

Gestational Thermal Environment Alters Postnatal Response to Heat Stress

A.S. Leaflet R2738

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Summary and Implications

Pigs were exposed to heat stress (HS) and thermoneutral (TN) conditions in-utero. Post-weaning, they were exposed to acute heat-stress for a 24-hour period, and differences in physiological response between in-utero treatment groups were determined. Our results indicated that in-utero heat-stress had no effect on core body temperature; however the HS group had a larger cumulative difference (~50%) between rectal and skin temperatures compared to TN pigs. Preliminary, this provides evidence suggesting pigs exposed to in-utero HS may have an altered tolerance to post-natal HS.

Introduction

Heat stress is a widespread issue that negatively impacts production across every livestock industry. It is estimated, that the U.S. swine industry averages \$299 million in losses annually due to heat stress related issues, despite heat abatement efforts (i.e. sprinklers, fans). These economic losses can be traced to heat stress during fetal development and post-natal life that negatively affects growth, reproductive performance, and carcass quality. Production issues could worsen if climate change predictions are accurate and increased summer temperatures are projected in most U.S. pig producing areas. In addition, genetic selection for rapid lean tissue accretion increases basal metabolism and thus basal heat production. This may likely result in less tolerance to heat stress. Furthermore, defining biology and mechanisms of how heat stress reduces pig performance could help to further develop mitigation strategies to improve growth performance, reproductive status, and overall well being of pigs.

Materials and Methods

Pregnant sows were exposed to thermoneutral (TN; n = 9; stable 25°C) or heat stress (HS; n=7; 24 hr cyclic 25-35°C) conditions for the duration of gestation in the Brody Environmental Chambers at the University of Missouri. Post weaning, resultant offspring were transported to Iowa State University where they were allowed to mature to three months of age prior to trial initiation. At 45 kg BW, pigs

were exposed to a constant temperature of 35°C for a period of 24-hour. Throughout heat exposure, rectal (Tr) and skin temperatures (Ts) were monitored every four-hours. The area under the curve was calculated for both Ts and Tr and the difference between them was compared statistically.

Results and Discussion

Pigs exposed to HS and TN temperatures in-utero both had an immediate and sustained elevation ($P < 0.05$) in Ts (Fig. 1) as well as Tr (Fig. 2) throughout the entire HS period. However, no in-utero treatment differences ($P > 0.05$) existed for Tr (Fig. 2). Skin temperature was higher ($P < 0.05$) following 16 and 20 hrs of heating in HS compared to TN in-utero treatment groups, respectively (Fig. 1). In addition, the cumulative difference in Ts and Tr was greater in HS animals compared to TN animals (Fig. 3).

The higher Ts compared to Tr exhibited by HS animals compared to TN animals could indicate:

- 1) Increased removal of heat potentially through vascular activity
- or
- 2) Increased retention of heat in potentially more abundant fat.

If the first explanation were supported it would suggest enhanced tolerance to HS caused by in utero hyperthermia whereas the later would indicate compromised tolerance to HS do to changes in nutrient partitioning. We will work to determine the extent to which in utero hyperthermia alters body composition in swine.

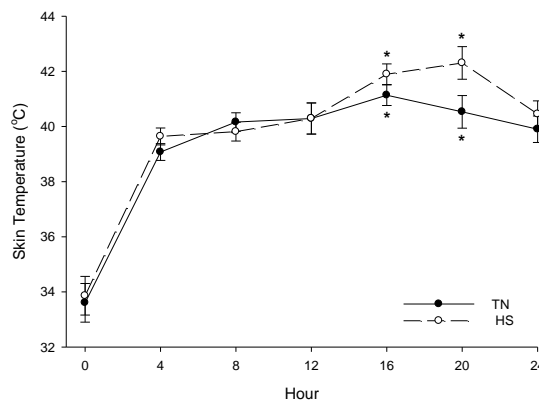


Figure 1. Skin temperature (Ts) during acute heat stress from pigs exposed to TN vs. HS gestational environments. * indicates differences at $P < 0.05$.

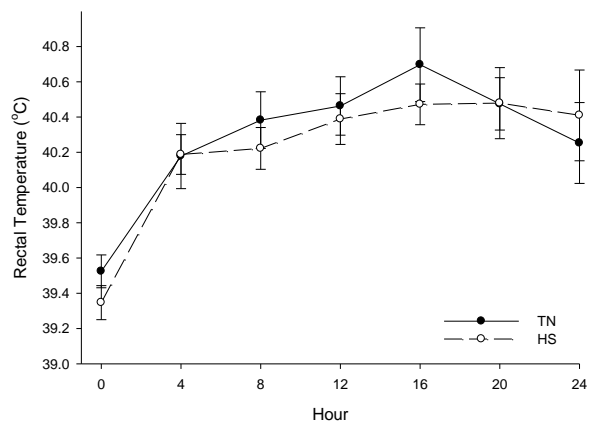


Figure 2. Rectal temperature (Tr) during acute heat stress from pigs exposed to TN and HS gestational environments. * indicates differences at P < 0.05.

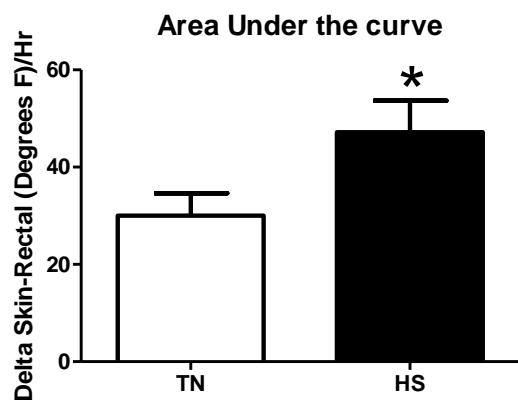


Figure 3. The difference of the area under the curve of Ts and Tr was determined in TN and HS gestational groups during acute heat stress. The HS gestational treatment group has a greater AUC than TN by ~50%.