



Isotopes as tracers of the main environmental factors that contribute to the specificity of the green coffee bean

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World coffee production – approximately 70% arabica (*Coffea arabica*) and 30% robusta (*Coffea canephora*) – recently shows large annual fluctuations. The enormous variation in annual coffee output by the leading producer Brazil, as a result of recurring climatic calamities (frosts and droughts) has had a major impact on world coffee supply and market prices. Climate alterations influence coffee production with considerable impact at socioeconomic level, as coffee production may be related with sustainability and fair-trade projects. Moreover, in the last 10 years, a range of alternative coffee trade networks have emerged, focusing on notions of 'quality', 'place' and 'nature'. Several analytical techniques have been applied to determine the geographical origin of the green and roasted coffee beans. Preliminary studies indicate that mass spectrometry analytical techniques for multi-element and isotope ratio analysis are powerful tools for the discrimination of the geographical origin of coffee (Rodrigues, Mágua & Prohaska, 2010; Serra et al., 2005). These studies show that the elemental and isotopic composition of the coffee bean depends on where the coffee plant is grown.

The general aim of this work is to evaluate the relevance of multi-elemental composition along with carbon, nitrogen, oxygen, sulfur and strontium isotope ratios for the discrimination of the geographical origin of the green coffee bean. The results obtained were combined to define the best multi-element and multi-isotope approach for the differentiation of coffee producing regions/countries. Moreover, a case-study with coffees from Hawaii allowed to study in greater detail how different environmental factors (altitude, distance to the sea, volcanic activity) are reflected by the isotopic composition of the coffee bean and how this may help to determine its origin. Additionally, a scale-down study was performed, from the 'bulk' green coffee bean to a specific compound extracted from the bean, caffeine. Isotope ratio analysis of this important alkaloid indicates that the green coffee bean is a possible 'ecological proxy', for coffee plant water relations.

Key-words: isotopes, green coffee bean, caffeine, geographical origin, ecological proxy

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