THE PROTEIN CONTENT OF THE BREAST MILK OF AFRICAN WOMEN

BY

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Infant-feeding follows a similar pattern in most tropical African countries. Cow's milk is rarely available, and breast-feeding is therefore the rule. This is usually begun during the first few days of life and continued for two to three years, although occasional feeds may be given as late as six years. Supplementary feeding consists almost entirely of carbohydrate gruels and pastes, including plantains, maize, cassava, and bananas. These may be given in the early months of infancy, but more usually are introduced at about the age of 6 months (Housden, 1950; Brock and Autret, 1952; Jelliffe, 1952a). When weaned completely, children share the adult diet, and although this food is slightly more nutritious it still consists almost exclusively of carbohydrate. It must be stressed that all forms of artificial feeding with dried cow's milk, etc., are prohibitively expensive for the vast majority of African mothers.

As is well known, the syndrome of malignant malnutrition, or kwashiorkor, occurs most commonly some months after the child has been weaned from the breast, and is probably produced by the gross and cumulative lack of protein in the diet. However, occasional cases are seen while the child is being breast-fed, usually after the age of 1 year, and very rarely much earlier in infancy. Thus, Gelfand (1951) has reported a case of kwashiorkor from Southern Rhodesia in an African baby of 3 months.

In Ibadan and in many parts of Africa pregnant women and nursing mothers do not seem to receive special food, and their diet is certainly very deficient in protein, as has been emphasized recently by Woodruff (1951). In view of the prolonged lactation in these poorly nourished women, it was thought likely that the protein content of their breast milk might have deteriorated during the later stages of breast-feeding, and the following investigation was accordingly undertaken.

Collection and Analysis of Specimens.—Specimens of breast milk (5–10 ml.) were collected from 88 consecutive apparently healthy Yoruba nursing mothers in Ibadan. All were of a low-income group and most of them were poorly nourished. The length of lactation varied from 1 to 36 months. The milk was sealed to prevent evaporation, after the addition of 0.1 g. of boric acid and 1 minim (0.06 ml.) of commercial formalin as preservatives, and was shipped to the Mead Johnson Research Laboratories. For most of the journey the specimens were refrigerated. On arrival 12 samples were found to be broken or clotted. These were discarded, leaving 76 in good condition, which were analysed for total nitrogen, using the semi-micro-Kjeldahl method.

Results

The protein content was calculated from the figures for total nitrogen ($N \times 6.38$). The mean for the group was found to be 1.04%, with a range of from 0.59% to 1.76%.

Discussion

The protein content of human breast milk, as shown by analyses in Caucasian women, varies with different stages of lactation. During the first days of secretion the colostrum produced contains 4–8%. This rapidly decreases during the first two weeks and then remains constant for about a month and a half. About two months after the beginning of lactation, and subsequently, a very gradual decline in the protein probably occurs. It must be noted, however, that few estimations seem to have been made late in lactation—that is, over 10 months—in Caucasian women.

“Mature” human milk—after the first month of lactation—usually shows a protein content of 1–2%. Various investigators have recorded the following results: Holt *et al.* (1915), 1.15%; Schlossmann (1902), 1.25%; Bell (1928), 1.21% (at 7–8 weeks); Nims *et al.* (1932), from 0.98% to 1.96%, etc. More recently, in an extensive investigation of 200 healthy American women, Macy (1949) reported the surprisingly low mean figure of 1.06% (range 0.73% to 2%) in mature milk. Clements (1949), quoting unpublished data, also notes that the protein content of breast milk of healthy Australian women, as shown by analyses made at the Australian Institute of Anatomy, Canberra, is lower than the usually quoted textbook figures. Not many figures are available for milk taken very late in lactation. In America, Holt and his associates (1915) found an average of 1.07% protein in 10 nursing mothers who had been lactating for from 10 to 20 months. More recently, in 1941–2, Kon and Mawson (1950), in the course of a large-scale investigation into the composition of breast milk in Reading under wartime dietetic conditions, found the protein content to be 1.17% in 33 women between the 21st and 24th weeks of lactation, while in 10 mothers still lactating at from 25 to 28 weeks this had fallen to 1.00%. In 1946–7, Gunther and Stanier (1951) analysed the breast milk of mainly undernourished German mothers in Wuppertal and, in 11 women between the 9th and 28th weeks of lactation, found the protein content to be 1.17%.

Few analyses seem to have been undertaken in the Tropics, especially in Africa, and these have shown an unexpectedly high protein content to occur in malnourished mothers all over the world. Bray (1928) found the protein content to be 1.06% in Nauru, in the Pacific, while Bunce (1931) analysed the breast milk of Burmese and Indian mothers in Rangoon and reported the protein to be within normal Caucasian limits. In Africa, Dufour and Gourry (1934) have investigated the milk of women at Dakar; this was found to contain 1.24% protein. In the case of kwashiorkor in a 3-months-old breast-fed baby reported from Southern Rhodesia by Gelfand (1951) the mother's milk contained 1.35% protein. Recently Walker *et al.* (1952) have given a preliminary outline of an investigation of the breast milk of 200 urban Bantu women undertaken at the Nutrition Unit of the South African Institute of Medical Research at Johannesburg. They found the usual wide range of variation, but the average content of protein, as well as of other constituents, was almost identical to that given for Caucasian mothers.

In the present series of 76 specimens of breast milk obtained from African nursing mothers in Ibadan, the mean protein content was found to be 1.04%. In view of the protein-deficient diet of these women and the extreme length of lactation, it is felt that this figure is gratifyingly high. In particular, there was no apparent diminution of the protein content with prolonged lactation. This lack of relationship is emphasized by the “scatter diagram.” For example, a woman who had been suckling her child for 36 months showed 1.56%, while a grandmother who had been breast-feeding her grandchild for three months was found to have 1.68%. In addition, again as shown by the “scatter diagram,” there appeared to be no obvious relationship between the protein content and the nutritional status of the child.

Growth curves of African infants usually show a satisfactory gain in weight for the first six months or so, when

"Scatter-diagram" showing the lack of relationship between the protein content of the specimens of breast-milk and (a) the length of lactation and (b) the nutritional status of the infants.

adequate calories and protein are being supplied by the breast milk. After this, when prolonged breast-feeding and small supplementary feeds of carbohydrate are continued with, it is usual for the growth curves to become definitely retarded as compared with Caucasian standards (Meyers, 1951). This is partly the result of the child's struggle for malarial immunity, which occurs at this time, but is probably mainly due to the fact that even normal breast milk, with occasional feeds of carbohydrate, is not sufficient to supply the calorific and, particularly, the protein demands of the growing infant. While the present investigation has suggested that the breast milk of poorly nourished African mothers contains a comparatively normal content of protein, it is of course possible that some other factor may become deficient, or more likely that the actual yield diminishes when lactation is prolonged. Albanese (1951) has analysed the same problem in Chinese infants, and believes that the retardation of the curve is probably due to a quantitative rather than a qualitative milk deficiency, while recent work in Ibadan, when breast milk has been manually expressed from lactating African women, has suggested that a poor yield occurs (Jelliffe, 1952b).

At the Inter-African Conference on Nutrition (1949) it was estimated by the Belgian delegation that the *per capita* supply of animal protein for the Congo as a whole was less than 5 g. a day. It is certain that similar figures apply in most tropical African countries, and recent food analyses in Ibadan by Woodruff (1951) have shown that it is unusual for pregnant women to have more than 1 oz. (28 g.) of animal protein every three or four days, while many only have about 1 oz. each week. In addition to this, their diet was also shown to be very deficient in non-animal protein. It has been found (National Research Council of the United States, 1945) that during normal lactation 8–12 g. of protein will be secreted daily, which represents 8–12% of the protein intake usually recommended for the average pregnant woman—namely, 100 g. (Clements, 1949). At the present state of knowledge it is difficult to understand how the malnourished African nursing mother is capable of producing milk of such high protein content for so long under such adverse dietary conditions. It is, however, of interest to note that experimental work with goats and cows has suggested that it is the globulin of the serum that provides most, if not all, of the nitrogen for the synthesis of milk protein (Petersen, 1944). As Clements (1949) observes, if the same mechanism holds for human milk, the supply of serum globulin must be maintained at a satisfactory level if the demands of the mammary tissue are to be met. It has been emphasized by numerous observers (Mohun, 1946; Stephen, 1948; etc.)

that, for reasons largely unknown, the plasma proteins of Africans, as of Fijians (Wills and Bell, 1951) and other tropical peoples, tend to be particularly high in globulin, despite the poor intake of amino-acids.

The relatively normal protein found in the present survey re-emphasizes the fact that under present conditions in tropical Africa the custom of prolonged breast-feeding should be continued with, as the alternative is an early weaning on to a diet of carbohydrate pastes and almost no protein. Prolonged breast-feeding should, however, be combined with early and adequate supplementary feeds of the most easily digestible carbohydrate foods, and, in addition, such locally produced protein foods as are available (eggs, beans, goat's milk, etc.).

Summary

Seventy-six specimens of breast milk from Nigerian nursing mothers were analysed to determine the protein content. The average was found to be 1.04% (range 0.59% to 1.76%). The length of lactation varied from 1 to 36 months. No evidence was found of a decrease of the protein content with prolonged lactation. The results are believed to compare favourably with those from other parts of the world.

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