

Table
Computed Percentages of Metal Ions Complexed by EDTA.
Temp. 20°C, pH 5.2, EDTA the only variable

EDTA/Fe Ratio:	1.0	1.05	1.10	1.15	1.20
Ca	0	0	0	0.1	0.2
Cu	53.8	100	100	100	100
Fe	99.5	100	100	100	100
Mg	0	0	0	0	0
Mn	0	21.6	53.4	73.2	83.1
Zn	0.8	99.3	99.8	100	100

EDTA only binds Fe, when FeNaEDTA salt is used, is invalid. Statistical analyses show that increasing EDTA results in decreased Fe and P uptakes but enhanced Cu and Mn uptakes. Al, Ca, Mg, Na, K, Mo and Zn levels were not affected neither were the plant growths. Both complexation and mutual metal ion interactions are seen to influence the metal uptakes. Further work is proceeding.

ACKNOWLEDGEMENTS

This work is supported by the Agricultural Research Council, U.K.

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PS7.4 — MO

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VARIATION OF METAL CONCENTRATIONS IN DIFFERENT PARTS OF SUGARCANE

The average concentrations and the relative standard deviations for K, Ca, Mg, Mn, Cu, Fe and Zn in different parts of 10 samples of sugarcane were obtained. The relative standard deviations ranged from 12 to 87%.

The low productivity of sugarcane crops in the Northeast of Brazil is attributed to deficiency of nutrients, including some metals, in the soil. Knowledge about the absorption of nutrients by a plant would be useful for an efficient soil correction. It is also important to verify the antagonistic effects of these elements, since the excess of one can imply in the deficiency of the other. Some metals also play an important role in the fermentation of molasses in the production of ethanol.

Several authors have studied metals in sugarcane: ORLANDO *et al.* [1,2] studied the influence of age and soil and HUMBERT [3] the effect of variety. A review on the subject was done by MALAVOLTA *et al.* [4]. CAMPOS and CURTIUS [5] studied the distribution of metals in different internodes of three varieties of sugarcane. They found that generally, the upper internodes are enriched in metals, and that different samples of a same variety, showed, for the same internode and metal, very different

concentrations. In the present work a more complete study of this variation was done.

Ten sugarcane plants of the variety CB 45-3 grown in the same soil and with the same age, 15 months, were collected. Individual parts were prepared and analysed. After cleaning, the plants were cut with a plastic knife, dried, and ashed at 500-550°C. The ashes were dissolved in an acid solution. After filtering, the K was determined by flame photometry, and the other metals by atomic absorption spectrophotometry. Experimental details are given elsewhere [5].

In this work, leaf 1 is the farthest from the root, that, at the basis makes an angle different from zero with the stem. Internode 1 is just below leaf 1. The number of internodes increases from the top of the plant to the root.

The results are shown in Table 1.

were found for K which also is the major element among those studied.

When studying plants, it is necessary to be aware that such strong individuality is common. Therefore, it is difficult to interpret the variations of metal concentrations in terms of the effects of climate, soil, variety, etc. The possibility of using an element as an internal standard should be considered.

The authors have also applied these findings to the study of metal distribution in sugarcane of different ages grown in soils enriched in Zn or in K.

ACKNOWLEDGEMENTS

The authors are thankful to FINEP and CNPq for financing this project.

Table 1

Average concentration (in ppm, dry material) standard deviation and relative standard deviation (in %) for sugarcane parts (10 plants)

		K	Ca	Mg	Mn	Cu	Fe	Zn
Leaf 1	\bar{x}	9200	5190	2230	220	3,7	73	75
	s	5140	2300	953	27	0,8	13	34
	RSD	56	44	43	12	22	17	45
Internode 1	\bar{x}	3850	1430	1330	93	5,9	42	55
	s	2720	800	520	32	1,6	8	17
	RSD	71	56	40	35	28	19	31
Internode 5	\bar{x}	4500	1020	850	80	3,8	32	42
	s	3710	430	450	43	1,2	8	36
	RSD	82	42	53	56	32	24	84
Internode 7	\bar{x}	2860	720	830	68	2,6	27	32
	s	2490	360	290	31	1,1	7	15
	RSD	87	50	35	46	43	24	47

In all the plants studied, leaf 1 was enriched in K, Ca, Mg and Mn in comparison with the internodes. Generally the average metal concentration decreases from internode 1 to internode 7, being about the double in the upper internode. These results are in agreement with those of Campos and Curtius [5] who studied plants grown in a different soil.

The relative standard deviations are very high, ranging from 12 to 87%. Except for Zn in internode 5, the higher relative standard deviations

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PS7.5 — TU

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TRACE ELEMENTS IN FOOD: EFFECTS OF DIGESTIVE ENZYMES ON SOLUBILITY

Treatment of food with digestive enzymes can have a marked effect on the solubility of trace elements such as Cu, Zn, Fe, Pb and Cd. In some cases the change in solubility indicates enzymic release of the trace element from a previously insoluble form but in other cases solubility decreases. This may indicate enzymic breakdown of a soluble complex to release the element in a «free» state which then forms an insoluble species; alternatively it may indicate the enzymic release of a chelating agent which forms an insoluble complex with a trace element which was previously in a soluble form.

A range of foods (bread, crab, beef, liver, green vegetables) have been examined and show these effects in varying degrees which reflect compositional (and processing) differences between the foods. Changes which occur when foods are enzyme-digested together, rather than separately, can be attributed to analogous processes.

The possibility of extending this information through chromatographic separation of the soluble species has been explored in studies of the cadmium species in canned crab; these indicate release of enzymes of a Cd species with an apparent molecular weight around 500 dalton. Further extension of the work through interfacing chromatography with an ICP-MS (VG «plasmaquad») is in progress.



PS7.6 — TH

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ANALYTICAL DETERMINATION OF METALS IN BIOLOGICAL AND ENVIRONMENTAL SAMPLES

For the determination of trace elements in various samples there are a lot of analytical methods which are described in the literature. The application of the optimal method depends on different properties of the sample:

- 1) element to be determined
- 2) concentration range of this element
- 3) composition of the sample (matrix, interference)
- 4) amount of the sample
- 5) phase in which the sample is available.

Instrumental neutron activation analysis and X-ray fluorescence analysis are the preferable methods for solid samples, whereas atomic absorption spectrometry, atomic emission spectrometry with an inductive-coupled plasma and electrochemical methods have to be applied to liquid samples.

Obviously solid samples can be transferred into the liquid phase by dissolution or by digestion and trace elements in liquid samples can be concentrated in a solid phase by evaporation of the solvent or by separation at an ion exchanger or adsorbents.

For an optimal analysis first the right method has to be chosen and examples are summarized in the following part.

The water of the river Rhine has been analyzed by instrumental neutron activation analysis and by atomic absorption spectrometry because the con-