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# Toxic metals in cigarettes and human health risk assessment associated with inhalation exposure

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## Abstract

This study evaluated the concentrations of cadmium (Cd), copper (Cu), iron (Fe), manganese (Mn), lead (Pb), and zinc (Zn) in 10 branded cigarettes commonly consumed in Nigeria. Chemical sequential extraction method and pseudo-total metal digestion procedure were used for extraction of metals from filler tobacco and filter samples. Samples were analyzed using flame atomic absorption spectrometry (FAAS). The filler tobacco of cigarettes had Cd, Cu, Fe, Mn, Pb, and Zn concentrations in the ranges of 5.90–7.94, 18.26–34.94, 192.61–3494.05, 44.67–297.69, 17.21–74.78, and 47.02–167.31 µg/cigarette, respectively. The minimum and maximum concentrations in the filter samples were 8.67–12.34 µg/g of Cd, 1.77–36.48 µg/g of Cu, 1.83–15.27 µg/g of Fe, 3.82–7.44 µg/g of Mn, 4.09–13.78 µg/g of Pb, and 30.07–46.70 µg/g of Zn. The results of this study showed that the concentrations of heavy metals in the filler tobacco samples were consistently higher than those obtained for the cigarette filters except for Cd. Toxic metals were largely found in the most labile chemical fractions. Moderate to very high risks are found associated with potential exposure to Cd and Pb. The carcinogenic risks posed by Cd and Pb ranged between 1.87E-02 and 2.52E-02, 1.05E-03 and 4.76E-03, respectively, while the non-carcinogenic risk estimates for Cd and Pb were greater than 1.0 (HI > 1). Toxic metals in cigarette may have significant carcinogenic and non-carcinogenic health effects associated with inhalation exposure. Continuous monitoring and regulations of the ingredients of imported and locally produced tobacco products are advocated.

## Keywords

Tobacco Cigarette brands Heavy metals Chemical fractionation Risk assessment  
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