

Elevated Levels of Cerium in Tubers from Regions Endemic for Endomyocardial Fibrosis (EMF)

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The soil in Karunagapally region of Kerala (South India) is rich in monazite elements. Beach sand of Chavara, a small town in the same region, has minable deposits of these elements. In this region, the incidence of endomyocardial fibrosis is reported to be higher compared to other regions of Kerala (Kutty et al. 1996). Studies have shown elevated levels of cerium, the most biologically active lanthanide present in monazite, in the cardiac tissue (Valiathan et al. 1989) and serum (Eapen et al., in press) of patients with endomyocardial fibrosis (EMF), when compared with control subjects without EMF. It was proposed that elevated levels of cerium, in conjunction with magnesium deficiency, cause endomyocardial fibrosis in the tropics (Valiathan et al. 1989). Patients generally belong to low-socioeconomic group and their staple diet includes tubers, a cheap source of energy. To investigate the possibility that cerium is ingested through consumption of tubers, a study was conducted to find out levels of cerium in the tubers cultivated in this region.

MATERIALS AND METHODS

Vegetables, especially tubers, grown in Karunagapally region were identified, collected, cleaned and the edible portions were separated. Similarly, tubers cultivated in Trivandrum district, where no reported monazite deposits are present, were collected. All samples were processed at Trivandrum before transporting it to Bhabha Atomic Research Centre, Bombay for neutron activation analysis. Samples were weighed, dried to constant weight and powdered. A portion of the powdered material was weighed, packed in clean aluminium foil and irradiated along with 100 ng of cerium standard in a neutron flux of 100 billion neutrons/cm/s in the Cirus Reactor for 7days. For quality assurance of the analysis, 200 mg of orchard leaves powder (NBS 1577) was packed in clean aluminium foil and irradiated along with the samples and standard. After the irradiation, they

were cooled for 7 days to allow for the decay of short lived isotopes formed during irradiation. Irradiation converts Ce to its isotope and emits main gamma energy of 241 keV. After irradiation the samples were digested with nitric acid and the isotope of interest was separated by co-precipitation with barium sulphate. The precipitate was counted on a 54 ml intrinsic germanium detector.

RESULTS AND DISCUSSION

Table 1 shows levels of cerium present in the edible portions of tubers grown in Chavara and Trivandrum regions. The levels of cerium are significantly elevated in tubers grown in Chavara region when compared with tubers grown in Trivandrum region.

Table 1. Concentration of cerium (Mean +/- SD) in tubers grown in Chavara and Trivandrum regions.

Tubers	Concentration of cerium (ng/g dry wt)	
	Chavara	Trivandrum
1. Taro (<i>Colocasia sp</i>)	*173.25 +/- 79 (4)	40.97 +/- 10.02 (3)
2. Yams (<i>Dioscorea sp</i>)	*467.25 +/- 134.83 (4)	32.78 +/- 13.52 (3)
3. Elephant yam (<i>Amorphophallus sp</i>)	#196.00 +/- 91.80 (3)	41.57 +/- 28.91 (3)
4. Tapioca (<i>Manihot sp</i>)	*466.75 +/- 169.04 (4)	78.70 +/- 19.74 (3)

p<0.05, * p<0.01

Figures in parenthesis denotes number (n).

There is increasing interest in rare earth elements like cerium as they find wide application in modern industry (Evans 1990). Moreover, a role for cerium has been attributed in the causation of tropical endomyocardial fibrosis and recent studies carried out in this laboratory have furnished evidences of increased cerium accumulation under magnesium deficiency (Eapen et al. 1996) and endomyocardial fibrosis in rats administered cerium (Kumar et al. 1996). In monazite soil, the levels of lanthanides like cerium are higher compared to soils in other regions. Generally the elements present in monazite are insoluble in water and hence are not bioavailable. Therefore, the question arises as to whether cerium would get concentrated in tubers, a point

of obvious relevance to its biological effects.

Results in this communication show that plants, in this region, accumulate cerium (Table 1). In fact our earlier studies had shown increased levels of lanthanides in root (wilt) disease-affected coconut palms, the disease rampant in this area (Valiathan et al. 1992, Eapen 1993). It is believed that under certain conditions, cerium may leach into the groundwater and become bioavailable if the soil is acidic, as in Kerala. This may partly explain the observation of elevated levels of cerium in plants in this region. However, a detailed lysimetric study of monazite soil in this region is warranted.

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REFERENCES

- Eapen JT (1993) Coconut root (wilt) disease - an update. Indian Cocon J 24:3-10
- Eapen JT, Kartha CC, Rathinam K, Valiathan MS (1996) Levels of cerium in the tissues of rats fed a magnesium-restricted and cerium-adulterated diet. Bull Environ Contam Toxicol 56:178-182
- Eapen JT, Kartha C C, Valiathan MS Cerium levels are elevated in the serum of patients with endomyocardial fibrosis (EMF). Bull Trace Elem Res (in press)
- Evans CH (1990) Biochemistry of lanthanides. Plenum Press, New York
- Kumar BP, Shivakumar K, Kartha CC, Rathinam K (1996) Magnesium deficiency and cerium promote fibrogenesis in rat heart. Bull Environ Contam & Toxicol 57: 517-524
- Kutty Vr, Abraham S, Kartha CC (1996) Geochemical distribution of endomyocardial fibrosis in South Kerala. International Journal of Epidemiology 25:1202-1207
- Valiathan MS, Kartha CC, Eapen JT, Dang HS, Sunta CM (1989) A geochemical basis for endomyocardial fibrosis. Cardivasc Res 23:647-648
- Valiathan MS, Eapen JT, Mathews CK (1992) Reciprocal relationship between magnesium and cerium as a common basis for coconut root (wilt) and a human cardiomyopathy. Curr Sci 63: 565-567