SERUM MINERAL VALUES FOR THREE SUB-SPECIES OF ZEBRA OVER 22 YEARS AT DISNEY'S ANIMAL KINGDOM®

Ashley L. Fowler, PhD[1,2]*, Shannon Livingston, MSc[2], Kathleen E. Sullivan, PhD[2], Scott M. Williams, MS[2], and Eduardo V. Valdes, PhD[2]

[1]Department of Animal Sciences, University of Florida, Gainesville, FL 32611, USA.
[2]Disney's Animals, Science and Environment, Lake Buena Vista, FL 32830, USA.

Abstract
Serum reference ranges can be useful for assessing mineral status of exotic animals under human care. However, it is also important to consider factors that may impact circulating minerals, including diet, breed, and physiological state. We analyzed 22 years of serum samples collected from a population of zebras at Disney's Animal Kingdom® and Animal Kingdom Lodge® to determine factors that may affect mineral concentrations. Minerals and vitamin E were measured in serum from three sub-species of zebra (common plains zebra, Grevy's zebra, and Hartmann's Mountain zebra) resulting in 336 total samples from 60 individual animals. All zebras received a similar base diet of forage and a pelleted complete feed, with differences in training and enrichment items as well as amounts fed. Medical records were examined to determine the physiological state (growth [≤ 2 yr], pregnant, lactating [≤ 6 mo post-partum], or adult) of the animal at the time of sampling. The effects of sub-species and physiological state on serum values were examined using ANOVA and means were compared using an LSD test to determine statistical significance. There were significant differences among sub-species in average serum values for vitamin E and all minerals except Cl. Different sub-species showed specific mineral differences, such as the Hartmann's Mountain zebra having the lowest Cu, the Grevy's zebra having the lowest Zn, and the common zebra having the greatest Ca ($P < 0.05$), while all animals remained apparently healthy. Perhaps different sub-species have adapted different mechanisms for transporting serum minerals. Physiological state also significantly affected all serum minerals and tended to affect vitamin E. Growing animals had greater P, Mg, and Co compared to all other physiological states ($P < 0.05$). Adults had the greatest Cu, while pregnant and lactating animals had the greatest Se ($P < 0.05$). Diet can affect many serum trace minerals, but the differences seen in some minerals, such as Ca, are most likely due to physiological state and species because they have limited responses to dietary changes. Serum reference ranges can provide useful information about mineral status, but should be used as one tool in a toolkit when advising diet changes. Statistically analyzing trends for minerals within populations, while considering factors such as physiological state, will help us better understand normal health parameters in zebras.

Acknowledgements
The authors wish to thank the Savannahs and Lodge teams for helping to collect serum samples and care for the animals and to Animal Health team for collecting and analyzing serum samples.