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Q&A REVIEW

Benefits of Mitigating Heat Stress in Dairy Cows

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1. At what temperature do dairy cows experience heat stress? This is difficult to answer as it depends upon many variables and whether or not they've acclimated to the heat (i.e. spring vs. late summer). But in general, we believe lactating cows start having decreased milk production at a THI of 68. The effects of heat stress on reproduction (especially soon after insemination) could be even lower than 68.

2. Which system do you recommend for measuring heat stress – THI? Yes, THI. But of course, this is not a great tool for grazing cows.

3. Can you explain the interaction of temperature & humidity on heat stress? To dissipate heat you need a thermal gradient. To evaporate water you need a vapor gradient. So, when it's hot AND humid, both gradients are small and thus both radiation and evaporation are minimalized.

4. Can you define leaky gut? The intestinal barrier should prevent unwanted molecules from infiltrating into the body. When that barrier is compromised, it is colloquially referred to as "leaky gut".

5. How can reduction in DMI be considered a small portion of the problem with reduced production during heat stress if it represents 50% of it? If I said "small", then I misspoke. 50% is a big opportunity to recapture some lost milk. Encouraging cows to eat and approach the bunk is very important.

6. With all the talk about reducing milk production on dairies in the US to limit milk shipped, could you possibly use reductions in heat mitigation on a selected group(s) of cows (not pre-peak) to accomplish this? Would the cows "bounce back" any better or worse than if you feed restricted them or fed lower energy diets? It wouldn't be my first strategy, as there are long term consequences to heat stress on reproductive metrics. I would concentrate on reducing the milking frequency and feeding low energy diets first.

7. With regard to heat stress and LPS, how significant does a bout of heat stress need to be to initiate the response? For example, if a group of cows experience heat stress during the day but it cools off at night, will that initiate leaky gut or does it require a more prolonged exposure? I suspect it is heavily dependent upon the total amount of heat load generated. BUT, in general if cows are able to dissipate heat during the cooler parts of the day, they seem to handle heat stress much better.

8. Is LPS unique in its effects or are there other antigens or compounds that can elicit the response? LPS is just one of thousands of immune stimulating molecules that undoubtedly infiltrate the intestinal barrier during "leaky gut". The effects on the immune system will vary, but even non-pathogens will stimulate an immune response if they get through the intestinal epithelium.

9. So cows exposed to heat stress have increased circulating insulin levels which would suppress lipolysis and hence prevent an increase in NEFA. What drives the increase in insulin, the immune system? It is either LPS itself, or a LPS-stimulated cytokine (i.e. TNFa). But, ultimately the reason is that most leukocytes require glucose to obtain the large amount of glucose they need.

10. What are the thresholds of heat stress for youngstock? This is very difficult to answer accurately. But, clearly they can withstand large heat loads better than lactating and bigger animals. It depends upon too many variables to give one specific answer.

11. Has much heat stress work been conducted in youngstock? Not nearly as much as has been conducted with lactating cows.

12. Is there a level of leaky gut? For instance, a level where only toxins access the blood stream and a level where bacteria access the blood stream? Presumably there's a gradient or continuum where early stages of leaky gut allow smaller molecules (i.e. LPS), but as it becomes more severe larger substances (bacteria, fungi etc.) can infiltrate.

13. Are there dietary strategies to fix leaky gut (i.e. additives)? There are dietary strategies to ameliorate it, but not that prevent it.

14. Should I ask my nutritionist to consider niacin as a help to combat heat stress ? Or are there other measures to consider first other than water availability? Niacin is one of the tools available to nutritionists and it should be on their radar screen.

15. You mentioned in your presentation that peripheral vasodilation can cause vasoconstriction at the gut level being part of leaky gut. With Niacin supplementation you are causing vasodilation, but you achieve very positive response in the animal. Why is that? My understanding is that Niacin acts on the periphery to induce vasodilatation and not the core. In this scenario, niacin would counteract the vasoconstriction in the gut.

16. Are there any type of diets favoring a lower availability or supply of niacin to the cow? I'm not familiar, and I'd encourage you to speak with your Balchem Technical Support person.

17. Could you explain the role of Zn in heat stress? And of glutamine? Zn has been shown effecting and lessening the negative consequences of heat stress in multiple species. The mechanism isn't clearly known, but likely involves its ability to increase heat shock proteins (which would stabilize the tight junction proteins and prevents them from being withdrawn back into the cell that made them). There's also likely an antioxidant component to Zn. Glutamine appears to be an important fuel (especially for the small intestine) for enterocytes and this is seemingly the mechanism by which glutamine influences leaky gut.

18. What's your suggestion in terms of macromineral supplementation during heat stress? I refer to people more knowledgable than myself.

19. How many days/weeks before the first heat wave arrives should we start feeding additives to help heat dissipation? I suspect it depends upon the specific additive. But, in general it's likely a good idea to have been feeding the target molecule prior to the heat wave. Likely 1 or 2 weeks is a good approach.

20. Where do you think the gut gets most of its energy from? Oxidation of VFA's? If so, can we feed the rumen better to potentially preserve gut function? I think it depends upon which segment of the gut you're referring to. Certainly butyrate seems to be a key fuel for some portions of the gut. It is very likely that there are nutrients/toxins etc...that escape the gut and potentially damage the small and large intestine. Vice versa, there are likely molecules that we could feed that support small and large intestine health.

21. Valuable information regarding energy metabolism in the heat stressed animal. As a primary nutrient, amino acid metabolism can also be changed in the heat stressed animal. Do you have any data regarding amino acid composition changes in the physiological status of the heat stressed animal? It appears that muscle is mobilized in an effort to provide amino acids for the production of acute phase proteins and the carbon skeleton for gluconeogenesis. So, in theory, providing these particular amino acids via the diet could reduce muscle catabolism and prevent the BUN surge that happens during immune activation and heat stress. In cows, there is a reduction in plasma free amino acids and a vast majority of that is accounted for by glucogenic amino acids. These changes are similar to the effects of experimentally induced immune-stimulation. We have shown that I.V. LPS administration markedly decreases plasma arginine and branched chain amino acids. The decreases in plasma AA concentrations is even more impressive when considering the massive decrease in milk protein synthesis. In other words, despite the reduced removal of AA by the mammary gland, plasma concentrations still decrease. Thus, it appears that the effects of heat stress on circulating AA is similar to that of immune activation and this provides additional evidence that most of the direct effects of heat stress are mediated by an activated immune system.

22. What about cooling with water under already humid conditions (Netherlands)? Even in humid conditions, utilizing evaporative cooling is a good strategy.... assuming the humidity isn't 100%. Clearly, evaporative cooling gradually loses its effectiveness as humidity increases...AND it needs to be more closely managed (i.e. timing of water on/off, droplet size, etc..) to avoid wasting water, but it still has an opportunity cool cows.

23. If you were implementing a cooling system on a dairy and you could only do one project at a time, where would you put your first priority? 1) Water availability, 2) shade, 3) evaporative cooling, 4) fans

24. When using water to cool cows, it is recommended to use a fine mist or rather big droplets? I was told that fine mist will form a layer on the cow so that the cow's ability to get rid of the heat will even decrease? Depends upon the location. In humid areas, you'll want a bigger droplet. In dryer areas, you can use a finer mist.

25. What effective systems do you see for wetting prefresh cows? Often sprinklers are running without cows underneath compared to milking cows? Managing the evaporative system is more difficult in pre-fresh as they spend less time at the bunk.

26. Is there a difference in impact on the cow with heat waves versus constant heat stress? I think heat waves are more dangerous to cows than constant heat. This is likely mediated by the huge fluctuations in feed intake patterns....and thus huge fluctuations in rumen pH AND highly soluble nutrients escaping rumen digestion and ending up in the large intestine.