

α -TOCOPHEROL LEVELS IN PLANTS CONSUMED BY BLACK RHINOCEROS (*DICEROS BICORNIS*): NATIVE BROWSES COMPARED WITH COMMON ZOO FORAGES

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Plasma α -tocopherol levels in free-ranging black rhinoceros (*Diceros bicornis*) have previously been shown to be higher than in zoo animals (0.8 vs. 0.2 μ g/ml, $P < 0.001$). Dietary vitamin E levels may be correlated with health problems observed in captivity. Plants ($n=73$) consumed by black rhinos were collected from the Zambezi Valley in Zimbabwe, and 4 locations in Kenya. Following tissue homogenization, lipids were extracted from fresh plants using sodium dodecylsulfate, ethanol, and hexane. Aliquots were evaporated under N_2 , reconstituted with methanol containing BHT, and kept under freezer storage until analysis via HPLC. Sample preparation was rapid and convenient; results were highly repeatable under field laboratory conditions. Leaf:stem ratios and dry matter determinations were conducted separately on duplicate samples. Similar sample preparation was applied to green produce, selected browse plants, and dried forages fed at the New York Zoological Park. Results of these assays are presented in Table 1 (selected African plants) and Table 2 (locally available feeds). Leaves contained 2 - 50 X more α -tocopherol than stem fractions of the same plant; mature tissues had higher concentrations than young, growing parts. Of native browses, whole plants ranged from 4.1 (*Acacia drepanolobium*) to 420.9 (*Scutia myrtinus*) mg α -tocopherol/kg dry mater. Dark green, leafy produce fed at the zoo ($n= 7$ spp.) contained an average of 157.0 mg α -tocopherol/kg dry matter; fresh forages averaged 22.3 mg/kg dry matter. NRC dietary vitamin E recommendations for horses (1989), used in designing diets for zoo rhinoceros, are currently 50 to 80 mg/kg. Almost half (43%) of the native browses sampled in this study contained higher levels than current NRC recommendations; dried forages were consistently < 50 mg/kg, and fresh green plants were highly variable. These data suggest that typical zoo diets (hay, grain, and some fresh browse or green produce) fed to zoo rhinoceros may provide marginal vitamin E nutrition.

Table 1. Mean (\pm SE) α - tocopherol content of leaves and stems from important browse species consumed by the black rhinoceros in Kenya (n = 5 spp. from 3 different sampling locations) or Zimbabwe (n = 10 spp.). All data are presented on a dry basis.

SPECIES	LEAF:STEM RATIO	a-TOCOPHEROL mg/kg	
		LEAF	STEM
Kenyan Plants:			
<i>Acacia xanthophloea</i>	28:72	64.8 \pm 19.9	15.7 \pm 6.2
<i>Carissa edulis</i>	56:44	86.4 \pm 17.9	29.2 \pm 13.7
<i>Erythrococcus bongensis</i>	32:68	207.4 \pm 81.3	23.8 \pm 6.4
<i>Grewia similis</i>	54:46	96.3 \pm 45.7	21.6 \pm 7.3
<i>Rhus natalensis</i>	65:35	183.1 \pm 99.8	23.3 \pm 9.9
Zimbabwean Plants:			
<i>Bahenia</i> spp.	31:69	178.9	4.9
<i>Colophospermum mopane</i>	66:34	135.6	13.3
<i>Combretum eleganoides</i>	52:48	83.3	6.1
<i>Combretum mossambiencis</i>	45:55	289.3	26.6
<i>Diplorhynchus</i> spp.	57:43	72.0	12.0
<i>Grewia bicolor</i>	55:45	341.6	7.3
<i>Grewia flavescens</i>	15:85	63.0	19.4
<i>Holmskioldia</i> spp.	18:82	100.2	2.7
<i>Markhamia acuminata</i>	46:54	96.1	13.5
<i>Securinegra virosa</i>	17:83	57.5	4.8

Table 2. α - tocopherol content of selected green forages, green produce, and dried forages fed at the New York Zoological Park.

GREEN FORAGE	α -TOCOPHEROL
Alder	47.9
Bamboo	202.5
Clover	33.3
Duckweed	33.2
Grape	66.3
Grass	71.4
Maple	25.4
Mulberry	127.1

GREEN PRODUCE	α -TOCOPHEROL
Bok Choi	206.1
Broccoli (florets)	44.2
Collard Greens	160.5
Dandelion Greens	129.4
Hydroponic Grass	71.4
Kale (leaves)	136.1
Kale (stems)	24.4
Mustard Greens	158.5

Willow	45.5
DRIED FORAGES	
Alfalfa Cubes	5.9
Mixed Hay	26.8
Timothy Hay	34.1

Romaine	163.9
Spinach	143.4