CHANGES DURING LACTATION IN THE COMPOSITION OF THE MILK OF THE AFRICAN BLACK RHINOCEROS (*DICEROS BICORNIS*)

BY

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(With 2 figures in the text)

With the birth of a second rhinoceros calf at Bristol Zoological Gardens, it was possible to obtain samples of rhinoceros's milk during the colostral period and subsequently at regular intervals throughout sixteen months of lactation. The chemical composition and vitamin content of the samples are reported here. The analysis shows that rhinoceros's milk contains very little fat at all times during the lactation cycle.

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INTRODUCTION

We have previously reported the chemical composition and vitamin content of a sample of milk from an African Black Rhinoceros at the end of nineteen months of lactation (Aschaffenburg, Gregory, Rowland, Thompson & Kon, 1961). The same rhinoceros, Stephanie, gave birth to a second male calf at Bristol Zoo on 28th December 1961. Her keeper found that Stephanie would allow him to milk her from the time the calf was born. Therefore, Mr R. E. Greed, Director of the Bristol Zoological Gardens, kindly arranged for us to have samples of milk from her at regular intervals throughout the sixteen months that the youngster was being suckled. The chemical composition and vitamin content of the samples were determined and the results for a complete lactation are reported here.

DIET

Stephanie's diet was the same as that described by Aschaffenburg *et al.* (1961).

MILK SAMPLES

Samples of milk were obtained at the following times after the birth of the calf : five, twelve, twenty-eight and fifty-two hours, two and four weeks and then at monthly intervals up to the eleventh month. The twelfth, thirteenth and fourteenth months coincided with the extremely cold weather from December 1962 to February 1963 when Stephanie was confined indoors and refused to be milked. Samples were again collected in March and April, the fifteenth and sixteenth month of lactation. The calf (Ronald) was sold to Dublin Zoo on 1st May 1963. Milk samples were obtained from Stephanie on the fifth and sixth days after the removal of the calf.

Stephanie was normally milked in the morning before her calf had suckled. During the third month of lactation two samples of " strippings ", i.e. the milk left in the udder after the calf had suckled, were also taken. Usually, 150 ml of milk were obtained but during the colostral period only about 50 ml could be collected. The samples were sent by letter post and arrived at Shinfield on the morning of the day after the collection. Only one of them showed signs of bacterial spoilage ; it was not analysed. Upon arrival, the samples were portioned out for the chemical and microbiological tests and stored at $-20°$ C. For purposes of comparison and for ease of handling they were analysed in two batches : (1) those collected during the first two months and (2) those from the third month to the end of lactation.

ANALYTICAL METHODS

Methods used for chemical measurement of major constituents and vitamin A and for the microbiological assays of the B-vitamins in the milk

Table 1—The chemical composition and vitamin content of rhinoceros's colostrum and early milk (second week of lactation)

	Colostral period				Early lactation
Time after calving	5 h	12 h	28 h	52 h	2 weeks
	g/100 g milk				
Total solids	—*	11·63	11·84	10·37	9·26
Protein (total $N \times 6{\cdot}38$)	—*	6·39	6·10	4·79	2·26
Lactose	—*	4·38	4·90	4·81	84
Casein ($N \times 6{\cdot}38$)	—*	2·67	2·69	2·34	1·39
Fat	—*	—*	—*	—*	—*
	μg/ml milk				
Nicotinic acid	0·30	0·24	0·23	0·14	0·20
Calcium pantothenate	3·2	3·6	4·1	4·6	3·8
Riboflavin	2·1	2·0	2·2	1·9	1·2
Thiamine	0·40	0·38	0·48	0·34	0·18
Vitamin B_6 (as pyridoxal)	0·2	0·20	0·18	0·16	0·13
	mμg/ml milk				
Vitamin B_{12}	4·0	3·8	4·5	3·3	3·0
Biotin	<1	<1	<1	<1	3·1

* Insufficient sample for these tests.

days after the calf was removed. It was similar in chemical composition to that of the mature milk presented in Table 2.

2. *Vitamin content*

The contents of nicotinic acid, calcium pantothenate, riboflavin, thiamine, vitamin B_6, vitamin B_{12} and biotin in the samples of colostrum and early milk are also given in Table 7. Fig. 2 shows the changes in the contents of these

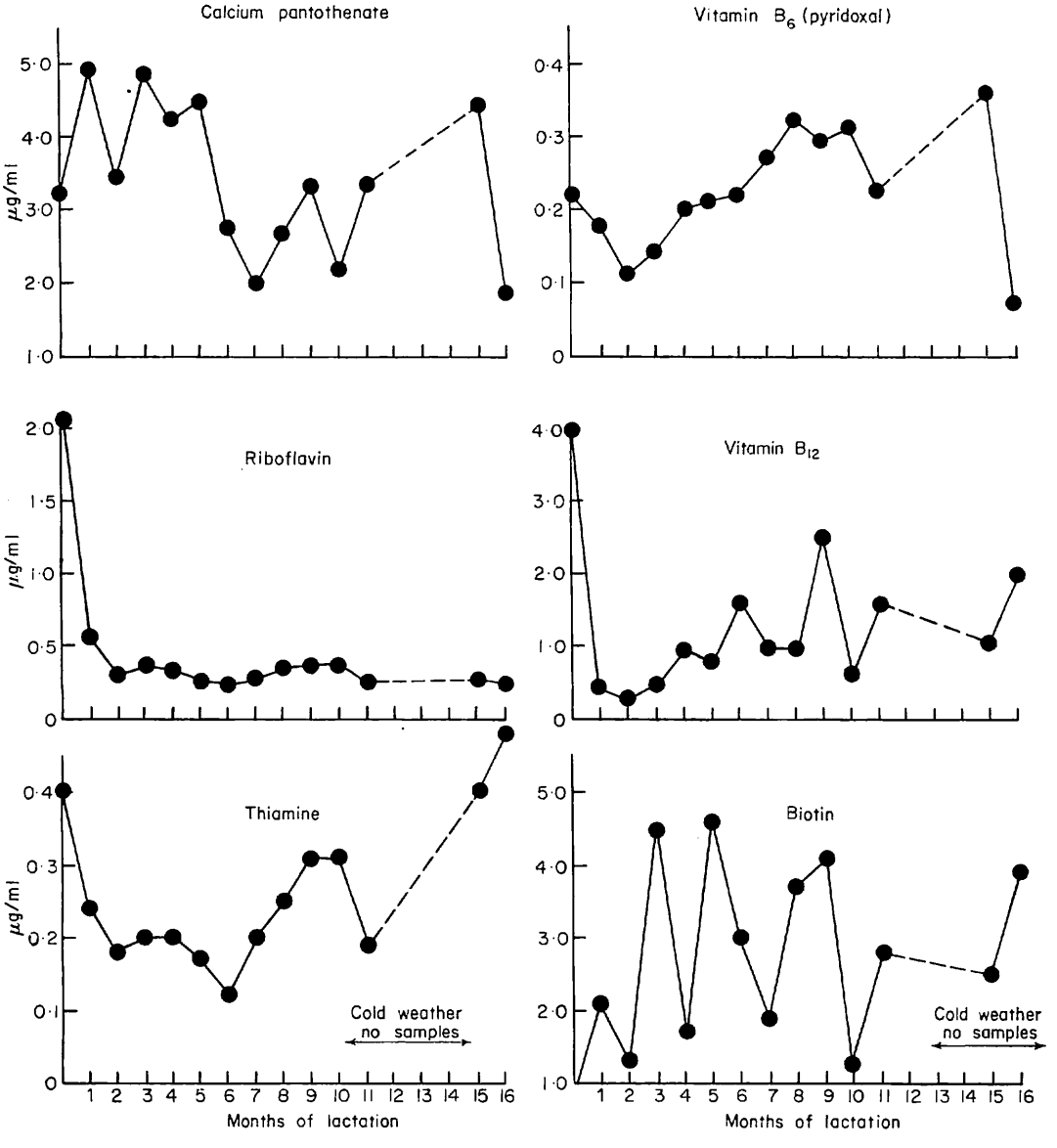

Fig. 2—Variation with stage of lactation in contents of calcium pantothenate, riboflavin, thiamine, vitamin B_6, vitamin B_{12} and biotin in rhinoceros's milk.

vitamins that occurred during the lactational cycle. The calcium pantothenate content varied considerably from month to month, but in general was highest during the first five months of lactation. The content of riboflavin followed the typical lactation curve found with cow's milk (Gregory, Ford & Kon, 1958; Houston, Kon & Thompson, 1940): it was high in colostrum and fell rapidly to a steady value in mature milk. The content of thiamine was also high in colostrum, but it fell more gradually during the first six months of lactation and then increased up to the ninth month. The content of vitamin B_6 was low in colostrum and decreased further during the first two months of lactation. From the third month onwards it increased gradually. The content of vitamin B_{12} behaved similarly to that of riboflavin in that it was high in colostrum and fell rapidly during the first month. The monthly values for the mature milk were, however, very variable. Similar fluctuations have been observed with cow's milk (Gregory *et al.*, 1958). The most variable in content of all the water-soluble vitamins was biotin. Because of this variability no lactational trends could be recognized, except that all the colostrum samples contained very little of this vitamin and even in the mature milk the level was only about 3 mμg/ml. Changes in the nicotinic acid content of the milk are not shown in Fig. 1, as after the second week of lactation the content was less than 0·1 μg/ml of milk and the assay method was not sufficiently sensitive for measurement. During the "drying-off" period the level increased sufficiently for it to be measured once more (Table 2).

The sample of rhinoceros's milk previously analysed at this Institute (Aschaffenburg *et al.*, 1961) contained more biotin, nicotinic acid, thiamine and vitamin B_{12} and less vitamin B_6 and riboflavin than the mature milk from the second lactation. Neither did its composition correspond exactly to that of either of the two samples of milk from the "drying-off" period. However, these samples were taken on the fifth and sixth days after the removal of the calf whereas the previous sample was from the second and third days. The composition of the previous sample falls within the range of values reported here for the mature milk and milk from a later stage in the "drying-off" period.

Because of the very low fat content of the milk, determination of tocopherols was not attempted and there was not enough carotene and vitamin A for for detection.

SUMMARY

(1) Samples of milk were obtained from a lactating rhinoceros five, twelve, twenty-eight and fifty-two hours, and two and four weeks after the birth of the calf. Subsequently, samples were collected at monthly intervals until the calf was removed after sixteen months.

(2) The total solids, fat, protein and lactose contents of the samples were determined. The fat content of the milk was low (less than 0·45 per cent) throughout lactation. That of lactose was lower in colostrum (4·38 per cent) than in mature milk (6·1 to 6·9 per cent), and that of the protein decreased from 6·4 per cent in colostrum to between 1·0 and 1·65 per cent in the milk.

(3) Variations in the contents of nicotinic acid, calcium pantothenate, riboflavin, thiamine, vitamin B_6, vitamin B_{12} and biotin in the milk were

measured. Those of biotin, vitamin B_{12} and pantothenate showed marked fluctuations from month to month. That of riboflavin remained low in the milk having been high in colostrum. The vitamin B_6 and thiamine contents both decreased during the first few months of lactation and then increased gradually.

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