



Estimating glucose requirements of an activated immune system in lactating Holstein cows¹

Dairy cows experience frequent immune challenges, as bacterial insults can originate from many different situations. Economic consequences of sickness are decreased milk, inefficient feed utilization, poor reproduction, and increased health costs. An activated immune system requires energy in the form of glucose, and the literature suggests glucose homeostasis is disrupted during an endotoxin challenge.² The increased need by the immune system occurs in addition to decreased nutrient intake and thus reduced intestinally derived carbohydrates. Consequently, there is a negative glucose balance that likely limits the immune response. The objective of the study was to use the quantity of glucose needed to maintain euglycemia (normal blood glucose level) during an immune challenge.

Materials and Methods

- 18 mid-lactation Holstein cows (169 ± 7 DIM; 718 ± 16 kg BW)
- Conducted in two replicates of 9 cows
- Cows were milked 4x/d at 0, 0600, 1200, and 1800h
- Feed removed on d 7 (LPS Challenge Day)
- Assigned one of the following bolus IV treatments:
 - Control (n=6): ~3 mL sterile saline
 - LPS (n=6): LPS from *E. coli* 055:B5; 1.5 µg/kg BW
 - LPS-Eu (n=6): LPS (1.5 µg/kg BW) + euglycemic clamp (50% dextrose)
- Blood samples were pulled every 3 hours and cows were milked every 4 hours
- Data collection and infusion lasted for 12 hours or 720 minutes
- Data analyzed using the PROC MIXED procedure in SAS 9.4

Results

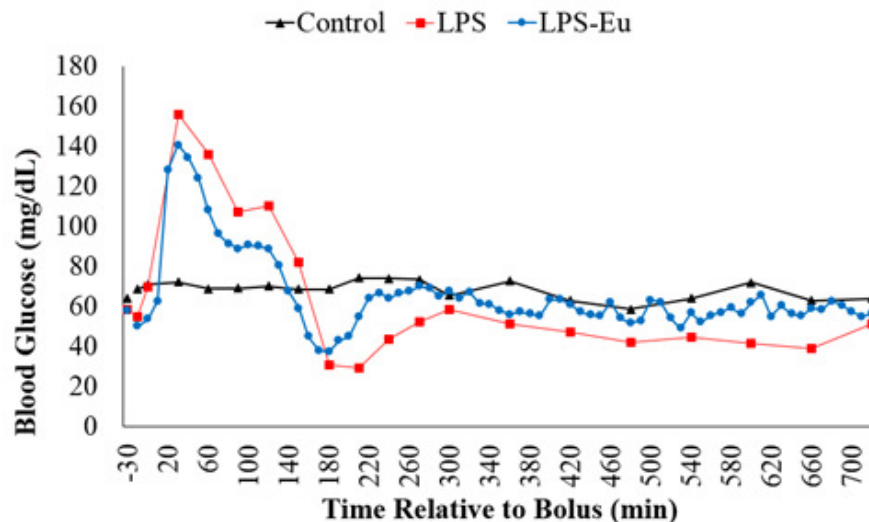


Figure 1. Effect of saline (control), LPS infusion (LPS), or LPS infusion + euglycemic clamp (LPS-Eu) on blood glucose for all time points in lactating Holstein cows

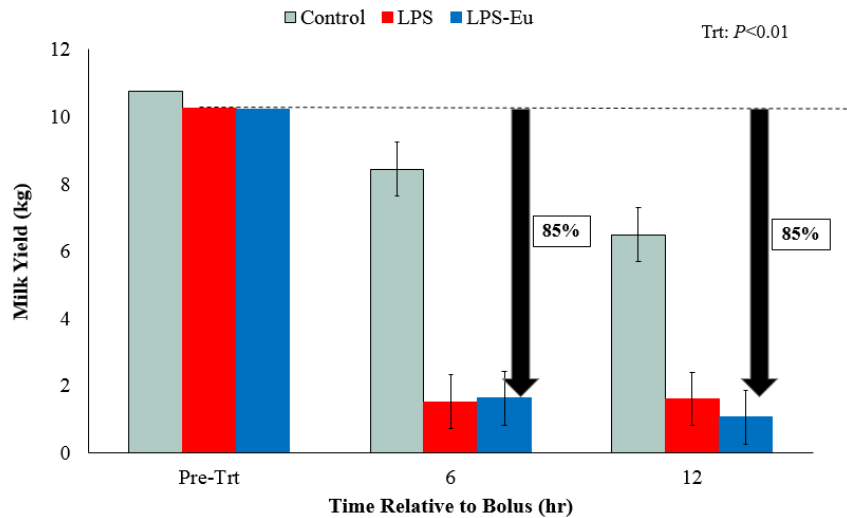


Figure 2. Effect of saline (control), LPS infusion (LPS), or LPS infusion + euglycemic clamp (LPS-Eu) on milk yield in lactating Holstein cows

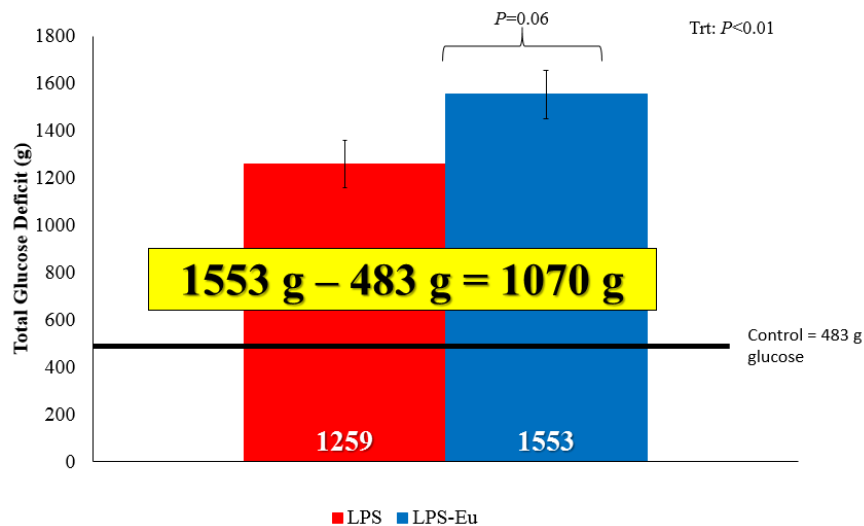


Figure 3. Total glucose deficit in LPS infusion (LPS) and LPS infusion + euglycemic clamp (LPS-Eu) on milk yield in lactating Holstein cows

Conclusion

An activated immune system uses approximately 1070 g of glucose in a 12 hour period. If the amount of glucose required to maintain euglycemia can be used as a proxy, then the glucose requirements of an activated immune system are approximately 90 g/h in lactating ruminants.

References

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2. Leininger, M.T. et al. 2000. Physiological response to acute endotoxemia in swine: effect of genotype on energy metabolites and leptin. *Domest. Anim. Endocrinol.* 18:71-82.

This abstract was presented at the ADSA-ASAS Joint Annual Meeting, July 2015.