FIELD DAY REPORT - 1993

Texas A&M University Agricultural Research and Extension Center at Overton

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

May 28, 1993

Research Center Technical Report 93-1

METABOLITE AND METABOLIC HORMONE RESPONSES TO NOREPINEPHRINE IN *BOS TAURUS* AND *BOS INDICUS* NEWBORN CALVES

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Background. Calf losses from birth to weaning typically range from 8 to 14%, with the majority of calf losses occurring during the neonatal period. The primary factors associated with neonatal calf mortality are dystocia, hypothermia, starvation and infectious disease. Exposure of newborn calves to severe cold can result in generalized weakness of skeletal musculature, extensive subcutaneous hemorrhages and edema formation in the extremities.

Newborn calves which exhibit severe depression, generalized weakness and have difficulty in standing and nursing are often described as having "Weak Calf Syndrome". Bos indicus newborn calves have been shown to be more susceptible to cold environmental stressors than bos taurus newborn calves. To maintain homeothermy during environmental cold stress, newborn calves have the ability to activate both shivering thermogenesis (which occurs in the muscle tissue) and nonshivering thermogenesis (which occurs in the brown adipose tissue). Nonshivering thermogenesis is primarily regulated by the release of norepinephrine (NE) from the sympathetic nervous system.

Previous studies with bos taurus and bos indicus newborn calves indicate that cold environmental conditions induce a variety of metabolic responses in newborn calves, including an elevation in key metabolites (glucose (GLC) and nonesterified fatty acids (NEFA)) and metabolic hormones (cortisol (CORT), triiodothyronine (T_3) and thyroxine (T_4)). These metabolites and metabolic hormones play a major role in regulating thermogenesis in the newborn calf. The objective of this study was to examine metabolite and metabolic hormone responses to NE in newborn bos taurus and bos indicus calves.

Research Findings. Metabolite and metabolic hormone concentrations were measured in newborn Angus (A; n=8), Brahman (B; n=11), A x B (n=9), B x A (n=9), Tuli (T) x A (n=9), and T x B (n=10) calves prior to and following NE infusion. At birth each calf was fed pooled colostrum and fitted with an indwelling jugular catheter. At ≈ 2 h of age, calves were placed into a temperature-controlled water immersion system (37°C), and following a 30-min adjustment period NE was infused at 35 $g \cdot kg^{-1} \cdot min^{-1}$ for 4 min via the jugular catheter. Blood samples were collected at 60, 45, 15, and 0 min prior to and at 5, 20, 40, 60, 80, 100, and 120 min after NE infusion. Plasma was analyzed for GLC, NEFA, blood urea nitrogen (BUN), CORT, T_3 and T_4

GLC, NEFA and CORT using the trapezoidal method excluding basal values at 0 min. Average concentrations from 5 to 120 min post infusion are presented for T_3, T_4 and BUN concentrations.

Table 1. Metabolite and metabolic hormone measurements in newborn calves from Angus, Brahman and Tuli sires born to Angus and Brahman dams.

	--Dam Breed--		-----Sire Breed-----			--P values--		
	A	B	A	B	T	Dam	Sire	SE
Birth GLC, mg/dl	58.0	69.7	66.0	67.1	58.5	.18	.67	7.90
GLC, AUC*	2767	3518	3155	2929	3343	.25	.86	589.80
Birth NEFA, mEq/l	6691	1877	770	920	1094	.0001	.12	112.05
NEFA, AUC	5104	7716	5298	8109	5823	.21	.49	1907.68
BUN, mg/dl	18.0	18.8	18.7	17.1	19.4	.71	.62	1.90
Birth CORT, ng/ml	101.6	116.0	93.0	114.7	118.7	.14	.08	8.79
Peak CORT, ng/ml	36.8	50.4	30.5	49.5	50.8	.06	.06	6.42
CORT, AUC*	867	1068	530	1608	764.	.68	.07	336.68
Avg T3 , ng/ml	4.96	5.55	5.25	5.12	5.39	.08	.79	.30
Avg T4, ng/ml	248.1	332.8	267.0	288.4	316.0	.0001	.07	5.16

* Arbitrary Units

Although not significant, GLC and NEFA AUC responses to NE were numerically higher in calves born to B dams than in calves with A dams. At birth, NEFA concentrations were 77.4% higher in calves born to B dams than calves born to A dams. BUN concentrations were similar for all calf breed types. CORT concentrations at birth and CORT peak amplitudes tended to be higher in B- and T-sired calves than in A-sired calves. CORT AUC tended to be higher in B-sired calves. Peak CORT values were 37.0% higher in calves born to B dams. Average T_3 and T_4 concentrations were 11.9 and 34.1% higher in calves born to B dams. Average T_4 concentrations tended to be higher in T-sired calves. These data would suggest that the inability of newborn B calves to properly thermoregulate is not due to lower plasma concentrations of important energy substrates (i.e. GLC and NEFA), nor to a lack of responsiveness of these substrates to a NE challenge. The elevated concentrations of CORT, T_3 and T_4 in calves born to B dams seem to suggest that these hormones may play a suppressive role in thermoregulation.

Application. New cost effective management techniques are needed to reduce neonatal calf mortality losses, especially in Brahman and Brahman crossbred cow herds. More research is needed to understand why calves born to Brahman cows are unable to thermoregulate as well as calves born to bos taurus dams. Until the mechanisms for thermoregulation in the neonatal calf are better understood, management practices such as improved prepartum nutrition, adequate shelter at birth and shifting the calving season to more favorable months should be considered to reduce neonatal calf mortality losses.