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Technical Note

Chemical Estimation of Some Inorganic Elements in Selected Tropical Fruits and Vegetables

ABSTRACT

The levels of four macroelements—calcium, magnesium, potassium and sodium—and four microelements—copper, iron, manganese and zinc—were determined by atomic absorption spectrophotometry or flame photometry in the edible portions of a variety of raw fruits and vegetables; namely, banana, plantain, African pear, lime, orange, cucumber, cabbage, okra, onion, pepper, pumpkin leaf, tomato and waterleaf. The vegetables, especially the green leafy ones, were found to contain the highest levels of most of the elements, with few exceptions.

INTRODUCTION

The literature already contains a fair amount of information on the levels of some of the inorganic elements found in green leafy vegetables and fruits. Various reports are available on the calcium (Leung, 1968; Oyenuga, 1968; Munro & Bassir, 1969), phosphorus (Leung, 1968; Oyenuga, 1968; Chakraborty & Eka, 1978) and iron (Leung, 1968; Oyenuga, 1968) content of foodstuffs. However, there appears to be rather limited data on most of the other elements. The failure of most investigators to focus much attention on such elements may be due to the belief that the ordinary diet is not apt to be deficient in these elements. The recent report by Atinmo *et al.* (1986), however, suggests that such a belief may be mistaken because inadequate intake of mineral elements has been observed to be a major nutritional

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TABLE 1
Levels of Some Inorganic Elements in Selected Fruits and Vegetables (mg element per 100 g dry matter)

	Dry matter (%)	*Calcium*	*Magnesium*	*Potassium*	*Sodium*	*Copper*	*Iron*	*Manganese*	*Zinc*
Fruits[a]									
Banana (ripe, firm) (10) *Musa sapientum*	23·0	7·4 ± 0·6[b]	86·5 ± 1·2	1 472 ± 29	54·2 ± 2·0	2·74 ± 0·65	5·8 ± 1·0	1·51 ± 0·11	2·76 ± 0·08
Plantain (ripe, firm) (7) *Musa parasidiaca*	34·6	33·5 ± 2·9	37·0 ± 0·5	1 914 ± 22	48·4 ± 3·5	0·87 ± 0·38	11·5 ± 3·8	Trace	0·89 ± 0·11
African pear (mature) (5) *Pachylobus edulis*	41·0	47·1 ± 2·6	118·0 ± 9·7	777 ± 26	69·3 ± 3·8	0·99 ± 0·59	4·8 ± 0·8	1·95 ± 0·17	3·06 ± 0·06
Lime (ripe, peeled) (4) *Citrus aurantifolia*	10·5	11·3 ± 0·9	14·1 ± 0·2	239 ± 8	9·8 ± 0·3	0·18 ± 0·07	2·1 ± 0·0	0·40 ± 0·09	Trace
Orange (ripe, peeled) (4) *Citrus sinensis*	12·0	16·1 ± 0·7	7·7 ± 0·1	153 ± 2	25·0 ± 0·9	Trace	4·9 ± 0·2	0·76 ± 0·33	2·47 ± 0·15
Cucumber (green) (5) *Cucumis satirus*	5·0	55·1 ± 1·7	10·7 ± 0·2	142 ± 5	59·1 ± 4·7	1·92 ± 0·70	9·0 ± 1·1	0·64 ± 0·15	5·46 ± 1·70

Vegetables[a]									
Cabbage (Fresh) (3) *Brassica oleracea*	8·6	2·4 ± 0·2	102·9 ± 1·4	1 177 ± 37	173·3 ± 10·5	Trace	13·2 ± 0·4	4·35 ± 0·41	7·66 ± 0·61
Okra (green, immature) (10) *Hibiscus esculenta*	31·5	395·0 ± 15·5	305·5 ± 25·3	—[c]	—	3·67 ± 0·50	7·3 ± 0·4	3·00 ± 0·21	76·1 ± 8·3
Onion (bulb, mature) (7) *Allium cepa*	12·0	101·1 ± 14·7	127·0 ± 8·3	146 ± 2	62·4 ± 6·6	1·62 ± 0·49	1·6 ± 0·49	3·62 ± 0·39	7·98 ± 0·88
Pepper (red, hot) (7) *Capsicum frutescens*	70·5	60·0 ± 2·8	140·3 ± 1·9	3 644 ± 34	68·8 ± 5·9	1·44 ± 0·13	1·4 ± 0·13	0·86 ± 0·16	3·94 ± 0·02
Pumpkin (leaf, green) (10) *Curcuribita pepo*	10·8	77·5 ± 3·8	166·3 ± 3·4	3 750 ± 44	87·4 ± 7·1	1·40 ± 0·12	6·0 ± 0·7	6·93 ± 0·25	5·01 ± 0·20
Tomato (ripe, firm) (5) *Lycopersicum solanum*	25·0	64·6 ± 4·2	8·2 ± 0·4	220 ± 5	20·7 ± 3·5	0·41 ± 0·03	9·4 ± 0·8	0·90 ± 0·72	2·57 ± 0·11
Waterleaf (green) (7) *Talinum triangulare*	3·3	880·5 ± 29·1	321·5 ± 15·7	3 166 ± 34	183·5 ± 18·0	3·31 ± 0·29	26·4 ± 5·1	5·62 ± 0·90	28·93 ± 5·1

[a] Figures in parentheses indicate the number of examples of items analysed.
[b] Each value represents mean ± standard error of the mean.
[c] — = not determined.

problem in our environment. The present report is aimed at updating and supplementing existing data with respect to the inorganic constituents of fruits and vegetables which are commonly consumed.

MATERIALS AND METHODS

Materials

Three to ten examples of each sample were purchased from markets in eastern and northern Nigeria. The banana, plantain, lime and orange samples were peeled, the nuts of African pear removed, and the leaves of pumpkin and waterleaf picked to obtain the edible portion in each case. Each sample was subsequently chopped or sliced, weighed and dried to constant weight at 60°C before milling into a fine powder for analysis.

Methods

The wet digestion method of the AOAC (1975), followed by atomic absorption spectrophotometry, was used to determine the levels of the various elements, with the exception of sodium and potassium which were determined by flame photometry.

RESULTS AND DISCUSSION

The results of the mineral determination in six fruits and seven vegetables are shown in Table 1. A comparison of the calcium levels found in this work with those reported by Leung (1968), and Munro and Bassir (1969), reveals a lack of agreement in the three sources of data. In general, the present values occupy an intermediate position between those found in the other two reports. The relatively high calcium in okra is confirmed by the value reported by Munro and Bassir (1969), but Leung (1968) found a smaller value for waterleaf than that in this report.

The values of magnesium ranged from 7·7 (in orange) to 321 mg/100 g DM (in waterleaf). The values found in the fruits appear relatively low when compared with those in the vegetables, with the exception of African pear and tomato. Data on the magnesium content of foodstuffs appear to be missing or limited in the literature.

The levels of potassium in the fruits were found to agree with those reported previously (Davidson *et al.*, 1975). The vegetables, however, mostly had higher values than those in the latter report, but lower compared with

the values reported by Smith (1983). Higher than normal levels of sodium were found in cabbage and waterleaf (Table 1) compared with the values reported by Smith (1983) and Davidson *et al.* (1975).

Little information was found in the literature concerning the copper levels in foodstuffs in general. Underwood (1977) reported ranges of 0·4–0·8, and 1·5–3·0 mg/100 g in grains and leguminous oilseeds, respectively. The values in the present report thus supplement the existing data on copper. The values of iron appear generally higher than normal when compared with the data of Leung (1968) and Oyenuga (1968), although they generally fall within the range of values reported by Davidson *et al.* (1975).

Limited data were found in the literature on the manganese levels in foodstuffs. The values reported here show that the vegetables, excepting pepper, contain markedly higher levels of manganese than the fruits. Although the level normally found in individual items is not known, the values found here appear to fall within the mean of 2·0–2·3 mg/100 g fresh weight reported previously in vegetables (Davidson *et al.*, 1975). Fresh fruits and leafy vegetables have been reported to be relatively poor sources of zinc (Underwood, 1977). The levels of zinc reported here appear to be confirmed by the latter report, especially with respect to the fruits. Among the vegetables, however, okra and waterleaf appear to be exceptions because they contain relatively high levels of zinc (Table 1).

The present results update and supplement existing data on the mineral composition of fruits and vegetables.

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