

Levels of Na, K, Ca and Mg in Infant Formulae and in Corn-Flour Infant Feeds

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ABSTRACT

Eight different brands of popular infant formulae and two corn-flour infant feed varieties commonly consumed in Nigeria were analysed for sodium, potassium, calcium and magnesium using the SP-9 atomic absorption spectrophotometer.

Results obtained showed that high amounts of sodium, potassium and calcium (Na, 1.8-3.5, K, 4.1-7.5 and Ca, 1.2-6.0 mg g⁻¹ formula, respectively) and low amounts of magnesium (Mg, 0.5-0.9 mg g⁻¹ formula) are present in the infant formulae. The corn-flour types have considerably lower amounts of these mineral elements (Na, 0.3-0.4, K, 0.3-0.5, Ca, 0.2, and Mg, 0.2-0.3 mg g⁻¹ flour, respectively).

INTRODUCTION

Infant formulae have become culturally acceptable as part of the diet (Dark, 1976). In some developing countries of the world, however, most poor people who cannot afford the high cost of infant formulae have resorted to the use of corn-flour types as substitutes. This is because the corn-flour types are cheap and readily available.

In recent times there has been considerable interest in the levels of trace elements in baby foods possibly because of the deleterious effects on health caused by contamination of foods by trace amounts of toxic metals and also to ascertain the beneficial and nutritional requirements of those elements known to be essential.

Most commercially-available formulae contain Na, K, Ca and Mg in the ranges 0.3–10 mg g⁻¹ formula. The importance of these elements in human nutrition has long been recognised. Sodium and potassium are principal cations of extracellular and intracellular fluids, respectively. Sodium functions mainly to maintain the osmotic pressure of body fluids, potassium exerts an important effect in muscular contractability, calcium is principally combined with magnesium and phosphorus in the body in the complex formation of bone while magnesium is also vital in cell carbohydrate metabolism (Krehl, 1975; Harper, 1975). Deficiency or over-supply of these elements may result in diseases. For instance, while excess of sodium ions in foods has been linked with raised blood pressure, potassium deficiency is related to heart muscle degeneration, and cellular edema (Taitz, 1977; Bosco, 1980; Marshal, 1983). Due to the known relationship between trace elements in foods and disease, this study was carried out to determine the levels of sodium, potassium, calcium and magnesium in infant formulae and corn-flour infant feeds. This study is necessary to assess the suitability of the latter as substitutes for formula foods as is the current practice in some developing countries like Nigeria. Such a study has rarely been reported in the literature.

MATERIALS AND METHODS

Materials

Eight different brands of infant formulae were bought in supermarkets in Nigeria for the analysis. The corn-flour feeds were produced locally from two corn varieties (maize and millet, respectively) by the traditional wet-milling process which is still the commercial practice of corn-flour manufacture in Nigeria. The flours were dried thoroughly to obtain the powder forms which are of the same texture as the infant formulae. All samples were kept in a clean, cool and dry place until analysis.

Methods

About 2 g sample aliquots from each formula and the corn-flours were accurately weighed into clean dry silica crucibles and redried at 104°C in an oven followed by dry ashing in a muffle furnace at 450°C for 16 h. The

residual white ash was dissolved in about 2–5 cm³ concentrated nitric acid. This was transferred quantitatively into a 250 cm³ volumetric flask, 5% lanthanum solution was added and the solution was made to the mark with distilled water. Subsequent steps for the atomic absorption measurements were done using the standard addition procedures whereby the sample solution in the 250 cm³ volumetric flask was divided into five equal parts, each part in a separate 250 cm³ volumetric flask. To all but one were added varying amounts of standard sodium, potassium, calcium and magnesium from stock standard solutions of these elements and all were then made up to the mark with distilled water. Absorptions were taken on the SP-9 atomic absorption spectrophotometer using appropriate hollow cathode lamps.

Recovery experiments were carried out to determine the efficiency of the method by spiking an SMA milk sample of known amounts of sodium, potassium, calcium and magnesium with known amounts of these elements and then redetermining these elements following the above procedure.

RESULTS AND DISCUSSION

Based on three replicate addition experiments using standard analyte mineral elements and infant formula as control, the percentage recoveries obtained for the elements are Na, $98 \pm 1.4\%$, K, $96 \pm 2.7\%$, Ca, $98 \pm 2.9\%$ and Mg, $103 \pm 5.8\%$, respectively.

Survey results and the manufacturers' levels for the composition of Na, K, Ca and Mg in the formulae are given in Table 1. Survey results for the

TABLE 1
Na, K, Ca and Mg Contents in Infant Formulae: Comparison of Survey Results with Manufacturers' Levels (mg constituent/g formula)

<i>Brand</i>	<i>Survey result</i>				<i>Manufacturers' level</i>			
	<i>Na</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>	<i>Na</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
Isomil	2.9	5.7	5.7	0.7	2.3	5.4	5.3	0.4
Cow & Gate	3.5	7.5	6.0	0.7	2.0	7.4	5.3	0.5
Nan	2.5	4.2	4.1	0.9	1.3	5.7	4.0	0.4
My Boy	3.1	4.1	4.8	0.6	2.4	7.7	7.5	0.6
SMA	3.2	5.8	1.2	0.6	2.0	7.4	5.6	0.4
Similac	3.0	7.2	4.0	0.5	1.8	6.1	4.2	0.3
Frisolac	1.8	4.3	3.0	0.7	1.1	4.2	3.5	0.4
Dialac	2.3	6.2	6.0	0.7	1.9	6.2	6.0	0.5
Overall mean	2.8	5.6	4.4	0.7	1.8	6.3	5.2	0.4
Standard deviation	0.6	1.3	1.7	0.1	0.4	1.2	1.3	0.1

composition of the same minerals in corn-flour feeds are presented in Table 2. The survey results were in reasonable agreement with the levels given by the manufacturers for all formulae. The results also indicate that the formulae are good sources of sodium, potassium and calcium (Na, 1.8–3.5, K, 4.1–7.5 and Ca, 1.2–6.0 mg g⁻¹ formula, respectively) and poor sources of magnesium (0.5–0.9 mg g⁻¹ formula). Similar analyte element constituents are present in both infant formulae and the corn-flour infant feeds but the values of the elements are much lower in the latter (Na, 0.3–0.4, K, 0.3–0.5, Ca, 0.2 and Mg, 0.2–0.3 mg g⁻¹ flour, respectively).

TABLE 2
Na, K, Ca and Mg Contents of Corn-Flour Infant Feeds
(mg constituent/g flour)

<i>Brand</i>	<i>Na</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
Millet flour	0.4	0.5	0.2	0.3
Corn flour	0.3	0.3	0.2	0.2
Overall mean	0.4	0.4	0.2	0.2

The Recommended Daily dietary Allowances (RDA) (USA) for calcium is 360 mg for infants while the RDA for magnesium is 50 mg for infants (Food and Nutrition Board, 1980). No RDAs are established for sodium and potassium but authorities have recommended that potassium intake should equal sodium intake to counteract the effect of sodium in raising blood pressure and the National Research Council has suggested a daily intake from 1.87–5.6 g (UK recommended values) as 'safe and adequate' (Bosco, 1980; Food and Nutrition Board, 1980). The determined levels seem to lie within the recommended guidelines for the infant formulae. This does not hold for the corn-flour feeds as their elemental contents are very low which seems to make them deficient. The corn-flour infant feeds, therefore, are not good substitutes for the infant formulae.

CONCLUSION

This study has shown that infant formulae contain high amounts of sodium, potassium and calcium and relatively low amounts of magnesium which would meet dietary requirements in babies.

It has equally been demonstrated that the corn-flour feeds are deficient in the analyte mineral elements and are therefore not good substitutes for infant formulae.

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