

The Metabolism and Productive Responses to Heat Stress PART TWO

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The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Heat Stress and Gut Health

Diversion of blood flow to skin and extremities
Coordinated vasoconstriction in intestinal tissues

Reduced nutrient and oxygen delivery to enterocytes
Hypoxia increases reactive oxygen species (ROS)

Reduced nutrient uptake increases rumen and intestinal osmolarity in the intestinal lumen

Multiple reasons for increased osmotic stress









The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Intestinal Morphology



Thermal Neutral

Heat Stress

Pair-fed

Pearce et al., 2011



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Heat Stress and Gut Integrity

Endotoxin (aka. Lipopolysaccharide: LPS)

- Component of bacteria cell wall
- When bacteria die, LPS is released into intestine
- Normally LPS is prevented from entering through GIT tight junctions
- During HS some LPS enters blood stream



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Heat Stress and Gut Health

LPS can cause liver damage

- May impair gluconeogenesis capability
- May impair ability to export VLDL (fatty liver)
- May impair ability to secrete anabolic hormones
- LPS stimulates inflammatory cytokine production....catabolic condition
 - TNF , IL-1 etc..
 - Reduced appetite
 - Stimulates fever
 - Causes muscle breakdown
 - Induces lethargy
 -reduces productivity



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies The Effects are Rapid Plasma LPS & LBP







The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Mammary LPS Infusion Causes Insulin Levels



Tom Overton et al. Cornell University



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies I.V. LPS Acutely Increases Insulin Secretion



Rhoads et al., 2009 ADSA Abstract



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies I.V. LPS Challenge to Pigs





The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies LPS and Insulin

 LPS stimulates or at least augments glucose stimulated insulin secretion.

Insulin promotes adipose tissue accretion

Partitions nutrients from lactation

 This explains the differential effects on milk yield and a fatter carcass during growth



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Glucose and the Immune System

•At rest, immune cells can oxidize multiple fuels

 Once activated, immune cells become obligate glucose utilizers

• How much glucose does the immune system use?

 Milk synthesis is regulated by lactose synthesis....glucose is precursor to lactose



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies LPS Challenge & Blood Glucose





The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies LPS Challenge & Blood Glucose



Stoakes et al., 2015



Feed Immune System Milk, Meat & Reproduction



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Summary



Baumgard & Rhoads, 2013



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Summary



Baumgard & Rhoads, 2013



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Summary

 Heat stress markedly effects metabolism independent of reduced nutrient intake

- Can in large-part be explained by increased insulin action
- Maximizing glucose synthesis will improve production

There is no dietary magic pill

- Dietary and management modifications
 - Consult with your nutritionist
- Heat stress abatement (shade, soakers, fans, etc.) should be the primary strategy!



The Metabolism and Productive Responses to Heat Stress: Potential Nutritional Strategies Acknowledgments

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