ALTERNATIVE METHOD FOR THE ELEMENTAL CHARACTERIZATION OF FINE PARTICULATE MATTER (PM2.5) USING HANDHELD X-RAY FLUORESCENCE ON QUARTZ FILTERS: APPLICATIONS IN HEALTH RESEARCH

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INTRODUCTION: Air pollution is classified as carcinogenic by IARC due to its composition, where particulate matter carries Potentially Toxic Elements (PTEs). It is linked to cardiovascular and respiratory diseases, lung cancer, and causes around 7 million deaths per year, mainly from high exposure in low-income countries and vulnerable populations. **OBJECTIVES:** To evaluate the use of a handheld X-ray fluorescence (XRF) analyzer for the trace elemental analysis of PM2.5. **METHODS:** A methodological validation was conducted to enable the use of the Niton XL2 700S (Thermo Scientific) for trace element analysis in PM2.5, using reference materials and optimized analytical conditions. PM2.5 samples were collected from June-October 2024 with a high-volume air sampler (1.13 m³/min, 24 h) on a high-traffic avenue in São Paulo, using high-purity quartz filters (Whatman® QM-A). Elemental composition was assessed for 13 PTEs (Pb, Cd, Hg, Cu, Fe, Au, Ni, Se, Mo, Cs, Br, K, Cl) with 180-second measurements**. RESULTS:** Thirty samples were analyzed, and the technique proved to be feasible for the quantification of the elements Pb, Cd, Hg, Cu, Fe, Au, and Ni. The median for the concentration (ng/m^3), minimums, and maximums for each element were: 0.236 (0.005–4), 2.21 (0.25–4.38), 1 (0.0004–24.0), 0.620 (0.22–50.0), 29.27 (3.0–1100), 1.42 (0.13–34.0) and 0.685 (0.03–30.0) for Pb, Cd, Hg, Cu, Fe, Au and Ni, respectively. In the total mass of the PTEs, the filters showed 63.41 µg of PM2.5, representing a concentration of 66 ng/m³ and indicating a percentage between 0.023–0.485% in the composition of the PM. **CONCLUSION:** To the best of our knowledge, this is the first study to optimize a handheld X-Ray device for the determination of the elemental composition of particulate matter in quartz filters in Brazil. The method proved to be reliable, as well as cheaper and faster than conventional techniques such as ICP-MS. Given that cumulative exposures individuals experience throughout life add up over time, estimating the concentrations of these pollutants in the air - especially in large metropolitan areas like São Paulo—is essential for guiding public health policies that protect the populations.

KEY-WORDS: Particulate Matter; Alternative Method; Potentially Toxic Elements

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