Breast milk fatty acids in mothers of children with atopic eczema

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The total lipid fatty acid composition of mature breast milk has been analysed in a group of twenty-five mothers of children with atopic eczema, and compared with breast milk from twenty-two controls. Total lipids were extracted into chloroform–methanol (2:1, v/v) and the methyl esters prepared by alkali-catalysed trans-esterification were separated by gas–liquid chromatography and identified by comparison with standard fatty acid methyl esters. Results show that mothers of children with atopic eczema have a significantly greater proportion of linoleic acid, and a smaller proportion of dihomo-γ-linolenic acid in their total breast milk lipid than the controls. Proportions of total derived fatty acids were similar between groups and there were no differences in the principal saturated and monounsaturated fats. It was concluded that mothers of children with atopic eczema have an abnormal breast-milk fatty acid composition. This supports previous evidence of a defect of conversion of linoleic acid into its long-chain polyunsaturated metabolites in the condition.

Breast milk: Polyunsaturated fatty acids: Atopic eczema

Children with atopic eczema were first demonstrated to have abnormal serum lipids by Hansen (1937) who proposed that a diet rich in polyunsaturated fatty acids produced clinical improvement in the condition in parallel with a return towards normal of the iodine number, a measure of the total degree of unsaturation (Hansen *et al.* 1947).

Recent studies show that subjects with atopic eczema have an abnormal fatty acid profile in plasma phospholipids (Manku *et al.* 1982, 1984; Bordoni *et al.* 1988), leucocyte membrane lipids (Rocklin *et al.* 1986) and adipose tissue lipids (Wright, 1988). These findings suggest that these patients have a defect in conversion of dietary linoleic acid to its long-chain polyunsaturated metabolites (Wright, 1985*a*; see Fig. 1). Partial correction of this abnormality in lipid composition by the administration of dietary supplements rich in γ-linolenic acid results in clinical improvement (Wright & Burton, 1982; Meigel *et al.* 1987; Biagi *et al.* 1988; Morse *et al.* 1989).

The role of breast-feeding in the prophylaxis and treatment of atopic eczema is controversial, with a number of studies producing variable results (for a review, see Atherton, 1983). As yet, no consensus exists as to whether breast-feeding exerts a protective or therapeutic effect and, if so, what the mechanism of action is. The present paper reports breast-milk lipid fatty acid composition in a group of mothers of atopic children compared with controls, with special reference to the *n*-6 and *n*-3 series of polyunsaturated fatty acids.

PATIENTS AND METHODS

Mothers attending the under fives' dermatology clinic at Harare Central Hospital, Harare, Zimbabwe, were asked to provide a sample of midstream breast milk if they had a child

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Table 1. *Fatty acid composition (area %) of total breast-milk lipids of Zimbabwean mothers of children with atopic eczema compared with controls*

(Values are means and 1 standard deviation)

	Mothers of atopic children (*n* 25)		Controls (*n* 22)	
Fatty acid	Mean	SD	Mean	SD
14:0	5·5	1·7	5·4	1·8
16:0	22·4	4·3	22·9	5·8
18:0	8·4	2·8	7·9	2·6
Total	36·3	—	36·2	—
16:1	2·9	0·8	3·1	1·2
18:1	27·0	7·1	25·2	6·4
Total	29·9	—	28·3	—
18:2*n*-6	12·8	3·6	10·2**	3·4
18:3*n*-6	0·5	0·2	0·6	0·4
20:3*n*-6	0·5	0·3	0·7*	0·4
20:4*n*-6	0·8	0·3	1·0	0·5
Total	14·6	—	12·5	—
18:3*n*-6	0·8	0·3	0·6*	0·4
20:5*n*-3	0·3	0·2	0·4	0·2
22:5*n*-3	0·5	0·3	0·6	0·3
Total	1·6	—	1·6	—

Mean values were significantly different from those for mothers of children with atopic eczema (Student's *t* test): $*P < 0{\cdot}05$, $**P < 0{\cdot}01$.

between the ages of 2 and 6 months with the clinical features of atopic eczema (Hanifin & Rajka, 1980). All children were examined by the same author (S.W.). Only mothers with infants born at full term after an uncomplicated pregnancy were admitted to the study. All mothers were asked whether they had a personal history of atopic eczema or other atopic symptoms, or whether there was a family history of eczema. All breast milk samples were collected between 10.00 and 12.00 hours.

Milk samples were collected from mothers of children with non-eczematous conditions as controls. All samples were taken into sterile plastic universal containers and stored immediately at $-20°$. Total lipids were extracted into chloroform–methanol (2:1, v/v) within 3 d of collection (Gibson & Kneebone, 1981). Methyl esters of fatty acids were prepared for gas–liquid chromatography by alkali-catalysed trans-esterification (Metcalfe *et al.* 1966). Peaks were identified by comparison with standard fatty acid methyl esters (Sigma, Poole, Dorset) and automatically integrated using a Hewlett Packard CDP 1 integrator.

Proportions of fatty acids present in the breast milk of subjects and controls were compared using Student's *t* test.

RESULTS

There were twenty-five mothers of atopic children and twenty-two controls from whom samples were obtained. Of the mothers whose children had atopic eczema, only six had a definite personal history of eczema and a further four had a history of eczema in a first-degree relative other than the child they were currently breast-feeding.

Results of fatty acid analysis are shown in Table 1. There were no differences between

the groups for the principal saturated and monounsaturated fatty acids. Over all, mothers of children with atopic eczema had significantly higher proportions of linoleic acid (18:2*n*-6; $P<0.01$) and α-linolenic acid (18:3*n*-3; $P<0.05$), the principal dietary unsaturated fatty acids. Both these differences were more marked in the group of mothers with a definite personal history of atopic eczema where linoleic acid comprised 13·4% of the total breast-milk lipids (control = 10·2%) and α-linolenic acid comprised 0·9% (control = 0·6%).

The proportion of the long-chain derivatives of linoleic acid, γ-linolenic acid (18:3*n*-6), dihomo-γ-linolenic acid (20:3*n*-6) and arachidonic acid (20:4*n*-6) were all lower in the group of mothers with atopy than in controls. In the mothers of atopic children, however, only dihomo-γ-linolenic acid was significantly different from control values. The ratio of linoleic acid to its principal long-chain polyunsaturated derivatives, dihomo-γ-linolenic acid plus arachidonic acid, was 5·92 in the control group, 8·48 in the group of mothers with atopic children taken as a whole and 10·4 in the group of mothers with a personal history of atopy. There was no difference in the sum of the fatty acid series between groups.

DISCUSSION

The results of our fatty acid analyses in the control Zimbabwean mothers compare well with published values for Caucasian women (Hall, 1979; Gibson & Kneebone, 1981; Bitman *et al.* 1983; Harzer *et al.* 1983). Long-chain derivatives of linoleic acid are higher in the Zimbabwean women, however, a finding of particular interest in view of the previous report of similarly high proportions of long-chain polyunsaturates in the plasma phospholipid fraction of healthy Zimbabwean blood donors (Wright, 1985*b*). This is evidence that their staple food, which consists of ground maize boiled with water and eaten two or three times daily, is an adequate source of essential fatty acids (Paul *et al.* 1979) since breast-milk fatty acid status reflects maternal diet (Mellies *et al.* 1979). The levels of α-linolenic acid probably reflect the presence of this fatty acid in the green vegetables usually eaten as an accompaniment to the staple ground maize porridge. Previous studies in African women have found slightly lower proportions of linoleic acid in breast milk, with values ranging from 1% in Tanzania (Mellies *et al.* 1979) to 10·7% on the Ivory Coast (Read *et al.* 1965). This may be a result of the less polyunsaturate-rich staple foods eaten in these areas.

It seems unlikely that the high levels of linoleate found in the breast milk of mothers with atopic children in the present study can be explained on the basis of an increased intake of linoleic acid. While it may be argued that women with dry skin might maximize their intake of polyunsaturates, none of the women in the present study had dry skin, and there were no significant differences in breast-milk fatty acid composition between those mothers with a definite personal history of eczema and those mothers whose children had eczema. Furthermore, the decreased levels of dihomo-γ-linolenic acid found in these mothers' breast milk is not consistent with increased dietary intake of linoleate, nor is there any difference in the total derived fatty acids between the groups.

The pathways of metabolism of the essential fatty acids are illustrated in Fig. 1. The breast-milk fatty acid status of this group of mothers with atopic children is similar to previously reported values in plasma and leucocytes and lends support to the hypothesis that atopic subjects have a defect in the conversion of linoleic acid to its long-chain polyunsaturated metabolites. The increase in the ratio of linoleic acid to its long-chain polyunsaturated metabolites from the experimental group to the group of control mothers supports this conclusion. Perhaps more intriguing is the finding that cord blood from newborn infants at risk of developing atopic eczema also shares the abnormal fatty acid profile that we have found in breast milk from their mothers (Strannegard *et al.* 1987).

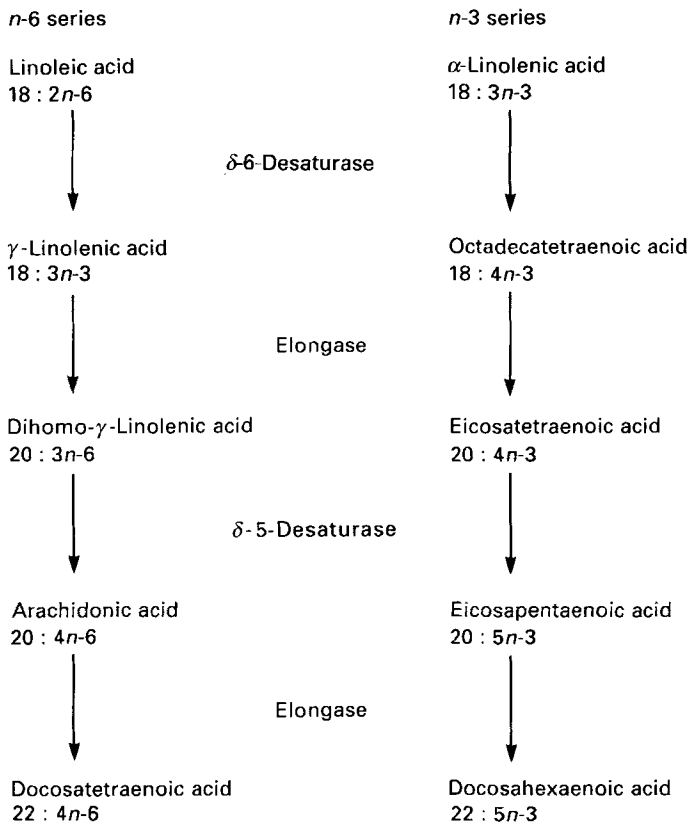

Fig. 1. Pathways of metabolism of the *n*-6 and *n*-3 series of fatty acids.

Correction of this deficiency by the administration of oil of evening primrose (*Oenothera biennis*) is accompanied by clinical improvement (Wright & Burton, 1982; Meigel *et al.* 1987; Biagi *et al.* 1988; Morse *et al.* 1989). Our finding of differences between the essential fatty acid content of breast milk from mothers of atopic children and that of 'normal' mothers also introduces a new element into the discussion of the potential protective effect of breast-feeding in atopic eczema, since the essential fatty acid composition of infant erythrocytes and plasma closely reflects maternal diet (Sanders & Naismith, 1979). Breast milk from 'normal' mothers would be expected to delay the onset of the clinical manifestations of atopic eczema by providing the infant with sufficient long-chain derivatives of linoleic acid to overcome the effects of deficient conversion of linoleic acid. Breast milk from mothers with atopic eczema themselves would be unable to exert this protective effect because it shares the abnormal fatty acid profile of the affected infant.

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