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The levels of zinc in breast milk of urban African women in Zimbabwe

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Summary

Two hundred and eighty milk samples expressed by healthy African women who had pre-term or full-term delivery, were digested using the wet digestion method. The digests were analysed for zinc (Zn) using an atomic absorption spectrophotometer. Mean Zn level in colostrum was 8.2 ± 1.02 μg/ml in transitional milk 4.33 ± 0.134 μg/ml and in mature milk 0.38 ± 0.03 μg/ml. The ranges were 1.4–21.7, 0.3–9.8 and 0.2–2.4 μg/ml in colostrum, transitional and mature milk respectively. The figures obtained agreed with some previous findings in which it was found that Zn levels decreased with progression in lactation.

Résumé

On a digéré deux cent quatre-vingts prélèvements du lait en utilisant la méthode de digestion humide. Ces prélèvements étaient exprimés par des femmes africaines en bonne santé qui ont accouchés avant ou à terme. Les digestes étaient analysés pour le zinc (Zn) en utilisant un spectrophomètre d'absorption atomique. Les niveaux moyens du Zn dans le colostrum étaient 8.2 ± 1.02 μg/ml, 4.33 ± 0.134 μg/ml dans le lait transitionnel et 0.38 ± 0.03 μg/ml, dans le lait proprement dit. Les variations étaient respectivement de 1.4 à 21.7, de 0.3 à 9.8 et de 0.2 à 2.4 μg/ml dans le colostrum, le lait transitionnel et le lait proprement dit. Ces chiffres correspondaient aux résultats précédents dans lesquels on a découvert que les niveax du Zn diminuaient avec la continuation de la lactation.

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Introduction

Until very recently the composition of human milk has been studied only in relation to the 'traditional nutrients', namely protein, carbohydrates, fats and vitamins. The observation of impaired growth in infants fed on a cows' milk formula [1,2], the development of acrodermatitis enteropathica-like syndrome (characterized by anal orificial lesions, diarrhoea, alopecia and mental depression) in children [3], zinc (Zn)-free total parenteral alimentation and the increased susceptibility to infection of these Zn-deficient individuals directed attention to the importance of trace elements in human milk.

Figure 1 illustrates the possible interaction of Zn with other trace elements. Accordingly, Zn interacts with nearly every element in the first transition group of the periodic table. Apart from these interactions, an antagonistic action has been shown between cadmium (Cd) and Zn in the rat with respect to increased growth, prevention of dermal lesions and teratogenic changes. Because of these effects, it has been suggested that in a sense, Cd could be considered as an anti-metabolite of Zn [4,5]. Cadmium has also been reported to affect the

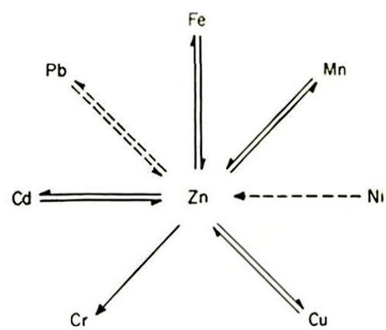

Fig. 1. Interaction of zinc with other trace elements.

immune function, e.g. the susceptibility to bacterial and viral infection, the humoral antibody synthesis and the activity of lymphocytes or macrophages [6]. In the case of both this interaction and all other inter-relationships of Zn, the ratio at which the two interacting elements are present in the diet is important.

Zinc is absorbed better from human than from cows' milk since formula-fed infants have been found to have lower serum and hair Zn, despite intake of up to 5.8 mg/l from cows' milk formula. Cows' milk does not contain the Zn/ligand of the type present in human milk [7]. New born mice deprived of colostrum but fed later with milk developed the clinical features of Zn deficiency.

This study was undertaken to estimate the levels of Zn in colostrum, transitional and mature milk of healthy urban African women in Zimbabwe, who delivered either pre- or full-term. The aim was to accumulate baseline data on the level of Zn in the milk of healthy lactating Zimbabwean women.

Materials and methods

One hundred colostrum samples were obtained from healthy mothers in the Mbuya Nehanda maternity clinic, 87 samples of transitional and 93 samples of mature milk from women attending antenatal clinics in Harare. All the women who participated in the study had given their consent. Mothers who had any evidence of under-nutrition, vitamin deficiency or anaemia were excluded from the study. The average age of the subjects was 25 years. Multiparous and primiparous women who had delivered pre-term and full-term babies were included in the study.

The samples were collected by manual expression during various stages of lactation, i.e. colostrum, from 48 h to 5 days, transitional, from 6 days to 10 days, and mature after 10 days. Approximately 5.0 ml was obtained and put into polyethylene containers. All the samples were deep-frozen until analysed by atomic absorption spectrophotometry.

An Instrumental Laboratory Atomic Absorption Spectrophotometer, model 257 was used for determination of Zn with air/acetylene as fuel. The instrument was calibrated every time with appropriate standards prepared in deionized water.

About 5.0 ml of milk were digested using the wet oxidation method [8]. The method was carried out with a mixture of concentrated nitric and sulphuric acid. During the digestion of each sample, a double blank was run in parallel. Recovery was about 90% by this method. Nitroso-compounds were removed by addition of ammonium oxalate to the digest which was then heated until a clear solution was obtained. The digested sample was brought to a volume of 10 ml with deionized water and directly aspirated into the spectrophotometer. Care was taken at all stages to avoid contamination. All laboratory glassware was soaked in chromic acid for 24 h, rinsed and washed in nitric acid and then deionized water.

Results and discussion

Zinc levels in expressed breast milk reported in the literature vary remarkably as can be seen in Table 1. Our observation about levels of Zn as shown in Table 2 correspond to the values obtained in some of the studies. For example, results for colostrum agreed with those of Sharda *et al.* [9], those for transitional milk agreed with those obtained by Rajalakshmi and Srikantia [10] and finally our results for mature milk were similar to those reported by the American Academy of Paediatrics [11]. From

Table 1. Zinc levels in milk

Stage of lactation	Study (reference no.)	Levels (μg/ml)
Colostrum	9	9.32 ± 1.63
	14	5.7
	15	6.0
	10	5.32 ± 0.312
	16	20
	11	4.6
Transitional	9	6.71 ± 1.21
	10	4.72 ± 0.275
	9	2.16 ± 0.38
	14	0.7 ± 1.6
	11	0.45 ± 0.9
	15	4
	16	2–3

Table 2. Concentrations of Zn measured in colostrum, traditional and mature milk of urban Zimbabwean women

	n	Zn (μg/ml)	Range
Colostrum	100	8.2 ± 0.02	1.4–21.7
Transitional	87	4.33 ± 0.134	0.3–9.8
Mature milk	93	0.38 ± 0.03	0.2–2.4

*Values are means ± standard deviation.

our study, it was also seen that colostrum emerged as a richer source of Zn and that the levels decreased with progression of lactation. This agreed with earlier reports [12].

The recommended dietary allowance for Zn was set at 0.5 ml/kg per day for infants by the Food and Nutrition Board [13]. This is met if infants consume human milk containing 3–4 μg/ml. Most of our colostrum and transitional milk values were in this range. It was therefore reasonable to assume that most of the infants of the mothers who took part in the study were receiving more than the recommended intake of Zn at least during the first 10 days. Unfortunately, none of the values of mature milk were in the recommended range, this could therefore mean that none of these infants was receiving adequate Zn at the time of this study. But if the results obtained and those reported by the American Academy of Paediatrics [11] were reliable, one could assume that in general, infants from the mothers who took part in our study would grow well, if all other nutrition was adequate.

The Zn content of the early milk is probably suited to the needs of the infants while that in the mature milk is inadequate, especially for the pre-term neonate who might therefore need supplementation [7]. The Zn supplement should be in an easily or readily absorbable form to avoid any effects associated with Zn deficiency.

Comparison between Zn levels in milk from multiparous and primiparous women was not done even though some workers have suggested an association between Zn content and multiparity [13]. Other workers have, however, suggested that a more reliable indication of age, parity and location history requires longitudinal rather than cross-sectional data.

In conclusion, the Zimbabwean women who took part in the study produced milk that contained an adequate amount of Zn required for normal infant growth.

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