THE COMPOSITION OF THE MILK OF THE AFRICAN BLACK RHINOCEROS (*DICEROS BICORNIS*; LINN.)

BY

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[Accepted 14th February 1961]

(With 1 figure in the text)

Little is known of the composition of the milk of the rhinoceros, partly because only so few have bred in captivity. We report here the chemical composition and vitamin content of a sample of milk of the African black rhinoceros (*Diceros bicornis*) taken during the nineteenth month of lactation.

CONTENTS

INTRODUCTION

The first African Black Rhinoceros born in captivity in this country was Roger, whose parents, Stephanie and Willie, arrived at the Bristol Zoo in October 1952 and were estimated to be then about eighteen months old. Roger was born on August 22nd 1958. When he was nineteen months old he was sold to the Chester Zoo. At this time he was still suckling, such a long suckling period being quite normal in this species. After he had been separated from his mother, the keeper noticed that Stephanie's udder was very tense and milk was being ejected from the teats. He was able to milk her without undue difficulty. For two weeks she gave daily about two quarts of milk, and then the yield began to decrease until, after a further two weeks, she was dry. As soon as we learnt that a rhinoceros at Bristol Zoo was lactating, we arranged with Mr R. E. Greed, the Director, to have some of the milk sent to Shinfield for analysis.

DIET

Stephanie's daily food intake was :

Cattle grazing nuts	4 lb
Flaked maize	$1\frac{1}{2}$ lb
Kale (winter) or cabbage or other green stuffs (summer)	8 lb
Clover or lucerne hay	76 lb
Mangolds or carrots	56 lb
Elm or evergreen oak branches *ad libitum*	

In addition, once a week, one-eighth of a pint of cod-liver oil was offered with the cattle grazing nuts, and also 4 lb linseed cake, $1\frac{1}{2}$ lb bran and $1\frac{1}{2}$ lb crushed oats.

MILK SAMPLES

About 300 ml of milk were collected each time on the second and third day after the removal of the youngster. The samples were stored in Polythene bottles and deep frozen as quickly as possible after collection. On arrival at Shinfield, the two samples were thawed and well mixed together, when portions were taken for the different analytical procedures. For the microbiological estimation of vitamins it was necessary to freeze the samples again until the assays could be done, but all other tests were done immediately on the thawed milk. The milk was white and very watery in appearance.

ANALYTICAL METHODS

The methods used for chemical measurement of the major constituents and for the microbiological assays of the B-vitamins in the milk were as described by Gregory, Kon, Rowland & Thompson (1955). Iron was measured by the method of Woiwod (1947). Riboflavin and thiamine were also measured fluorimetrically by the methods of Bessey, Lowry & Love (1949) and Houston, Kon & Thompson (1940). Total ascorbic acid was measured by the method of Roe & Kuether (1943) modified as recommended by Geschwind, Williams & Li (1951). The procedure described by Aschaffenburg & Drewry (1957) was used for the paper electrophoretic examination of the soluble proteins.

RESULTS AND DISCUSSION

1. *Chemical analysis*

The contents of the major constituents in the milk are shown in Table 1. One of the main differences between rhinoceros's and cow's milk is the low fat content of the former. Grzimek (1957) found an equally low content (0·27 per cent) in the milk of a rhinoceros at the Frankfurt Zoo. The stage of lactation of this rhinoceros was not stated but, like Stephanie, it was probably at mid or late lactation. An analysis of colostrum or early lactation milk would probably show a higher fat content, otherwise the young rhinoceros would receive very small quantities of fat soluble vitamins.

Table 1—The constituents other than vitamins of rhinoceros's milk.

	g per 100 *g*
Fat	Trace
Solids-not-fat	8·10
Lactose	6·06
Protein (Total N × 6·38)	1·54
Casein (N × 6·38)	1·11
Soluble proteins (N × 6·38)	0·29
Non-protein N	0·02
Ash	0·34
Calcium	0·056
Phosphorus	0·040
Sodium	0·037
Potassium	0·086
Chloride	0·079
	mg per 100 *g*
Iron	0·14

Grzimek's values for non-fatty solids (9·5 per cent), carbohydrates (7·2 per cent), casein (1·58 per cent) and ash (0·37 per cent) are similar to ours. In addition to being lower in fat, the rhinoceros's milk contained less protein and calcium than cow's milk, but the lactose content was higher.

The soluble protein/casein ratio was about the same as that normally found in cow's milk. Paper electrophoresis resolved the soluble protein fraction into at least five discernible components (Fig. la). The fraction was thus complex in composition like that of the milk of the cow (shown for comparison in Fig. 1b), sheep and sow, and unlike that of the group of species in which only a single major non-casein constituent is found, e.g. the goat and guinea-pig. From the mobilities it appears that both globulins and albumins are present.

2. *Vitamin content*

The vitamin content of the milk is shown in Table 2. The milk was similar to cow's milk in its content of ascorbic acid, calcium pantothenate and vitamin B_{12}. Values for nicotinic acid, biotin, riboflavin and vitamin B_6 were all less than those typical of cow's milk. Both microbiological and fluorimetric

Table 2—The vitamin content of rhinoceros's milk (Expressed as μg/ml milk).

Chemical assays	
Fat soluble vitamins	not measurable
Riboflavin free	0·44
total	0·58
Thiamine free	0·07
total	0·85
Ascorbic acid total	17
Microbiological assays	
Biotin	0·005
Nicotinic acid	0·09
Ca pantothenate	3·40
Riboflavin	0·15
Thiamine	0·73
Vitamin B_6 (pyridoxal)	0·04
Vitamin B_{12}	0·005

methods confirmed the high thiamine content of the milk. Fluorimetric tests showed that 90 per cent of the total thiamine activity was in a bound form, and the paper chromatographic method of Gregory (1960) demonstrated that the bound form comprised considerable quantities of thiamine monophosphate and some thiamine pyrophosphate and that, in addition, free thiamine was present. In cow's milk, phosphorylated thiamine is found only during the early stages of lactation. Our sample of rhinoceros's milk (taken at the nineteenth month of lactation) would probably correspond to the mid or late lactation secretion of the cow. Houston, Kon & Thompson (1940) have shown that in cow's and goat's milk, the content of phosphorylated thiamine is inversely proportional to their phosphatase activity. We found similarly that the rhinoceros's milk with its high content of phosphorylated thiamine was very low in alkaline-phosphomonoesterase activity.

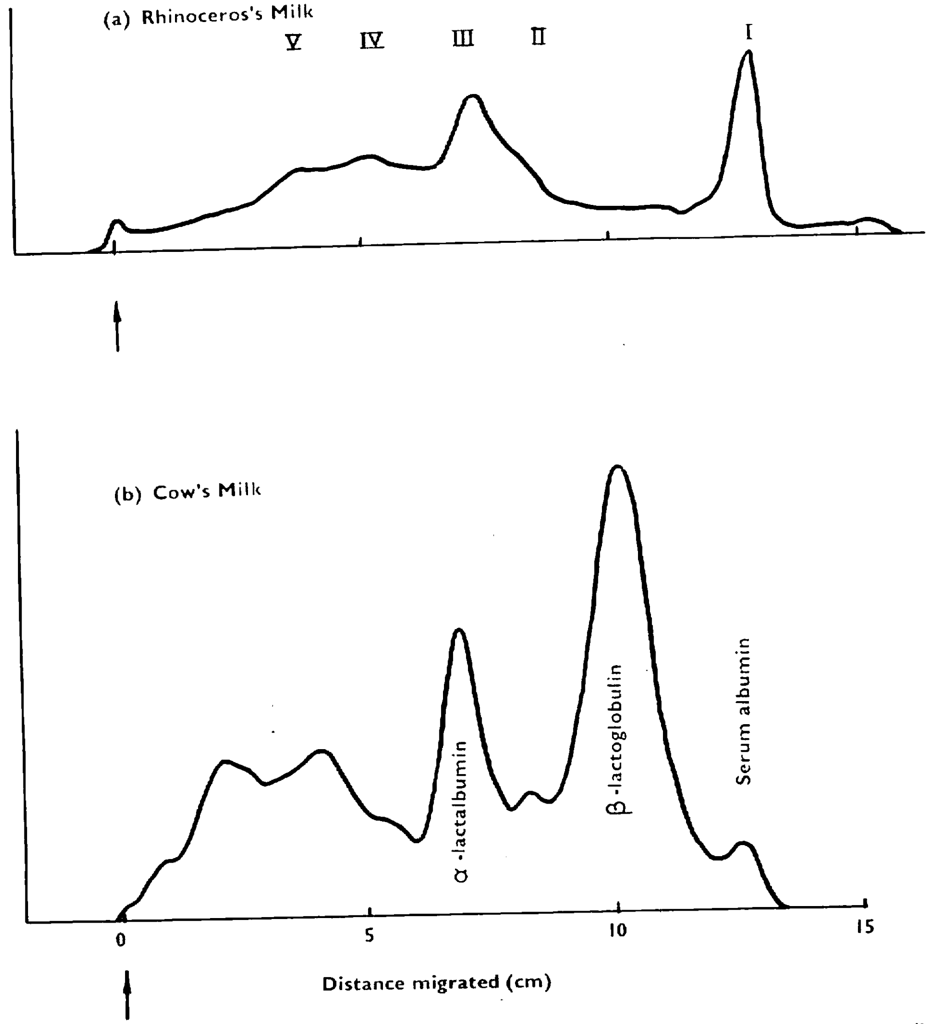

Fig. 1—Electrophoretic patterns of the soluble proteins of (*a*) rhinoceros's milk and (*b*) cow's milk.

Values for riboflavin obtained fluorimetrically were three times higher than those obtained microbiologically. We are at present unable to account for this discrepancy. The most probable explanation is that the milk contains substances that behave like riboflavin in the fluorimetric tests, but are biologically inactive. Such substances were shown by Pearson & Schweigert (1947) to occur in the milk of goats given large quantities of riboflavin.

SUMMARY

1. A sample of milk of the African black rhinoceros (*Diceros bicornis*; Linn) taken during the mid to late lactation period was analysed for fat, solids-not-fat, lactose, protein, casein, soluble proteins, non-protein nitrogen, ash, calcium, phosphorus, sodium, potassium chloride and iron. The milk contained only a trace of fat and less protein and calcium than cow's milk but more lactose.

2. Paper electrophoresis resolved the soluble protein fraction into at least five components.

3. The total ascorbic acid, calcium pantothenate and vitamin B_{12} contents were similar to those in cow's milk, whereas values for nicotinic acid, biotin, riboflavin and vitamin B_6 were lower and values for thiamine higher.

ACKNOWLEDGMENTS

We thank the keepers at the Bristol Zoo for their help in obtaining the milk samples, and Mr J. P. Fordham for the estimation of total ascorbic acid.

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NOTICE

Proceedings " Vol. 137, Part 2, was published on 20th September, 1961.]