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Investigation of inorganic elements in soil in the municipality of Barra do Corda using EDXRF technique

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1. Introduction

In the Northeast of Brazil meliponiculture is the economic activity that has grown mostly in recent years, for the low implementation and maintenance costs, as well as a quick financial return [1]. Meliponiculture is the creation of stingless bees (Meliponíneos) [2] for the production and sale of hives, honey, honeycomb, propolis, pollen and resins, in addition to these bees being the main agents of pollination and the conservation of local biodiversity. Native Meliponine bees mix resinous material from plants with wax, earth, saliva and pollen [3] consequently, their elemental composition is directly related to the local soil type [4, 5]. In the municipality of Barra do Corda, in the state of Maranhão (MA, Brazil), meliponiculture is an agricultural activity of great importance. Specifically the bee "*Scaptotrigona aff. Postiça*" [6], popularly known as "tubi", is the main source of local income due to the sale of its beekeeping inputs. Considering the growing interest of the scientific community and local rural producers in knowing the composition of these bee products, this study aims the multielemental characterization of soil (component of some beekeeping inputs) using the X-ray Fluorescence analytical technique.

2. Methodology

Samples were collected monthly for one year. Each sample was submitted to heating in an oven at 100ºC for a minimum period of 24 hours (in sterilized glass refractories with 92.8°GL ethanol). After that, the samples went through a granulation process and were weighed and stored in plastic containers duly identified. Samples were partitioned and compacted into tablets (~50 mg). The EDXRF measurements were performed using X-123 SDD X-ray spectrometer (from Amptek®) [7] with Ag X-ray tube [8]. The characteristics X-ray fluorescent intensity of the elements were measured with a Si detector (Si Drift 25 mm^2 x 500 μm, with Be window of 12.5 μm). The excitation was performed using 30 kV and 5 μA excitation for a counting time of 300s. The quantitative analysis was performed using WinQxas software [9].

3. Results and Discussion

To verify the variation in element contents measured in the soil over a period of one year, the results are shown in Table I. The results are expressed by: Mean Value (MV), Standard Deviation (±1SD), Minimum (min) and Maximum (max) values. The coefficient of variation (CV) is also included to evaluate the behavior of elements concentrations depending on the seasons.

Table I: Elements concentration in soil by EDXRF technique

Elements	**MV**	**±1 SD**	**Min**	**Max**	**CV,%**
Al, g/kg	119	18	71	140	0.11
Si, g/kg	161	47	24	208	0.08
P, g/kg	0.32	0.18	0.06	0.57	0.15
S, g/kg	0.19	0.10	0.08	0.39	0.06
K, g/kg	0.84	0.51	0.14	2.33	0.06
Ca, g/kg	1.01	0.78	0.03	2.74	0.04
Ti, g/kg	2.90	1.02	0.81	5.13	0.04
Mn, g/kg	0.48	0.15	0.26	0.84	0.04
Fe, g/kg	27	6	21	46	0.02
Zn, mg/kg	87	21	56	126	0.07
Rb, mg/kg	54	23	36	94	0.06
Sr. mg/kg	186	85	31	306	0.07
Cu. mg/kg	34	12	18	52	0.07
Y. mg/kg	3.11	0.60	2.30	4.40	0.18

Figs 1 and 2 represent. in percentage terms. the quantification of the soil according to the majority and traces elements.

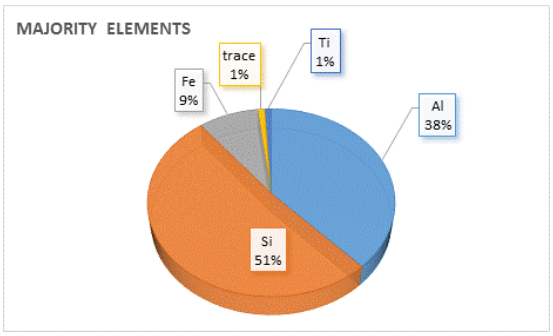

Figure 1: Composition of the soil as a function of majority elements

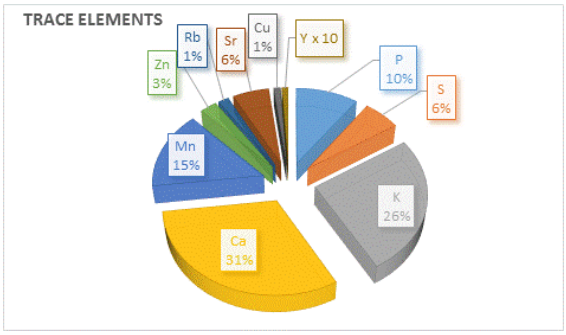

Figure 2: Composition of the soil as a function of trace elements

The soil has a high Si content (52%) and presents some metals such as Al and Fe in significant quantities (39% and 9%. respectively). The behavior of the concentrations of the elements investigated in the soil expressed by the coefficient of variation (CV). emphasizes that throughout the year the levels of the elements vary little (2% for Fe and 15% for P). Furthermore. according to this analysis. no toxic metals were identified in majority concentrations.

4. Conclusions

These data are the first qualitative and quantitative assessment of this soil and could serve as a model for the expansion of Meliponiculture in regions with healthy and similar soil. These results can be potentially useful for checking the quality control of bee products and even for use as an environmental monitor.

Acknowledgements

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