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**Water, electrolyte and acid-base balance in transported *Bos indicus*
steers**

Thesis submitted

by

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in April 2004

**For the Degree of Doctor of Philosophy in the
School of Biomedical Sciences at
James Cook University**

ABSTRACT

The objective of these studies was to investigate the physiological mechanisms involved in maintaining water, electrolyte and acid-base balance in *Bos indicus* steers placed under stress. These studies also sought to provide a novel approach to minimize the effects of stress on the physiology of *Bos indicus* steers during long haul transportation in the seasonally dry tropics.

Merino sheep provided a simulated stress response model, to evaluate the effects of the principle stress hormone cortisol on indices of water and electrolyte balance. This study indicated that stressed sheep suffer from a loss of body water in excess of that associated with a loss of electrolytes to support the hypothesis that elevated physiological levels of cortisol induce a diuresis in ruminants that contributes to dehydration.

A second pen study was performed to investigate the effects of excess cortisol on physiological mechanisms that resist dehydration in *Bos indicus* steers. The presence of excess cortisol suppressed the RAA axis but did not markedly affect plasma AVP concentrations. This reflected the complexity of endocrine interactions associated with water balance in *Bos indicus* steers that enabled homeostasis to be maintained.

A quantitative analysis of acid base balance in *Bos indicus* steers demonstrated long haul transportation or extended periods of feed and water deprivation to have no effect on blood pH. The primary challenge to a transported or feed and water deprived animal is a mild metabolic acidosis induced by elevated plasma proteins which may be the result of a loss of body water. The loss of electrolytes has little effect on the acid-base balance of the animals.

The treatment of *Bos indicus* steers prior to long haul transportation with the osmolyte glycerol provided a novel approach to conserving body water, decreasing the energy deficit and preserving muscle quality.

DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Anthony Joseph PARKER

April, 2004

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April, 2004

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LIST OF ABBREVIATIONS

ACTH	-	adrenocorticotrophic hormone
ADH	-	anti-diuretic hormone
AG	-	anion gap
Ang II	-	angiotensin II
AVP	-	arginine vasopressin
CRH	-	corticotrophin releasing hormone
d	-	day/s
FFA	-	free fatty acids
GIT	-	gastrointestinal tract
h	-	hour/s
HPA	-	hypothalamo-pituitary-adrenocortical
ICF	-	Intra-cellular fluid volume
min	-	minute/s
MSH	-	melanocyte stimulating hormone
POMC	-	pro-opiomelanocortin
RAA	-	renin-angiotensin-aldosterone
SAM	-	sympatho-adrenal-medullary
SID	-	strong ion difference
TBW	-	total Body Water
THI	-	temperature-humidity indices

LIST OF PUBLICATIONS ARISING FROM THIS WORK

Parker AJ, Hamlin GP, Coleman CJ and Fitzpatrick LA (2004) Excess cortisol interferes with a principal mechanism of resistance to dehydration in *Bos indicus* steers. *Journal of Animal Science* **82**: 1037-1045

Parker AJ, Hamlin GP, Coleman CJ and Fitzpatrick LA (2003) Quantitative analysis of acid-base balance in *Bos indicus* steers subjected to transportation of long duration. *Journal of Animal Science* **81**: 1434-1439

Parker AJ, Hamlin GP, Coleman CJ and Fitzpatrick LA (2003) Dehydration in stressed ruminants may be the result of a cortisol induced diuresis. *Journal of Animal Science* **81**: 512-519

“Work, Finish, Publish”

M. Faraday

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..... *"Knowledge once gained casts a faint light beyond its own immediate boundaries. There is no discovery so limited as not to illuminate something beyond itself."* J. Tyndall (1868)