

Rhino SSP Husbandry Manual

Ellen, S. Dierenfeld, Ph.D.

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Nutrition

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 plants with a diverse array of physical characteristics and nutrients. They represent a range of 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 nutrient 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 hay: 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, Foote (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 ungulate 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
Vitamin A (IU/kg)	2000	2000	3000
Vitamin D (IU/kg)	800	300	600
Vitamin E (IU/kg)	80	50	80

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

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.

Feeding Location

As with all zoo species, feed should be offered on a concrete pad or in livestock 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 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 to digestible. Table 22 lists North American browse species that have been successfully fed to rhinos.

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

Crabapple	<i>Malus sp.</i>	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 sp.</i>
Alder	<i>Alnus sp.</i>	Grape	<i>Vitis vinifera</i>
Hackberry	<i>Celtis occidentalis</i>	Banana	<i>Musa acuminata</i>
American Beech	<i>Fagus granifolia</i>	Torch Ginger	<i>Phaeoamerica sp.</i>
Weeping Fig	<i>Ficus banjamina</i>	Sweetgum	<i>Liquidambar styraciflua</i>
Forsythia	<i>Forsythia sp.</i>	Prickly Pear	<i>Opuntia leptocaulis</i>
Kentucky Coffee Tree	<i>Gymnocladus dioicus</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>		

HAND-REARING

Ann Ward, M.S.

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 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 the standardization of a hand-rearing diet. For current information, contact the author.

Milk Composition and Formula Selection

Based on available data, rhinoceros milk is more dilute than milks of other ungulate species. It is low in solids, low in protein, very low in fat, and high in sugar compared with milk of equids, bovids and cervids (Ofstedal, 1984). Formula selected (Table 23) should mimic mother's milk in composition as much as possible (Table 24). Two formulas are presented: Formula 1 has been used to raise a calf to 1 year of age; Formula 2 more closely mimics mother's milk.

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

Though rhinoceros' milk is different from cow's milk, the latter may still be appropriate for hand-rearing rhinos if used in combination with other ingredients. Cow's milk is low in iron; consequently, an iron source such as Fer-in-sol should be added to the formula at two drops per 100 g of formula. In addition, infant vitamins, such as Major Multi-Vita Drops, should also be added to the formula at two drops per 100 g of formula. Some infant vitamins, such as Mead Poly-vi-sol with Iron, contains added iron. The animal may also benefit from the addition of Lactaid at one drop per 100 g of formula. Lactaid aids in carbohydrate digestion and helps prevent possible gastrointestinal distress.

Table 24. Nutrient composition of rhino milk (Gregory et al., 1965) and recommended formulas (as-fed basis).

Formula	Percent as Fed			
	Solids	Protein	Fat	Sugar
Rhino Milk	8.8	1.4	0.2	6.6
Formula 1	10.3	3.3	0.3	5.9
Formula 2	8.3	1.7	0.2	6.6

If the neonate is less than 24 hr old, colostrums diluted 50% with water or an electrolyte solution for ungulates, such as Replenish, should be administered for the first 24 hr. Though species-specific is preferred, cow colostrums may be used. Products such as Colostrx may also be used (Table 25).

To avoid gastrointestinal distress, a diluted formula may be offered beginning on day 2. The formula can be gradually increased to full concentration depending on the animal's health, including weigh gain and stool condition.

Table 25. Products used in hand-rearing diets.

Product	Manufacturer / Distributor
Colostrx	Protein Technology, Inc. Minneapolis, MN 95403 1-800-645-3839
Replenish	Fermenta Animal Health Co. Distributor Kansas City, MO 64153
Fer-in-sol	Mead Johnson Nutritionals
Poly-vi-sol with Iron	Bristol-Meyer Co. Evansville, IN 47721
Major Multi-Vita Drops	Major Pharmaceutical Corp. Distributor Chicago, IL 60612
Lactaid	Lactaid, Inc. P.O. Box 111 Pleasantville, NJ 08232

Feeding Regime

Quantity fed should range from 10 to 13% of body weight. Animals should be fed every 2 hr. Because infants suckle during daylight hours, feeding should be equally spaced in a 12-hr period not to exceed 3% of body weight at any one feeding. It is recommended that feeding begin with 10% of

body weight split equally into 12 feeds 1 hr apart during daylight hours. The quantity of formula fed should be adjusted daily based on the animal's weight. Animals should be weighed at the same time each day. Fresh water should be available at all times.

If diarrhea occurs, the quantity of formula fed should be decreased or the formula diluted until stool condition returns to normal. If diarrhea is persistent, an electrolyte solution can be used to dilute the formula, replacing some or all of the water. In addition, the number of feedings can be increased to lessen the quantity fed at any one time.

Formula can be prepared ahead of time and warmed as needed. Water should be boiled to decrease possible contamination due to pathogens, then refrigerated before being added to the formula. The formula should be refrigerated and used within 72 hr. Prior to feeding, the formula should be warmed to the animal's body temperature. Calf nipples work well with large species. Bottles should be boiled before use. Diluted bleach may be used as a disinfectant. Formula left over from each feed should be discarded.

Weaning

Weaning may begin as early as 6 months and should be completed in 1 year. Weaning is a slow process involving carefully monitoring body weight and solid food consumption. Animals should have access to solid food at all times. A nutritionally complete pelleted diet such as Calf Manna, horse feeds or high fiber ungulate pellets, in addition to alfalfa hay, is appropriate. Formula may be decreased by gradually eliminating the number of feeds or decreasing the amount offered per feed and gradually decreasing the number of feeds.

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