CLINICAL EXPERIENCE WITH FATTY ACID SUPPLEMENTATION IN A GROUP OF BLACK RHINOCEROS (*Diceros bicornis*)

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Abstract

Evaluation of fatty acids (FA) in the diet of humans is an area of intense research.[6] Initial indications are that the ratio of linoleic to linolenic acid is more important than the levels of each in the diet of humans.[3,6] This also appears to be true in some laboratory animals.[5] Numerous physiologic abnormalities are encountered when improper dietary ratios or deficiencies are present. These include increased capillary permeability, phospholipid deficiency, changes in reproduction, mitochondrial "swelling" resulting in altered cellular respiratory and phosphorylating mechanisms, and various dermal abnormalities.[1-3,5] These deficiencies are accompanied, in most animals, by significant decreases in serum dienoic and tetraenoic FA levels with concomitant increases in monoenoic and trienoic FA levels.

A recently imported female black rhinoceros (*Diceros bicornis michaeli*), ("Lucy"), demonstrated two episodes of hyperbilirubinemia, moderate hypophosphatemia, hypercalcemia, elevated alkaline phosphatase, anemia and monocytosis less than 12 mo after arrival. Both episodes coincided with major stressful events. The episodes resolved over the course of 2-3 mo. The animal appeared to improve with supportive care and the supplementation of fresh browse flown in weekly.

Based on a suspicion of FA imbalance contributing to Lucy's medical problems, serum % relative FA profiles were evaluated in five black rhinoceroses before and after supplementation with a flaxseed based FA supplement (Missing Link, Designing Health, Valencia, California 91355 USA). FA % relative analysis of this product revealed 50% linolenic acid and 18% linoleic acid. The supplement was administered on a daily basis to two 4-yr-old, captive born male rhinoceroses ("Rudy" and "Tucker"), one long-term captive rhinoceros ("Dal49"), and the recently imported 3-yr-old female rhinoceros ("Lucy"). In July of 1997, a 3-yr-old female eastern black rhinoceros ("Luyisa") was imported from the Addo Elephant Park in South Africa to the Kansas City Zoological Gardens. Initial FA evaluation within 1 mo of arrival demonstrated FA levels comparable to the captive, supplemented rhinoceros. Therefore, FA supplementation was not initiated. Several FA profiles were evaluated over the course of 4 mo after arrival, whereupon changes consistent with the initial unsupplemented rhinoceroses were noted (Table 1).

Of 37 FA's profiled, consistent changes were noted in octadecadienoic (linoleic-18:2), octadecatrienoic (linolenic-18:3), gamma linolenic omega 6 (18:3), eicosatrienoic omega 6 (20:3), and eicosatetraenoic omega 6 (arachidonic-20:4) following supplementation. In addition, the ratios

of 20:3/20:4, and 20:3/20:5 "improved" in all five rhinoceroses supplemented (Table 1). In the human and laboratory animal literature, the 20:3/20:4 ratio may predict a FA (linoleic) deficiency or imbalance.[1] Ratios above 0.4 are indicative of an imbalance.[1] The 20:3/20:5 ratio may predict a FA (linolenic) deficiency.[1] Again, ratios above 0.4 are indicative of an imbalance.[1] In every rhinoceros evaluated, these ratios improved after supplementation.

Diets in four of the rhinoceroses were evaluated for FA composition. Dietary analysis on an as fed weight:weight basis without supplementation revealed a linoleic to linolenic acid ratio of 3:1. Diets were composed of alfalfa hay, a ground aspen pelleted feed (Mazuri Moose Maintenance, Purina Mills, Inc. St. Louis, Missouri USA), small amounts of oranges, a commercial salt block, and various browse items (mulberry, *Morus* sp.; *Pyracanthus* sp.; honeysuckle, *Lonicera* sp.; and willow, *Saliaceae* sp.) when available.

In the human and laboratory animal literature, the trienoic acid that accumulates during fat deficiency is eicosatrienoic acid.[1] In each rhinoceros; the eicosatrienoic acid levels decreased or disappeared after supplementation. In the most recently imported rhinoceros ("Luyisa") eicosatrienoic acid levels gradually increased without supplementation. After supplementation, eicosatrienoic acid levels decreased.

Using the human and laboratory animal results of FA evaluation as a basis for comparison, FA supplementation may be indicated in the black rhinoceros. The only addition to the diets of these rhinoceroses was the FA supplement. Recent research has demonstrated high levels of linolenic acid are contained in fresh browse items favored by the rhinoceros.[7] In addition, it has been demonstrated that FA levels in fresh-cut browse decrease dramatically over a short period of time.[8] During the winter of 1997, the ill rhinoceros ("Lucy") was not supplemented with fresh browse items, but continued on the FA supplement. No recurrence of clinical signs has occurred despite additional stressful events.

Changes in the FA profiles were consistent in all five rhinoceroses. Based on initial results, and compared to the human and laboratory animal literature, fatty acid supplementation appears to be a component of Lucy's improvement. To date, 1 yr after supplementation with FAs, this rhinoceros is clinically normal. Further feeding trials are continuing with analysis of each dietary component for FA determination.

To date, no adverse side effects of supplementation have been noted. Potential adverse effects of long-term supplementation will have to be investigated before recommendations can be made regarding supplementation of this product to rhinoceroses.[4]

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Table 1. Serum % relative fatty acid profiles in five black rhinoceroses (*Diceros bicornis*) before and after fatty acid supplementation.

		Eicosatrienoic 20:3	Linoleic 18:2	Linolenic 18:3	Linolenic-6 18:3	Arachadonic 20:4	20:3/20:4	20:3/20:5
Lucy	Before*	0.72	30.3	1.34	<0.1	1.41	0.51	2.57
	After**	<0.1	28.2	1.90	0.24	<0.1	<0.1	<0.1
Tucker	Before	0.23	38.1	0.77	0.47	<0.1	2.30	0.47
	After	<0.1	49.1	1.38	0.20	<0.1	<0.1	<0.1
Rudy	Before	0.90	45.4	0.94	0.24	<0.1	9.00	9.00
	After	0.42	42.8	4.20	0.27	0.14	3.00	4.20
Luyisa	Before	<0.1	31.7	2.13	0.23	2.56	0.03	<0.1
	Before	0.47	45.8	1.19	<0.1	2.12	0.22	4.70
	After	0.14	51.3	1.74	0.24	2.05	0.06	0.70
Dal49	Before	0.61	36.2	2.25	0.21	<0.1	6.10	6.10
	After	0.57	38.9	1.31	0.32	2.44	0.23	5.70

*Before FA supplementation

**After FA supplementation

INVESTIGATION OF DIAGNOSTIC PARAMETERS AND TREATMENT REGIMENS FOR TUBERCULOSIS IN BONGO ANTELOPE (*Tragelaphus eurycerus*)