



Tropentag, October 6-8, 2009, Hamburg

“Biophysical and Socio-economic Frame Conditions
for the Sustainable Management
of Natural Resources”

Physiology and Genetics of Heat Tolerance in Thai Native Cattle

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Abstract

Heat tolerance is one of the most demanding challenges for tropical livestock. The objective of this study was to estimate physiological responses and to investigate genes putatively related to heat tolerance in the two Thai Native cattle breeds White Lamphun cattle (WL) and Mountain cattle (MT) as well as Holstein-Friesian (HF) crossbred cattle (more than 82.8 % HF genetics). Physiological responses were assessed in the afternoon and the next morning (twice a month) for a 3 months period. The average thermo-humidity index (THI) was 87.33 for the morning and 78.79 for the afternoon. The average respiratory rates in WL, MT and HF were 28.68, 33.27 and 36.05 beats sec⁻¹, the packed cell volumes were 33.45 %, 37.97 % and 26.37 %. The measured rectal temperatures were 38.75 and 38.75 and 38.46°C. The results showed significantly different respiratory rates ($p < 0.05$) and packed cell volumes ($p < 0.05$) in all breeds, but no significant differences in the rectal temperature. All parameters were significantly enhanced with an increased THI ($p < 0.05$). Tissues were collected for DNA extraction from all animals. A 598-bp long PCR product (spanning exons 6 to 9) of the heat shock protein 90kDa gene (Hsp90) was comparatively sequenced on a panel of 24 animals (8 animals per breed). Three single nucleotide polymorphisms (SNPs) were detected in Thai native cattles (SNPexon 7; G96A and T199C, SNPexon 9; C480T). All three SNPs led to a missense mutation: Glu to Lys, Ile to Thr and Arg to Cys. The present study indicates breed specific different physiological responses to hot climates, which might be caused by Hsp90 polymorphisms. We intend to complete the search for polymorphisms in Hsp90 and to perform then expression studies. Moreover, an extended screening of polymorphisms of this gene in each population will be done. Possible mutations in Hsp90 could make it an attractive candidate for heat tolerance to be used as genetic marker to select appropriate breeds suitable to sustain the worldwide climate change.

Keywords: Heat tolerance, Physiology, Thai native cattle