MACRONUTRIENT COMPOSITION OF MILK FROM AN ASIAN RHINOCEROS ACROSS LACTATION.

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Introduction

Milk composition is a critical aspect of all female mammalian reproductive strategies. The first and usually sole food over an extended time period for mammalian neonates is mother's milk. The macronutrient composition of milks from different species can vary widely (Oftedal and Iverson, 1995; Skibiel et al 2013). In this study we present data on the macronutrient composition of milk from an Asian rhinoceros cow collected between calf ages 4 and 9 months and compare to the composition of milks of other large terrestrial herbivores.

Materials & Methods

Milk samples were collected by manual expression from a single Asian rhinoceros cow at the Fort Worth Zoo from day 123 through day 284 postpartum (N=14). Samples were assayed for dry matter (DM), fat, sugar, crude protein (CP), and ash using standard methods that have been validated at the Nutrition Laboratory of the Smithsonian National Zoological Park and performed on milk samples from about 200 species of mammals (Hood et al., 2009). Briefly, for DM, milk samples were aliquoted, weighed, and dried in a forced air convection drying oven for 3.5 hours at 100ºC and then reweighed [AOAC, 1990]. Total nitrogen was determined for the dried milk samples using a carbon, hydrogen, and nitrogen (CHN) elemental gas analyzer (Model 2400, Perkin Elmer, Norwalk, CT). This method has been validated against the macro Kjeldahl procedure with nitrogen recovery around 98-99%, and has been used at Smithsonian National Zoological Park to measure milk nitrogen for a wide variety of species. The obtained nitrogen value was multiplied by 6.38 to determine the amount of CP in the milk [Jones, 1931]. Total lipid was measured using a micro modification of the Roese – Gottlieb procedure by means of sequential extractions with ethyl alchohol, diethyl ether, and petroleum ether. Total sugar was analyzed by the phenol – sulphuric acid colorimetric procedure [Dubois et al., 1956; Marier and Boulet, 1959] using ultraviolet spectroscopy and lactose monohydrate standards. Gross energy content of the milk was calculated as: 9.11 * fat + 3.95* sugar + 5.86 * CP (Perrin 1958). This formula has been validated against values from adiabatic bomb calorimetry for milks from rhesus macaques (Hinde et al., 2009) and bongos (Petzinger et al 2014). Values are expressed on a wet weight basis, both as g/g (%) and on a per energy basis (mg/kcal). The mg of nutrient per kcal of milk was calculated by: 1000 * (nutrient expressed in g/g)/GE.

Results

Milk composition did not vary over the collection period. For example, the water content ranged from 90.43 – 91.05% and sugar, the next most common milk constituent, ranged from 6.31 – 7.22%. Mean values for water, sugar, protein, fat and ash content are given in Table 1. Asian rhinoceros milk has a high water content, with a correspondingly high sugar and low fat content. It is similar to milk from the white rhinoceros, though it appears higher in protein, both on an absolute basis and on an energy basis. Indeed, although the percent protein of Asian rhinoceros milk is about one-third the mean value for milk from an Asian elephant with a calf at about the same age, the milk protein on an energy basis is actually higher in the Asian rhinoceros (Table 1).

Discussion

These values must be interpreted with some caution, as they represent the results from a single cow over a single lactation. However, the results were consistent over lactation and with values from samples taken from multiple white rhinoceros cows. The value for milk protein on an energy basis has been suggested to be associated with relative growth rate. If this hypotheses is true for rhinoceroses, then we predict that Asian rhinoceros calves grow faster than white rhinoceros calves, and even relatively faster than Asian elephant calves. The high water content of the milk might benefit the calf by providing large amounts of water for heat regulation through evaporative water loss (Tilden and Oftedal, 1997). However, it may also suggest that lactating rhinoceros cows may face a water stress challenge, which might limit their range during lactation to areas with sufficient water.

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Table 1. Mean values for macronutrients in Asian and white rhinoceros milk

Species	GE (kcal/g)	Water (%)	Ash (%)	Sugar (%)	Fat (%)	Protein (%)	Protein (mg/kcal)
Asian rhinoceros	0.41	90.66	0.25	6.98	0.44	1.53	37.1
White rhinoceros[1]	0.37	91.48	0.24	6.86	0.42	0.98	26.7
Asian elephant[2]	1.44	77.4	0.69[3]	5.0	11.1	4.1	30

[1] Data from Petzinger et al., 2012 for milk samples from 3 months to one year of calf age

[2] Data from Abbondanza et al., 2013 for milk samples from 6 months to 1 year of calf age

[3] The sum of Ca, P, Mg, K, and Na