

MINERAL AND TRACE ELEMENT COMPOSITION OF MAIZE

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ABSTRACT

Grain samples of 14 maize varieties were analysed for mineral and trace element composition. Varietal differences were significant for calcium, iron, copper and molybdenum content. Among the three morphological components of the maize kernel, embryo was found to be rich in all the nutrients analysed and practically the entire phosphorus and magnesium of the maize kernel was localised in this component. Endosperm, though a poor source of most of the nutrients, contributed the highest proportion to the copper, molybdenum and iron content of the maize kernel.

WHILE there is considerable information on the protein, fat and vitamin content of maize the data on its trace element composition are scanty. In this communication, the mineral and trace element contents of some high yielding varieties of maize are presented. Maize germ is an important by-product of milling and is known to be a rich source of several nutrients¹. The distribution pattern of some inorganic nutrients in the morphological components of the maize kernel is therefore studied.

MATERIAL AND METHODS

Grain samples of 14 maize varieties grown under identical conditions during the 1976 winter season at the Amberpet Maize Research Station, Andhra Pradesh, were cleaned, washed with deionised water and dried in an oven at 100°C to constant weight. The dried grains were ground in a Wiley mill to pass through a 40 mesh sieve. The samples were dry ashed at 500°C to determine total mineral matter and molybdenum contents². For other elements, a 2 g sample was wet digested with a 4:1 mixture of nitric and perchloric acids. Calcium, phosphorus and iron were determined by AOAC methods³. Magnesium, manganese, copper, chromium and zinc were estimated by atomic absorption spectroscopy. Phytin phosphorus was estimated by the procedure described by Makover⁴.

Kernels of five maize varieties were quantitatively dissected into endosperm, embryo and pericarp. Each fraction was air dried and analysed for phosphorus, magnesium, iron, zinc, manganese and copper. Molybdenum was estimated in the endosperm fraction only.

RESULTS AND DISCUSSION

Composition of the whole kernel: Varietal differences were of significant magnitude (C.V. > 20%) only for calcium, iron, copper and molybdenum contents (Table I). The values for total ash, phosphorus, phytin phosphorus, iron and manganese contents were

comparable to those reported by others⁵⁻⁹. Correlations between pairs of nutrients analysed were not statistically significant.

TABLE I

*Mineral and trace element composition of Maize**

Total ash	g%	1.46 ± 0.005
Total phosphorus	mg/100 g	329 ± 6
Phytin-P	% of total phosphorus	79.3 ± 1.3
Magnesium	mg/100 g	139 ± 4
Calcium	mg/100 g	7.6 ± 0.6
Iron	mg/100 g	2.26 ± 0.34
Zinc	µg/g	27.7 ± 1
Manganese	µg/g	4.78 ± 0.23
Copper	µg/g	4.10 ± 0.53
Molybdenum	µg/g	0.375 ± 0.064
Chromium	µg/g	0.044 ± 0.004

* Values are Mean ± SE for 14 varieties.

Composition of endosperm, embryo and pericarp: The embryo was found to be far richer than the endosperm and pericarp with respect to all the nutrients (Table II) and the data compared well with those reported by Elias and Bressani¹⁰ and O'dell *et al.*⁸. The exceptionally high phosphorus, magnesium and zinc content in embryo noted in this study and earlier by Garcia *et al.*¹¹ are noteworthy. Values for iron, copper and manganese contents as obtained by us are nearly half of those reported by these workers.

Distribution pattern in the kernel: The endosperm constituted 81 to 86%, embryo 7.6 to 13.2% and pericarp 5.6 to 7.0% of the kernel. The distribution of many of the nutrients was highest in the embryo although the endosperm also contributed a fair propor-

TABLE II
Concentration and relative distribution of some inorganic nutrients in endosperm, embryo and pericarp of maize kernel¹

	Phosphorus	Magnesium	Iron	Zinc	Manganese	Copper	Molybdenum
	mg per 100 g			µg per g			
Endosperm:							
Concentration	59±8.0	1.49±0.11	1.35±0.13	10.0±1.8	1.67±0.32	1.99±0.37	0.189±0.035
% Distribution	14.5±2.5	0.9 ±0.1	45.8 ±1.3	29.4±5.4	26.6 ±1.9	60.0 ±4.2	51.1±4.5
Embryo:							
Concentration	2610±221	1087±114	8.61±1.28	158±14	26.5 ±2.9	6.97±0.34	
% Distribution	83.7±2.5	92.1 ±0.7	37.8 ±1.6	61.6±3.4	55.1 ±1.8	29.1 ±4.0	
Pericarp:							
Concentration	120±2	133±6	6.0 ±0.3	21.1±1.9	13.5 ±1.5	4.65±0.51	
% Distribution	2.1±0.2	6.8±0.7	16.4 ±1.9	4.9±0.7	17.9 ±0.5	10.5 ±0.4	

¹ Mean ± SE of five maize varieties.

tion in respect of copper, molybdenum and iron. The contribution of the pericarp to the total nutrient content of the kernel was negligible except for manganese and iron.

About 84% of grain phosphorus and 92% of magnesium were found to be concentrated in the embryo fraction, which by weight formed only 10% of the kernel. Zinc and manganese also resided predominantly in the embryo (*af. Garcia et al.*¹²). From the nutritional point of view, the embryo fraction of the maize kernel is a rich source of minerals and trace elements. However, its very high content of phytin phosphorus may affect adversely the availability of minerals. This warrants further study.

ACKNOWLEDGEMENTS

The author is grateful to Dr. S. G. Srikantia, Director, and Dr. Bhavani Belavady, Deputy Director, for the keen interest and helpful suggestions and to Mr. Kishan Narayan, Maize Breeder, Amberpet Maize Research Station, Hyderabad, for supplying the maize varieties.

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