

Identifying hyperthermia in heat-stressed lambs and its effects on β agonist-stimulated glucose oxidation in muscle

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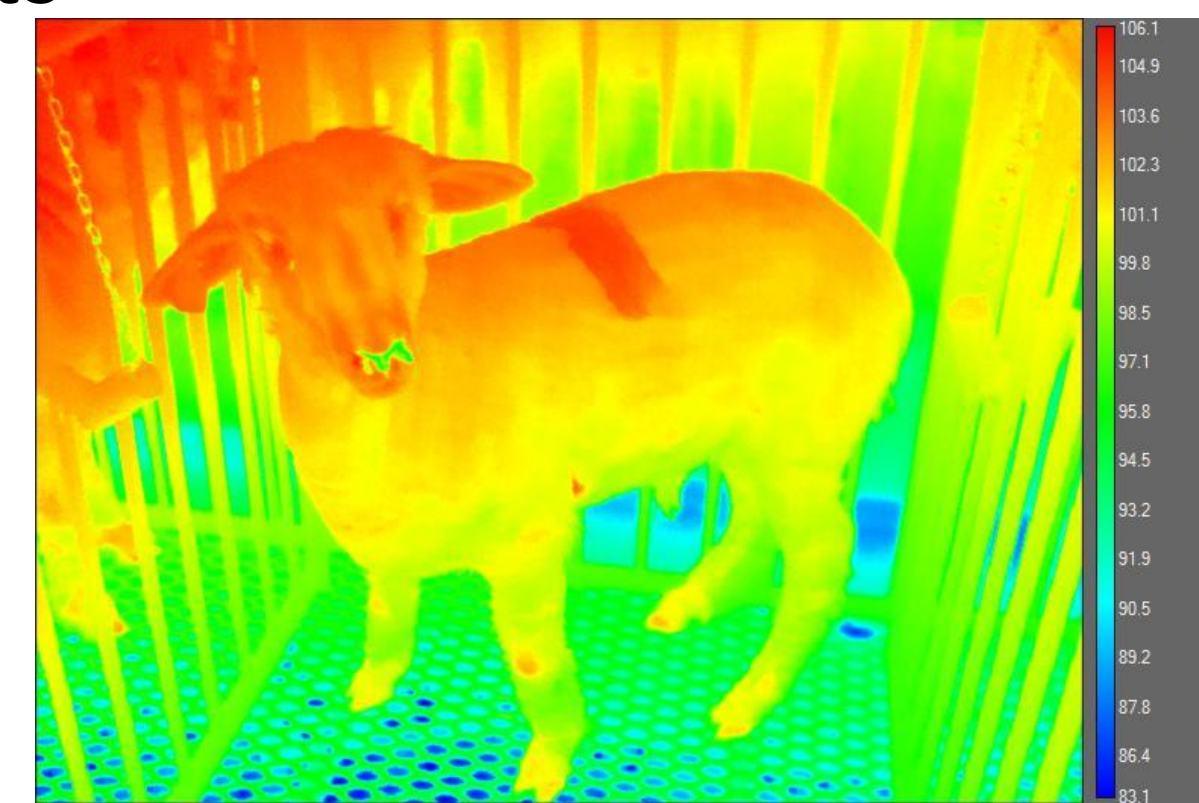
ABSTRACT

Heat stress is known to decrease value and production efficiency in food animals. Conversely, β agonists increase value due to increased muscle growth and efficiency, but it is unknown how each of these factors impacts the other. Lambs were fed diets containing one of three dietary treatments: no supplement, ractopamine HCl, or zilpaterol HCl. Lambs were housed in either thermoneutral or heat stressed conditions. On the last day of treatment, two alternative temperature-measuring devices (IR thermometer gun and IR camera) were compared to core body temperatures measured rectally. Lambs were harvested and intact soleus muscle strips were collected. It was found that ear and eye temperatures from IR camera and skin temperatures recorded with IR thermometer guns at higher emissivity, were consistently correlated with measured rectal temperature. Heat stress decreased oxidation by ~21%, zilpaterol HCl increased oxidation by ~15%, and insulin increased oxidation by ~25%. **Though heat stress and β agonist supplementation had clear effects on oxidation, they did not impact each other.**

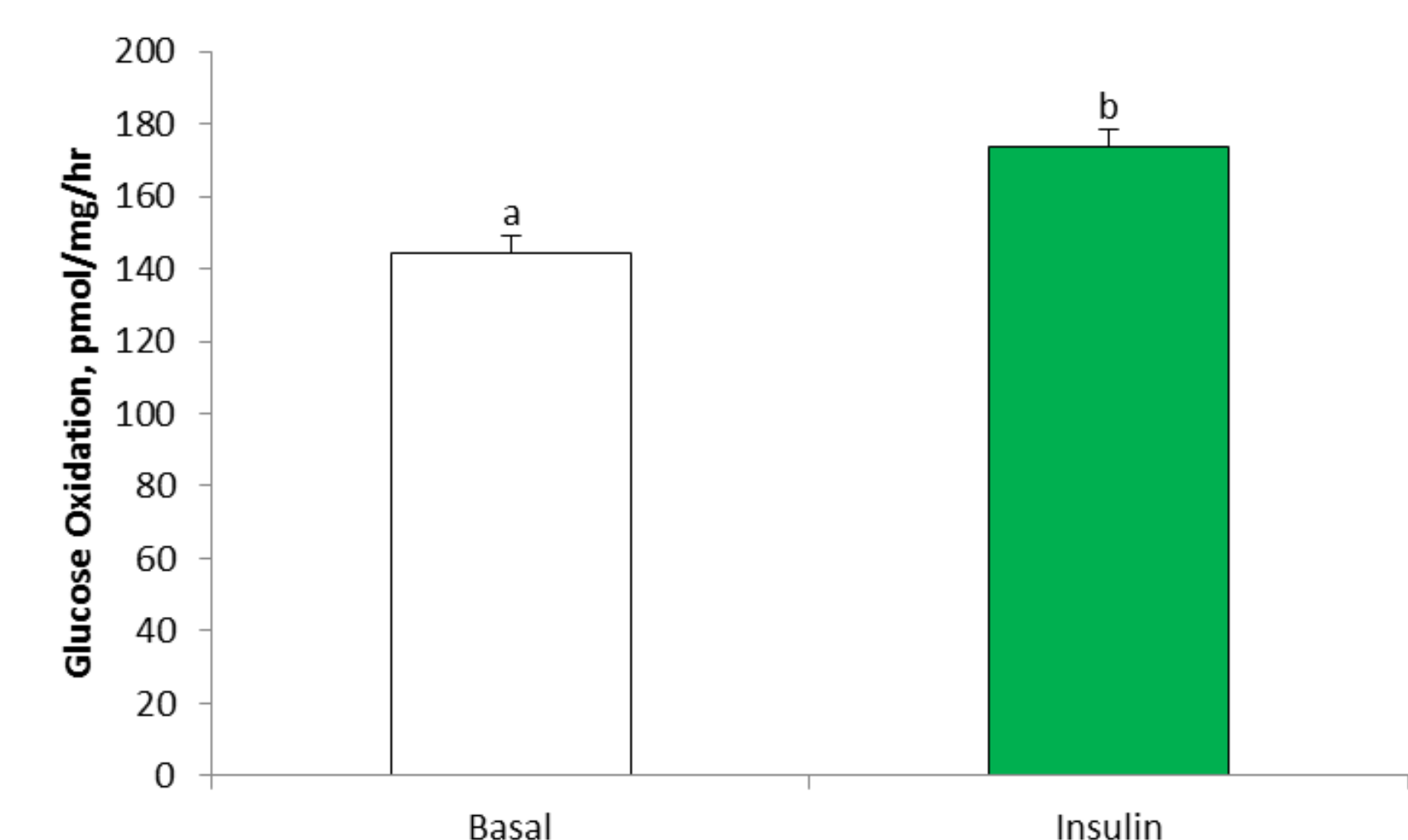
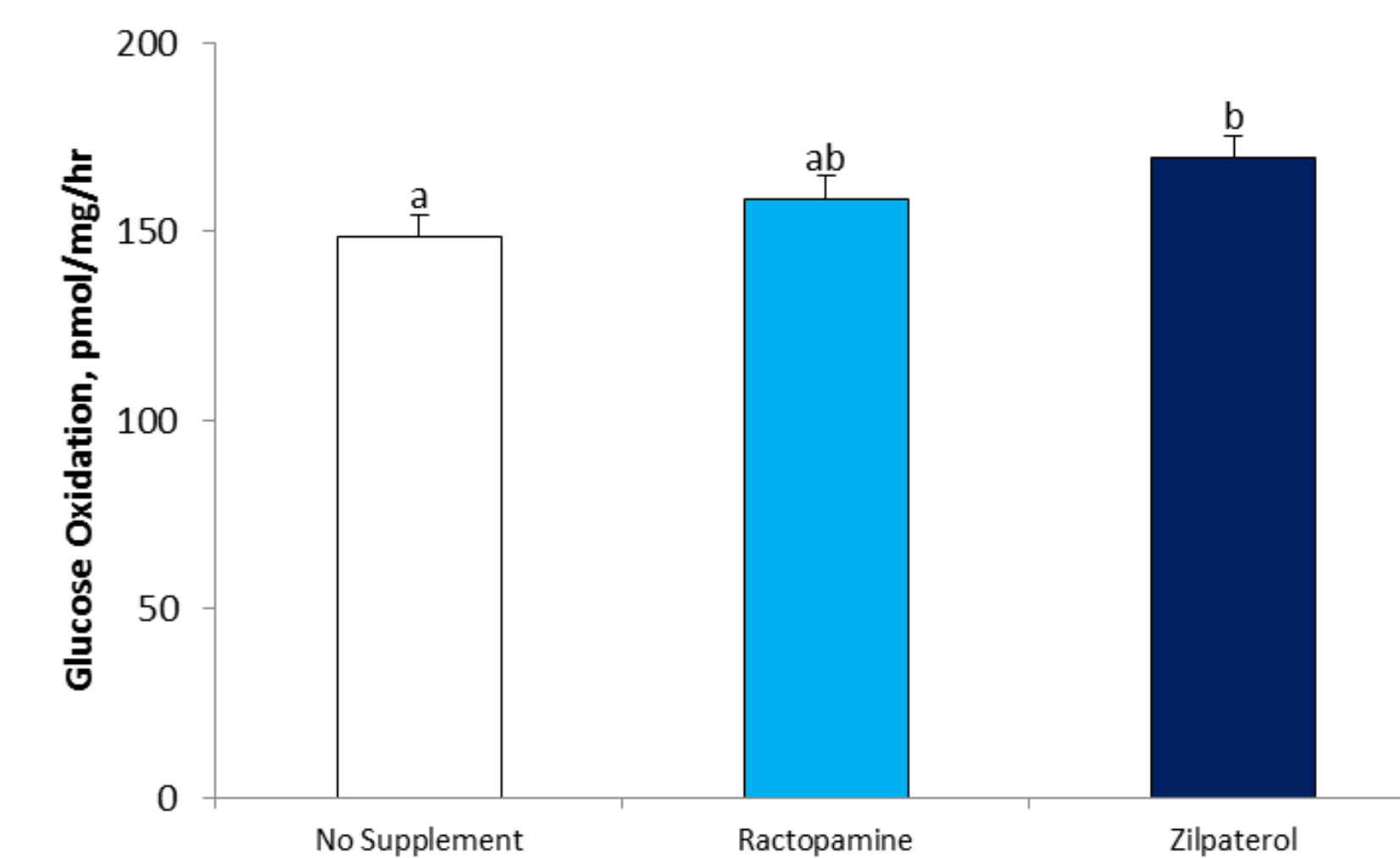
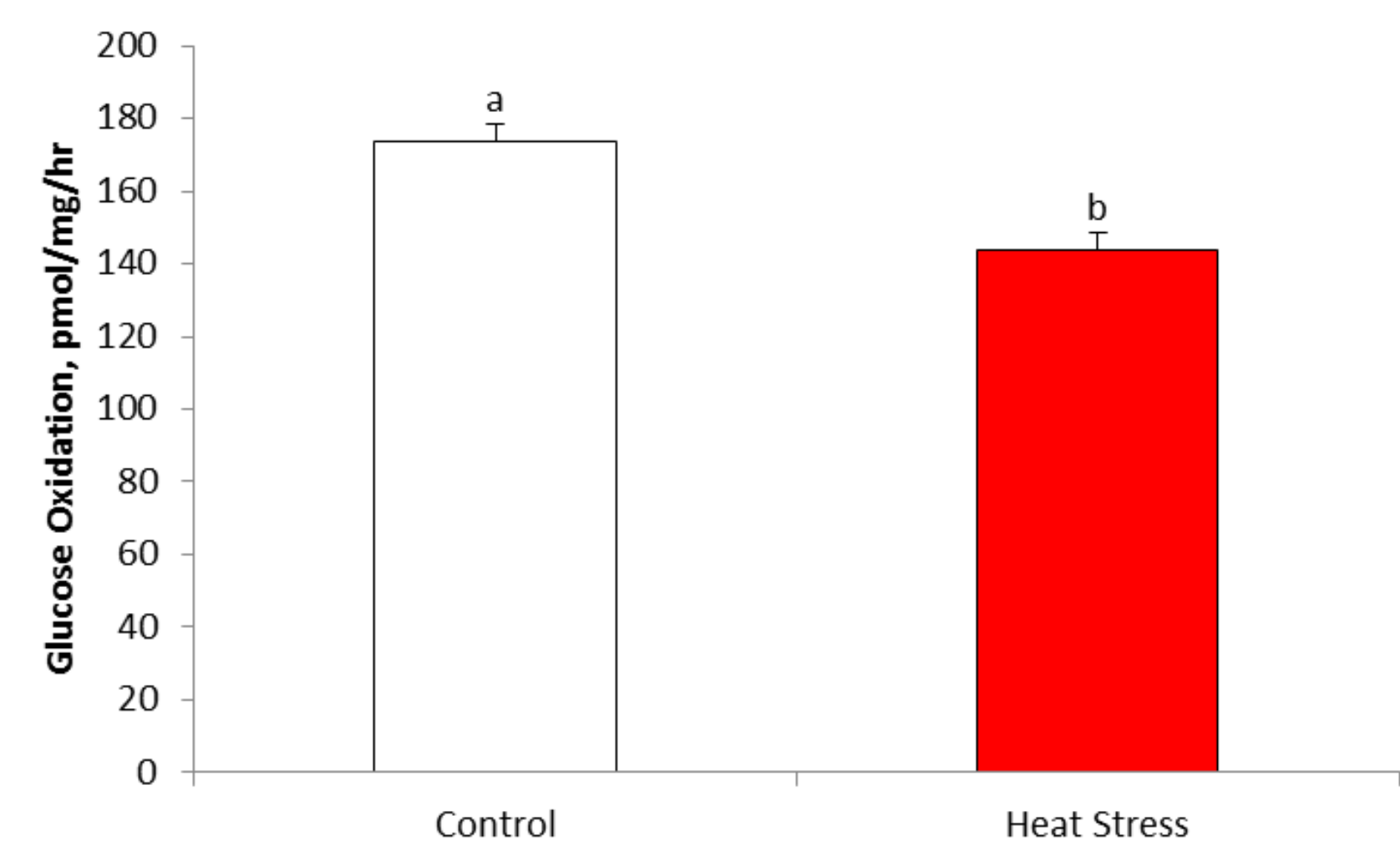
MATERIALS AND METHODS

- Crossbred lambs fed high energy diets for 21 d
 - Each animal assigned to 1 of 3 dietary supplements:
 - No supplement, ractopamine HCl (β -1), or zilpaterol (β -2)
 - And 1 of 2 environmental conditions:
 - Thermoneutral or heat stress
- Animals were harvested and soleus muscles were collected
- Ex vivo glucose oxidation was determined
 - 2hr incubation under the following conditions:
 - Basal (KHB + no additive)
 - Insulin (KHB + 5 mU/ml Humulin-R)
- Glucose oxidation rates
 - $^{14}\text{CO}_2$ produced from [14C] glucose, captured with 1M NaOH
 - NaOH mixed with UltimaGold scintillation fluid
 - Specific activity of ^{14}C measured in NaOH and media

- Two rectal temps taken and averaged
- Two IR thermometer guns measured for 10 sec average on multiple emissivity values (0.4-1.0)
 - Nose, unshaved, and shaved
- 3 IR camera pictures from two distances
 - 3-5 ft and 6-8 ft
 - Nose, eye, and ear
- Device measurements measured for correlation to rectal temp average for each sheep



RESULTS



- Heat stress ↓ oxidation 21%
- Zilpaterol ↑ oxidation 12%
- Insulin ↑ oxidation 25%
- No interaction between heat stress effects and β agonist supplementation
- Temperatures in heat stress lambs were higher than those in thermoneutral environments
- Both temperature-measuring devices correlated well with rectal temperatures on all locations except nose
 - IR camera at both distances
 - IR thermometer gun at higher (> 0.7) emissivity values

INTRODUCTION

- Heat stress ↓ oxidation
- β -2 agonists ↑ oxidation
- Both elicit responses by activating adrenergic pathways
- We hypothesized the two would have interacting influences on skeletal muscle glucose oxidation
- Also sought to test alternate temperature-measuring device accuracy

IMPLICATIONS

- IR devices may be a non-invasive alternative way to measure temperature in livestock
- Heat stress and β agonists affect oxidation while having no effect on the animal's metabolic response to the other factor

ACKNOWLEDGEMENTS

Pilot project supported by NIH Center for Biomedical Research Excellence grant (P20GM104320)