Nutritional Aspects of Hand-rearing Rhinoceros Calves

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The decision to hand-rear any species, let alone a rhinoceros, should not be approached lightly. Nutritionally, as well as behaviorally, remaining with the dam is the ideal situation. Additionally, in the case with rhinoceros, the financial commitment to provide a calf with milk replacer, appropriate housing, and socialization is considerable. Consequently, hand-rearing should be considered after other options have been exhausted. Once the decision to hand-rear has been made, the best nutritional strategy is to replicate dam's milk and follow the natural pattern of nursing intervals and lactation length. The gross nutrient composition of rhinoceros milk has been reported. Many of the gaps in information can be extrapolated from data collected from similar species.

Colostrum

The first feed item to provide is colostrum, the first milk. Relative to mature (midlactation) milk, rhino colostrum is higher in total solids, protein and fat (Figure 1). As with other ungulate species, rhinos do not receive placental transfer of antibodies, but require passive transfer of colostral immunoglobulins. The window of opportunity for the intestinal absorption of the immunoglobulins is short: the reported time spans are up to three days for piglets and 24 hours for calves, kids, and foals, with maximum absorptive capabilities in the first 12 hours. Colostrum has been shown also to contain bioactive substances, such as hormones and growth factors and is reported to produce a laxative effect, helping to expel meconium. The San Diego Wild Animal Park procures and processes cow colostrum (modified pasteurization) on site to be fed after arrival into the nursery. Additionally, with the assistance of the excellent keeper staff, rhino colostrum has been milked from the respective dams when possible. Colostrum is maintained in the diet (10% v/v) through at least one month of age to provide systemic protection of the gut.

Milk Analysis

Analyses have been performed on the milks of relatively few nondomestic species. Luckily, many samples from black rhinos (*Diceros bicornis*) have been collected, and the few collected from Asian (Indian, *Rhinoceros unicornis*) rhinos and a single reported sample from a white rhino (*Ceratotherium s. simus*) are consistent with the values obtained for black rhinos. It has been shown, as well, that milk composition can be grouped phylogenetically. The gross composition of the mature milk of black rhinoceros is similar to that of Przewalski horse (*Equus przewalski*) and domestic horse despite diverging some 54 million years ago (Table 1). Of particular note is the low fat and high carbohydrate, primarily lactose, content of the milk of perissodactyls. Thus, where data for rhinoceros milk is lacking, milk of the domestic horse can be used as the model.

Milk Replacer

To develop a milk replacer, a base milk must be selected. In the United States, cow and goat milk are readily available. The following outlines factors to consider:

Protein

Cow milk forms a firm curd and requires more than 6 hours to empty from the stomach. The formation of the curd in the stomach is largely determined by the casein content of the milk. Both rhino and horse milk contain about 70% casein. Horse milk forms a flocculent curd, and is reported to empty from the stomach in about 2 hours. Goat milk also forms a more friable curd than does cow milk. The Wild Animal Park has used cow milk successfully without symptoms of lactobezoars. Furthermore, the slow breakdown of the curd may facilitate the nursing schedule, which includes a 12-h overnight fast.

Fat

The size of milk fat globules may affect the digestibility of fat in the intestines. Fat globules in horse milk average approximately 2 μm, similar to that of goat milk fat globules. While the range and mean size of milk fat globules of raw cow milk are greater than that of raw goat milk, homogenization reduces the range and average size to a fraction of the original (0.7 μm). The fatty

acid profile of horse milk fat shows a high proportion of medium chain and long chain polyunsaturated fatty acids. Goat milk fat contains a higher medium chain, but lower polyunsaturated long chain fatty acid content than cow milk fat.

Cost

Goat milk is 4 to 5 times more expensive than cow milk (US). The price differential is not insignificant due to the volume necessary to feed a rhino calf upwards of 15 to 25% of its body weight in formula each day. An additional benefit of cow milk is the availability of skim, or nonfat, milk in order to keep the fat content of the formula low.

Where refrigeration is an issue, spray-dried powdered milks can be utilized. We do not recommend the use of canned evaporated milk, in part due to the added phosphates. Rhino and equid milks have a Ca/P ratio of 1.4: 1, while cow and goat milks are lower at 1.2: 1, so additional phosphate would skew it further.

Modifications of the base milk to simulate dam milk include increasing the lactose and including iron and vitamins. In order to increase the lactose content, using food-grade lactose would be ideal. However, dextrose, a breakdown product of lactose, is acceptable and easier to get into solution. Whey, a by-product of the cheese industry, has been suggested as lactose source. Whey, however, increases protein and ash content as well as the lactose content. Rhinoceros milk is reported to be 0.3 to 0.4% ash, while goat and cow milks, without any addition of whey, are 0.6-0.7% ash. High fructose corn syrup has also been suggested, but we have observed a possible osmotic effect, and do not recommend it. It is universally agreed that table sugar, sucrose, is not a viable option. It has been shown in domestic species that the sucrase enzyme is not produced until about 1 month of age. Milks of domestic species are low in iron. The formula can be supplemented easily with proprietary blends formulated for livestock, such as Vi-Sorbin®. At the Wild Animal Park, a commercial probiotic, Probios®, is added to the milk replacer daily until weaning. Adult feces has been used in several species as an inoculant, but must be first be screened for parasites and other pathogens.

Nursing Intervals

Rhino dam's milk and the milk replacer are low calorie (energy) foods. Thus, the calf needs large volumes daily. Natural nursing intervals are reported to be hourly or less in Asian (Indian) rhinos. Due to labor needs, we have fed every 2 hours over a minimum of a twelve-hour period without problems. It is important to maintain the natural frequency as best as possible so as to give the calf sufficient volumes without exceeding stomach capacity and causing digestive upset. If labor permits, an increased nursing day length would support an improved growth rate. As the calf ages, feeding intervals can be increased.

Solid Feed

The calf should be bedded on high-quality edible grass hay, such as Sudan or Bermuda grasses as they will begin mouthing the hay and have incidental consumption from a very early age. Adult feed items should be made available by at least one month of age. Treat items such as produce can be used to initiate solid feed consumption, but the calf should not be allowed to consume it at the expense of other feed items.

Weaning

Feeding milk replacer through a normal course of lactation provides the young herbivore a source of highly digestible food and permits the animal time for the development of the gastrointestinal tract. The digestibility of milk replacers far exceeds that of plant materials. Early weaning may prove difficult for the young animal if it cannot obtain sufficient energy and protein to support growth. Furthermore, the nutritional and psychological stress can reduce immunocompetency, complicating any reintroductions, etc.

In order to provide the hand-reared rhinoceros calf with the best nutritional base, the diet as well as the delivery of the diet should reproduce that which the dam would provide. Modifications should be made

thoughtfully, with regard to the possible consequences. Good nutrition requires the cooperation and active participation (feedback) of keepers with the veterinarians and nutritionists.

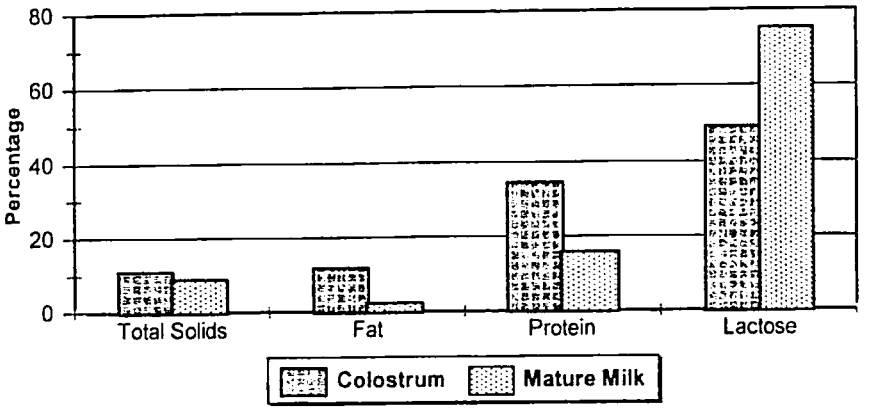

Figure 1. Gross nutrient composition (%DM basis) of colostrum[2] and mature milk[3] of black rhinoceros (*Diceros bicornis*).

Table 1. Gross nutrient composition (%DM basis) of the mature milk of black rhinoceros (*Diceros bicornis*)[3], Przewalski horse (*Equus przewalski*)[5], and domestic horse (*Equus caballus*)[6].

Species	Total Solids	Fat	Protein	Lactose
Black Rhinoceros	8.82	2.27	15.87	75.06
Przewalski Horse	10.50	14.29	15.10	64.00
Domestic Horse	10.50	12.10	18.30	65.60

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