

Suvit Boonprong 2010: Heat Tolerance Indicators for Beef Cattle in the Tropics with Special Reference to Blood Biochemical Properties. Doctor of Philosophy (Animal Science), Major Field: Animal Science, Department of Animal Science. Thesis Advisor: Professor Chanvit Vajrabukka, Ph.D. 148 pages.

Four experiments reported in this thesis were aimed to assess the heat tolerance indicators for beef cattle in the tropics with special reference to blood biochemical properties.

In Experiment I, the productivity of Simmental-Brahman crossbred (Kabinburi, K) cattle was compared to that of Thai Brahman (TB), which were kept under three different environmental conditions (Lamphayaklang Livestock Research and Breeding Center, LP; Nongkwang Livestock Research and Breeding Center, NK; Prachinburi Livestock Breeding Station, PC). The results revealed that bodyweight at birth, 200, 400 and 600 days of age of K cattle were significantly higher ($P < 0.05$) than those of TB cattle. K heifers gave birth to their first calf at a younger age and had a shorter calving interval than TB cows. TB cattle kept at LP had significantly higher ($P < 0.05$) bodyweight at 400 and 600 days than the animals kept at NK. TB cattle kept at LP were younger ($P < 0.05$) at first calving and had a shorter calving interval than the animals kept at NK. K cattle kept at NK were heavier at birth and at 200, 400 and 600 days of age than the animals kept at PC. K cows kept at NK were significantly younger at first calving ($P < 0.01$), but there was no difference in calving interval between the two groups kept at NK or PC.

In Experiment II, the relationship between the haemoglobin (Hb) type, reproduction and body weight was estimated in two cattle breeds, Thai indigenous and Simmental \times Brahman crossbred cows. The results showed that five haemoglobin types were found in indigenous cattle: HbAA (35.59%), HbAB (28.81%), HbAC (20.34%), HbBB (11.6%) and HbBC (3.39%); three types were found in Simmental \times Brahman crossbred cattle: HbAA (50.98%), HbAB (45.10%) and HbBB (3.92%). Thai indigenous cows with HbAB type were heavier at birth, but, by contrast, calves carrying HbBB type were the lightest animals at birth and were the youngest group at first calving. Simmental \times Brahman crossbred cows with HbAA type were significantly heavier ($P < 0.05$) than the animals with HbAB type at birth as well as on 200, 400 and 600 days of age whereas the animals with HbAB type gave birth to their first calf at a significantly younger ($P < 0.05$) age than those with HbAA type.

In Experiment III, plasma biochemical profiles were studied to investigate the effect of breed and sex in Thai indigenous and Simmental \times Brahman crossbred male and cyclic female cattle. The results showed that there were significant differences ($P < 0.05$) in the levels of plasma glucose and GGT in both breeds. The levels of urea, creatinine, albumin, total protein, AST, ALT and ALP in Thai indigenous were significantly higher ($P < 0.01$) than in crossbred cattle. Plasma urea concentration in male crossbred cattle was significantly lower ($P < 0.05$) than in the other groups. Female crossbred cattle had significantly lower ($P < 0.05$) plasma creatinine levels than the other animals. There were significant differences ($P < 0.05$) in the levels of AST, ALT, ALP and GGT between male and female. Female crossbred cattle had the lowest ($P < 0.05$) AST and GGT levels, whereas the lowest ($P < 0.05$) ALT and ALP concentration was determined in male individuals of these breeds.

In Experiment IV, Twenty two mature (2nd to 4th lactation) healthy lactating cows including 11 Holstein Friesian (HF) and 11 Schwarz Bunt cows (SBT) were used. The animals were divided into groups according to their reproductive status. Group 1 was consisted of 9 pregnant animals (5 HF and 4 SBT) and group 2 was consisted of 13 cyclic animals (6 HF and 7 SBT), respectively. Lymphocytes were harvested from blood and incubated at 37.2°C; 5% CO₂ and at 41.0°C; 5% CO₂ for 72 h in presence or absence of phytohemagglutinin (PHA-M, Sigma; 100 µg/ml). Growth hormone was measured by a highly sensitive radioimmunoassay in duplicate. Nitric oxide was estimated using a colorimetric assay based on the Griess reaction. A significantly high secretion of GH was noticed from PHA-M – stimulated PBLs in cyclic SBT and HF, and pregnant SBT, but GH production was not different between un-stimulated PBLs and stimulated PBLs in pregnant HF. When the temperature of culture increased from 37.2°C to 41.0°C in un-stimulated PBLs of cyclic SBT, GH was decreased significantly ($P < 0.05$). Moreover, GH levels from PBLs at 41.0°C in un-stimulated PBLs of the pregnant HF was significantly ($P < 0.05$) higher than pregnant SBT. The present data indicate that PHA-M – stimulated PBLs produced significantly higher NO than un-stimulated PBLs. However, when the temperature of culture increased from 37.2°C to 41.0°C, NO production from un-stimulated PBLs was significantly increased. In contrast NO level from stimulated PBLs was significantly decreased. NO production was not significantly different between breeds and reproductive stages. In conclusion the present data indicate that the sensitivity of the lymphocytes differs in HF and SBT cattle breeds.

Heat tolerance indicators such as haemoglobin phenotypes or blood biochemical parameters could be enlisted together with other factors for selection of high performing animals in the tropics.

Student's signature

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