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Identification of geographical origin using selected elements in tea produced in different tea regions of Sri Lanka

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Tea, derived from the leaves and buds of the shrub Camellia sinensis, is one of the world's most popular beverages owing to its unique flavour, aroma, and therapeutic properties. Due to the tendency for heavy metal accumulation in the plant, processed tea needs to be analyzed frequently to ensure its adherence to maximum limits in international standards. However, recent data is not available on the metal content in Ceylon tea. Ceylon Tea grown in certain geographical areas in Sri Lanka has also gained great popularity in the global tea market mainly due to its unique taste characteristics. As a result, identifying the geographical region of production for Ceylon tea is important to ensure its authenticity as well. Therefore, this preliminary investigation aimed to determine the content of twenty-seven elements and build a simple model that could be used to distinguish the geographical origin of Ceylon tea using processed tea leaves. Four samples each were selected from factories in all seven tea growing regions of Sri Lanka except from Nuwaraeliya (3 samples) and Kandy (2 samples) and analyzed using Microwave digestion and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Statistical evaluation was conducted with a one-way analysis of variance (ANOVA), Pearson's correlation, and cluster analysis with a dendrogram using Minitab 19 software package. A relatively high number of elements; Be, U, Ag, Ga, Tl, Li, Cs, Cd, As, and V were found within the range of 0.01-1.0 (mg/kg) and only Co, Pb, Ni, and Cr were in the range of 1.0 – 10.0 (mg/kg). Se, Sr, Ba, Rb, and Cu were in the range of 10.0 – 100.0 (mg/kg). Metals such as Zn, In, Fe, and Mn were detected in concentrations below 1000.0 mg/kg. And above 1000.0 mg/kg were the elements Al, Mg, Sn, and K. These results revealed that other than Pb, the content of all other metals was below the maximum limits recommended by the Sri Lanka Tea Board. Furthermore, in cluster analysis, Tl, In, Ga, Ag, Cs, and U mainly contributed to the variability across regions. Therefore, based on the limited number of samples analyzed, there is a possibility to use those six elements to identify the region of production. However, this needs further confirmation considering a greater number of samples and the heterogeneity of metal content in the soil in corresponding tea-growing regions to provide a broader understanding of the correlation between levels of the metals in tea leaves and its native soil.

Keywords: Camellia sinensis, Cluster analysis, Elements, Geographical origin, ICP-MS, Tea