

AZA Rhinoceros Husbandry Resource Manual

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Ellen S. Dierenfeld, Ph.D.

It is believed that many of the health problems identified in captive rhinos may be linked to nutritional factors. Rhinos consume a large number of species of plants with a diverse array of physical characteristics and nutrients. They represent a range in feeding strategies and consequently diet, from browsers (or selective feeders) to unselective grazers. Captive diets may include possible imbalances in some species in dietary fats (particularly essential fatty acids) and soluble and insoluble carbohydrates, as well as minerals and vitamins. This chapter outlines current dietary information for maintaining rhinos in captivity and includes a section on hand-rearing.

NUTRITIONAL REQUIREMENTS

Due to similarities in digestive tract morphology, the domestic horse probably represents the best nutritional model for all rhinoceros species. Until further information is obtained, diets should be formulated using current National Research Council (NRC) (1989) recommendations for horses of various physiological stages. Minimum nutrient requirements are listed in Table 21.

Good-quality forages should provide primary nutrients for all herbivores, with concentrate feeds used to balance energy, protein, minerals or vitamin needs. Hay storage is particularly important for ensuring proper dietary management. Moldy or dusty hay may cause colic and/or heaves. Large amounts of poor-quality hay should not be fed to rhinos, as it may be so poorly digested that impaction and/or colic will result. Very high-quality legume or small-grain hay may be so readily digested that when fed with concentrates, loose feces or colic may result. High-quality legume hays often necessitate mixing with grass hays.

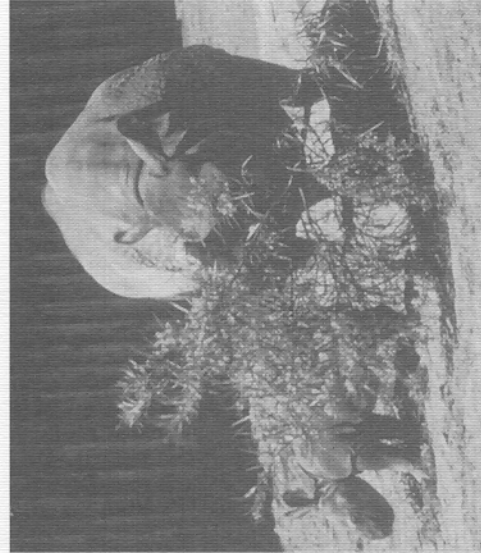
The larger, grazing rhino species (greater one-horned and white) should be fed high-quality grass hays, while browsing species (black and Sumatran) should be fed mixed grass-legume hays and/or a mixture of legume hay and less digestible browse. Hay and fresh water should be available *ad libitum*; the concentrate portion of the ration should be given in at least two feedings daily for better utilization. When practical, a small feeding of hay should be encouraged prior to each concentrate feeding.

In studies of intake, digestion and passage in zoo herbivores, Foose (1982) measured dry matter intakes of approximately 1% of body mass when greater one-horned (n=3), white (n=5) or black (n=3) rhinos were fed grass hays, and slightly higher levels (1.2 to 1.6% of body mass) when fed alfalfa hay. Diets were 43% (black rhinos eating grass) to 67% (white rhinos eating alfalfa) digestible. Thus, a guideline for as-fed diet quantity would be approximately 1.5% of body mass; for grazing species, no more than a third of total calories should be obtained from the concentrate portion (horse feeds or high-fiber unguilate pellets). Larger pellets (>1.0 cm diameter) work well with grazing species, while smaller pellets can be readily manipulated by browsing species.

TABLE 21. Nutrient concentrations in total diets for horses and ponies (dry matter basis, modified from NRC, 1989)

Nutrient	Growing	Mature/ Maintenance	Pregnant/ Lactating
Dig. Energy (Mcal/kg)	2.45 - 2.90	2.0	2.25 - 2.60
Crude Protein (%)	12 - 15	8.0	10 - 13
Ca (%)	0.6	0.3	0.4
P (%)	0.3	0.2	0.3
Mg (%)	0.1	0.1	0.1
K (%)	0.3	0.3	0.4
Vit A (IU/kg)	2000	2000	3000
Vit D (IU/kg)	800	300	600
Vit E (IU/kg)	80	50	80

Concentrations of Na, S, Fe, Mn, Cu, Zn, Se, I and Co should be provided at the following levels, respectively: 0.1%, 0.15%, 50 mg/kg, 40 mg/kg, 10 mg/kg, 40 mg/kg, 0.1 mg/kg, 0.1 mg/kg and 0.1 mg/kg.



Browse, which may be essential to the dietary health of rhinos, also serves as an effective form of behavioral enrichment. (Photo: San Diego Zoological Society)

Animals can sometimes be encouraged to consume less palatable forages if hays are soaked in water or sprinkled with molasses. Applesauce had proved to be helpful in administering unpalatable medications and/or supplements.

FEDING LOCATION

As with all zoo species, feed should be offered on a concrete pad or in live-stock troughs or bins. Sand impaction has previously been documented in rhinos (Nouvel & Pasquier, 1946); therefore, feeding directly on the ground is not recommended. To reduce competition for food, individual feeding stations or adequate space at communal feeders is recommended.

SUPPLEMENTS

Dietary supplements should be unnecessary in properly formulated rations. A possible vitamin-E deficiency has been suggested but not confirmed in zoo rhinos; current recommendations based on natural browse composition suggest that diets should contain 150 to 200 IU vitamin E/kg dry matter. Salt blocks and water should be available at all times. If grown in an area prone to soil selenium (Se) deficiency, forage should be tested routinely for determination of Se content in order to provide data needed for balancing rations.

PROBLEMATIC DIETS

High-quality alfalfa as an exclusive forage is unnecessary and may lead to mineral imbalances, colic and diarrhea. The consumption of fresh red maple browse has been associated with hemolytic anemia in horses and should therefore be avoided. Feeding cabbage, kale and onion to rhinos should also be avoided.

BROWSE

Particularly for the browsing rhino species, the addition of fresh and/or frozen browse may be essential to dietary health. Browse may contribute required nutrients that have not yet been quantified and may also be of benefit to dilute a captive diet that is too digestible. Table 22 lists North American browse species that have been successfully fed to rhinos.



HAND-REARING

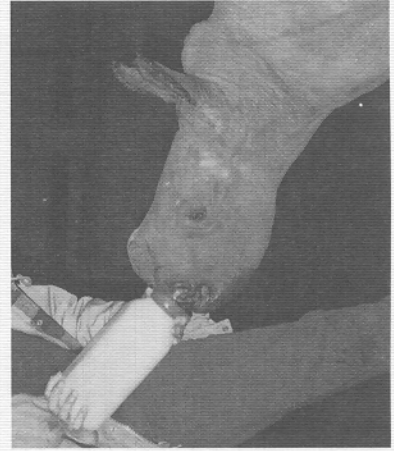
A limited number of rhino calves have been and are currently being raised using various formulas. Reports and published information must be carefully scrutinized for measures of success and methodology in milk-sample analysis. The following information uses the ungulate hand-rearing chapter in the AZA Infant Diet Notebook as a base for general feeding guidelines and formula selection (Reiter et al., 1994). This recommendation is to be used as a guideline for standardization of a hand-rearing diet. For current information, contact the author.

TABLE 22. North American browse species acceptable for rhinos (partial listing)

Crabapple	<i>Malus</i> sp.	Weeping Willow	<i>Salix babylonica</i>
Silver Maple	<i>Acer saccharinum</i>	Black Willow	<i>Salix nigra</i>
Sugar Maple	<i>Acer saccharum</i>	Fragrant Honeysuckle	<i>Viburnum</i> sp.
Alder	<i>Alnus</i> sp.	Grape	<i>Vitis vinifera</i>
Hackberry	<i>Celtis occidentalis</i>	Banana	<i>Musa acuminata</i>
American Beech	<i>Fagus granifolia</i>	Torch Ginger	<i>Phacocamerica</i> sp.
Weeping Fig	<i>Ficus benjamina</i>	Sweetgum	<i>Liquidambar styraciflua</i>
Forsythia	<i>Forsythia</i> sp.	Prickley Pear	<i>Opuntia leptocaulis</i>
Kentucky Coffee Tree	<i>Gymnocladus dioica</i>	Huisache	<i>Acacia farnesiana</i>
Hibiscus	<i>Hibiscus rosa</i>	Brazil	<i>Condalia obovata</i>
White Mulberry	<i>Morus alba</i>	Catclaw	<i>Acacia roemeriana</i>
Golden Bamboo	<i>Phyllostachys aurea</i>	Mesquite	<i>Prosopis juliflora</i>
White Poplar	<i>Populus alba</i>	Granjeno	<i>Celtis pallida</i>
Black Locust	<i>Robinia pseudoacacia</i>		

TABLE 23. Compositions of rhino hand-rearing formulas

Ingredients	Parts by Volume	
	Formula 1	Formula 2
Water	32	9
Skim milk	32	9
Karo Syrup	1	1



While not common, hand-rearing of rhinos has been accomplished by North American institutions. (Photo: Knoxville Zoological Gardens)