

TRACE-ELEMENT DEFICIENCIES IN PLANTS AND THEIR RELATION TO KWASHIORKOR

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The type of protein deficiency in infants called kwashiorkor has been described by Brock and Autret¹ as 'the most serious and widespread nutritional disorder known to medical and nutritional science'. Various aspects of this condition are being widely studied today from the medical point of view. There is a close relationship between malnutrition and the available sources of food, and the dependence of staple vegetable foodstuffs on the constitution of the soil in which they are grown is of particular importance. Brock² and other workers in this field have recognized that mineral deficiencies of the soil and of the crops growing on it may have an important bearing upon the health of the people living in such an area. This is especially true in Africa.

Schütte's³ survey of trace-element deficiencies of plants in Africa clearly showed the very extensive distribution of these deficiencies. In much of Africa the indigenous population lives primarily upon a vegetable diet, which is not supplemented by much animal protein as the diet is in most developed countries.

McLester and Darby's contention, that human beings do not suffer from trace-element deficiencies because they have a constant source of the necessary trace-elements in the animal part of their diet,⁴ does not apply to large areas in Africa. Thus plant deficiencies of a serious nature may be of direct importance in the study of human diseases.

Trace-element deficiencies in plants may influence the well-being of man in several ways. Firstly, they can cause a serious decrease in crop yields and promote conditions likely to lead to undernutrition and famine. But they can also alter the chemical nature of the crops. This is not generally appreciated. The nature of plant proteins may be altered and the relative amounts of essential amino acids markedly depressed.^{5, 6, 7} The amino-acid content of plant proteins may vary and low concentrations of certain amino acids may limit the efficiency of the utilization of the proteins present in the diet. Auffret and Tanguy,⁸ and Bigwood,⁹ have stressed the importance of deficiencies of essential amino acids in kwashiorkor, while Popper *et al.*¹⁰ have shown that deficiencies of sulpho-amino acids such as cysteine and methionine can produce liver lesions in rats.

The other important aspect of trace-element deficiencies in

African diets is that they may seriously reduce the activity of enzyme systems in the body, especially in the liver. In kwashiorkor,^{1, 11, 12, 13, 14} as well as in the livers of rats suffering from protein deficiency, there is an alteration in the enzymatic pattern of the cell and the activity of certain enzyme systems is greatly decreased. In acute cases the enzymatic machinery may be disrupted.

This alteration in the enzyme systems may be due to deficiencies of amino acids. Williams and Elvehjem¹⁵ have shown that methionine concentration can be a limiting factor in xanthine oxidase activity and also that this enzyme may decrease markedly without a decrease in the non-enzyme liver proteins in rats. Further, Westerfeld and Richert¹⁶ have shown that molybdenum appears to be part of this enzyme, and that its concentration will govern the amount of xanthine oxidase present in the liver of rats.

Iron, copper, cobalt and zinc⁴ are all essential constituents of important enzyme systems, which obviously cannot function adequately if only subminimal concentrations of these minerals are present. Magnesium¹⁷ is also necessary for proper development, especially in women. As these elements are all frequently and widely deficient in plants, it is very possible that adequate quantities are frequently deficient in the diet of Africans. In infants this is probably accentuated by the fact that the nutritional states of many lactating women is poor.^{11b}

It is thus very probable that trace-element deficiencies in plants is one of the important subsidiary factors contributing to the widespread occurrence of kwashiorkor in Africa and that the effect of trace-element supplements in the treatment of this condition may be important.

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