

**CONTENTS AND DISTRIBUTION CHARACTERISTICS OF RARE EARTH
ELEMENTS IN *Solanum lycocarpum* FROM BELO HORIZONTE AND SERRA DO
CIPÓ, MINAS GERAIS (BRAZIL)**

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INTRODUCTION

Rare-earth elements (REE) in tropical plants are poorly studied, despite interests in both, tropical systems and in rare-earth elements and their influences on plants (Wang *et al.*, 1997), there is still little information referring to tropical species. In Brazil, Lima e Cunha *et al.* (1993) have studied the species *Solanum lycocarpum*, in the alkaline-ultramafic complex of Catalão I, Goiás. Ceccantini *et al.* (1997), investigated the concentration of REE in different plant species related to the soil and underground waters in the alkaline-ultramafic complex of Salitre, Minas Gerais. These complexes show a high concentration of REE in the soil.

To study the contents and distribution characteristics of REE in *Solanum lycocarpum*, a typical Brazilian "cerrado" plant, widely distributed in Brazil, the concentration of REE in plant leaves of this species, and in the soil they have grown at, was determined by Instrumental Neutron Activation Analysis (INAA). Two different tropical ecosystems were studied: the alkaline-ultramafic complex of Salitre, in the west of the State of Minas Gerais (Piorino-Maria *et al.*, 1997a), and in "Cerrado de Emas", Pirassununga, State of São Paulo (Piorino-Maria *et al.*, 1997b). As a continuation of this study, the concentration of REE in leaves of *Solanum lycocarpum* and in the host soil from Lagoa da Pampulha and Mangabeiras park, located in the urban region of Belo Horizonte, and from Serra do Cipó, situated at 100 km from Belo Horizonte, were determined by INAA. The results are discussed and a comparison of the data obtained for the different regions studied are presented.

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EXPERIMENTAL

Sampling and analytical procedures.

Leaves were collected to provide sufficient quantities of ash for analysis in INAA. Thus, 300 to 500g of fresh leaves (50-100g when dry) were collected. Leaves were taken from 5 - 10 individuals in each location.

Leaves were washed with abundant deionized water, dried (30°C), and homogenized in a blender. The homogenate was put into ceramic capsules, dried (105°C for 24 h), weighed and ashed in a electric oven at 450°C for 12 h. Soil samples were taken from the same area where the plant material was collected, sieved to remove impurities (rock fragments or leaves) and then homogenized for weighing and irradiation.

Elemental synthetic standards of the REE, biological and geological reference materials (Pine Needles and DR-N), and samples (plant or soil) were irradiated for 16 hours at a thermal neutron flux of $10^{12} \text{ n cm}^{-2} \text{ s}^{-1}$, at the IEA-R1 nuclear reactor of IPEN. Measurements of induced gamma-ray activity were carried out in a GMX hyperpure Ge detector CANBERRA (resolution of 1,90 keV for the 1332 keV gamma-ray of ^{60}Co). Precision and accuracy of the method were verified by the analysis of reference materials NIST 1575 Pine Needles and BCR-CRM 101 Spruce Needles (Machado *et al.*, 1998).

RESULTS AND DISCUSSION

REE levels at Lagoa da Pampulha (0.05 to 108 $\mu\text{g}\cdot\text{g}^{-1}$) were more variable and higher than at Mangabeira park (0.047 to 10 $\mu\text{g}\cdot\text{g}^{-1}$) and Serra do Cipó (0.12 to 46 $\mu\text{g}\cdot\text{g}^{-1}$). These results suggest different transfer factors of REE from soil to plant as the substratum changes. These differences were also observed in previous studies with this species (Lima e Cunha *et al.*, 1993; Piorino-Maria *et al.*, 1997a; Piorino-Maria *et al.*, 1997b). The transfer factors ranged from 0.61 to 5.02, much higher than the values reported in the literature (Markert & De Li, 1991). This could be explained by a greater availability for the plants of REE in the soil, probably due to chemical characteristics of the soil like availability of exchangeable bases or pH.

The chondrite-normalized patterns of REE in *Solanum lycocarpum* leaves and in the host soil for the studied regions are shown in Figures 1 to 3. Similar distributions patterns were obtained for the soil and the plant in all the studied sites, presenting an

enrichment of the light REE, indicating that they remain available to the plant in the more superficial soil layers, in contrast to the heavy REE, which are less absorbed. This behavior was also observed for this species in other regions (Lima e Cunha *et al.*, 1993; Piorino-Maria *et al.*, 1997a; Piorino-Maria *et al.*, 1997b).

The similarity between those distribution patterns indicates a typical REE absorption by this species, in spite of the significant differences in the substratum. Moreover, the fact that high concentrations of REE in the plant are related to the concentrations in the host soils is promising for the use of this species to ETR prospecting or even to evaluate the possible contamination of the environment by these elements.

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Tabela 1. REE concentration in *Solanum lycocarpum* plant leaves and average values in the soil, in different tropical ecosystems of Brazil ($\mu\text{g}\cdot\text{g}^{-1}$)

Element	Lagoa da Pampulha, Belo Horizonte, MG		Mangabeiras park, Belo Horizonte, MG		Serra do Cipó, MG	
	<i>Solanum lycocarpum</i>	Soil (0-3.2m)	<i>Solanum lycocarpum</i>	Soil (0-60cm)	<i>Solanum lycocarpum</i>	Soil (0-70cm)
La	107±31	24±11	5.3±0.9	7±2	18±6	12±7
Ce	108±21	123±52	10	13±5	46±11	47±27
Nd	58±9	16±6	4±1	6±1	13±5	14±9
Sm	8±2	2.8±0.9	0.6±0.1	1.2±0.3	2.1±0.8	2.3±0.3
Eu	1.8±0.6	0.8±0.4	0.14±0.02	0.27±0.07	0.5±0.2	0.66±0.07
Tb	0.3±0.1	0.23±0.09	0.081±0.009	0.116±0.001	0.3±0.1	0.37±0.04
Yb	0.4±0.2	0.5±0.1	0.25±0.06	0.43±0.09	0.7±0.4	1.32±0.05
Lu	0.05±0.01	0.09±0.03	0.047±0.008	0.07±0.02	0.12±0.08	0.3±0.1

Figures 1. Chondrite normalized patterns for *Solanum lycocarpum* and host soil from the three studied ecosystems

Figure 1a

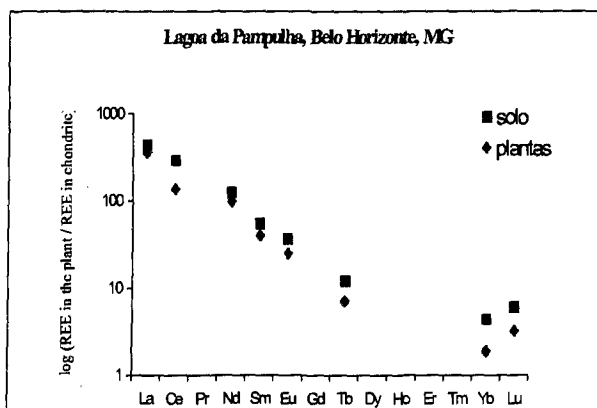


Figure 1b

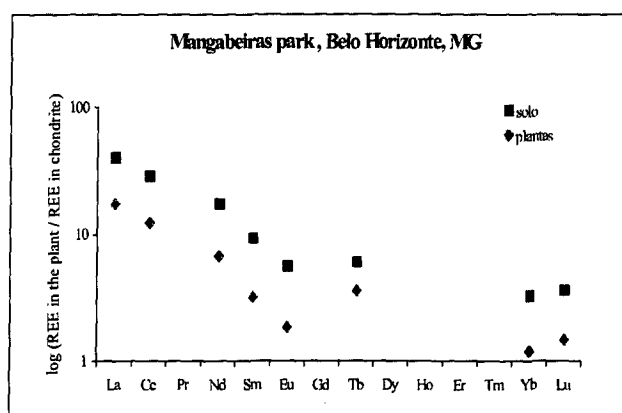
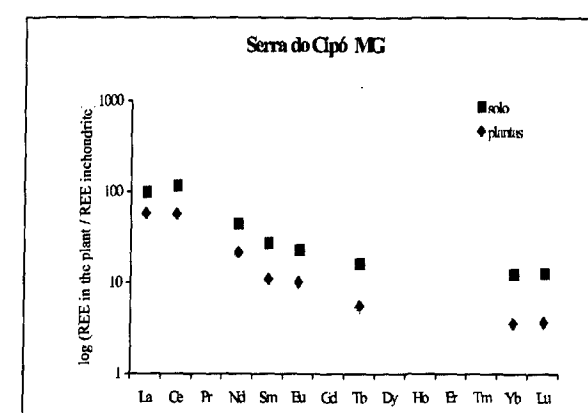


Figure 1c



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