

DIERENFELD, E.S., R. DUTOIT, AND W.E. BRASELTON. 1995. Nutrient Composition of Selected Browsers Consumed by Black Rhinoceros (*Diceros bicornis*) in Zimbabwe. J. Zoo Wildl. Med. 26: 220-230.

DIERENFELD, E.S. AND C.L. FRANK. 1998. Fatty Acid Composition of Adipose Tissue in Captive Rhinoceros. Proc. AAZV, Omaha (abstract). Pp. 508-509.

DIERENFELD, E.S., S. ATKINSON, A.M. CRAIG, K.C. WALKER, AND M. CLAUS. Mineral Concentrations in Blood and Liver Tissue of Captive and Free-Ranging Rhinoceros Species. J. Zoo Wildl. Med. (submitted 2001).

GHEBREMESKEL, K., G. WILLIAMS, J.C.M. LEWIS, AND R. DUTOIT. 1988. Serum alpha-tocopherol, all-trans retinol, total lipids and cholesterol in the black rhinoceros (*Diceros bicornis*). Comp. Biochem. Physiol. 91A:343-345.

GRANT, J.B., D.L. BROWN, AND E.S. DIERENFELD. 2001. Linoleic Acid and Linolenic Acid Contents in the Diet of Black Rhinoceros (*Diceros bicornis*) Differ between Captive Diets and Both Native African and North American Browse Species. J. Wildl. Dis.: in press.

LUNG, N., S. MURRAY, AND K. GAMBLE. 1998. Report of the Workshop to Investigate a Syndrome of Peripheral Vasculitis in the Black Rhinoceros (*Diceros bicornis*). Fort Worth Zoo and Dallas Zoo, Unpubl. Report, 20 pp.

MILLER, E. (ED.) 1999. Meeting to Review Research on Rhinoceros Health: Briefing Book. St. Louis Zoo.

PAGLIA, D.E., D.E. KENNY, E.S. DIERENFELD, AND I-H. TSU. 2000. Potential role for iron overload in the pathogenesis of leukoencephalomalacia in captive black rhinoceroses (*Diceros bicornis*). Amer. J. Vet. Res. 62:343-349.

SUEDMEYER, W.K. AND E.S. DIERENFELD. 1998. Clinical Experience with Fatty Acid Supplementation in a Group of Black Rhinoceros (*Diceros bicornis*). Proc. AAZV, Omaha (abstract). Pp. 113-115.

## Red Cell Metabolism in the Black Rhinoceros: Relevance to Haemolytic Disease

B. Weber, D. Paglia<sup>2</sup> and E.H. Harley<sup>1</sup>,

<sup>1</sup>Department of Chemical Pathology, University of Cape Town, South Africa, and

<sup>2</sup>Dept of Pathology and Laboratory Medicine, UCLA, USA

Captive black rhinoceros populations in the USA have been afflicted with a severe haemolytic anaemia syndrome, together with a leukoencephalopathy and other disorders suggestive of a free radical pathologic basis, and this has been the subject of intensive metabolic investigation for some years in our laboratories. The black rhinoceros (*Diceros bicornis*) shows a number of striking differences in its normal red cell biochemistry compared with humans: enzyme levels are often grossly different, ATP levels are 1/50th that of humans, and they contain very high levels of free tyrosine in their red cells (but not in plasma). On exposure to oxidative stress some tyrosine is converted transitorily to dityrosine, a substance never previously described in free form in cells, with an inverse relationship to glutathione levels. Human red blood cells incubated under the same conditions show no sign of dityrosine production.

Tyrosine is known to be a substrate for oxidative reactions, and has been implicated in contributing to defence against oxidative damage in seminal plasma. Experiments will be described which suggest that that tyrosine, together with some purine metabolites, are acting as an additional defence mechanism against reactive oxygen intermediates in red cells with marginal protective mechanisms. Oxygen radical absorbance (ORAC) assays, together with red cell tyrosine and purine levels, are currently being compared between in situ rhinoceroses in South Africa and captive (ex situ) individuals in Europe and the USA. The integration of these in vitro and in vivo analyses should reveal insights and mechanisms exploitable for the development of preventative or therapeutic measures against haemolytic and other free radical induced disorders in these populations.



Harald M. Schwammer  
Thomas J. Foose  
Michael Fouraker  
Deborah Olson



## **A Research Update on Elephants and Rhinos**

Proceedings of the  
International Elephant  
and Rhino Research Symposium,  
Vienna, June 7-11, 2001