and HS-ZnAA pigs had markedly increased ($P < 0.01$) rectal temperature (Tr). Interestingly, HS-ZnAA pigs had lower Tr compared to HS-CON pigs starting at 4 h (0.32 °C average; $P < 0.05$). HS increased (<3 fold, $P < 0.05$) respiration rates compared to both TN-CON and PFTN pigs. Overall, 12 h feed intake and body weight was reduced due to HS compared to TN pigs ($P < 0.05$). However, HS-ZnAA ileum APP did not differ from either TN or HS pigs. HS and PFTN ileal TER decreased by 31% compared to TN pigs ($P < 0.01$). However, compared to HS-CON, HS-ZnAA pigs had an increased TER (30.2%; $P = 0.05$). Under this short duration of HS, colon permeability and TER was not altered. Blood glucose did not differ between treatments, however, blood urea nitrogen (BUN) was increased in HS-CON and HS-ZnAA pigs by 3.3 and 2.3 fold compared to TN-CON and PFTN controls ($P < 0.01$). HS-ZnAA pigs had reduced (13.3 vs 9.4 mg/dL; $P = 0.04$) BUN compared to HS pigs. These data indicate supplementing ZnAA improves key aspects of small intestinal integrity, blood temperature, and blood markers of muscle catabolism during acute heat stress.

Key words: Heat stress, pig, zinc

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