

Human health risks to copper from urban and rural topsoils from East Midlands, England.

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Introduction: The purpose was to determine the distribution of copper (Cu) in topsoils from urban public parks across Leicester and its rural surroundings (Leicestershire, England).

Methods: A total of 850 topsoil samples were collected (2017-18). 26 composite samples were appropriately prepared after mixing samples collected per location (18 urban, 8 rural), which were further processed in duplicate. Cu was measured twice in each of the 52 composite samples by ICP-MS after acid/microwave digestion with nitric acid (69%)/chlorhydric acid (37%).

Results: Cu was found in all composites examined (LoD=1.335 mg/kg). Significantly higher levels were found in the urban areas [43.784 (27.200, 56.190) vs. 32.678 (20.280, 35.710); data presented as median and IQR, in mg/kg; Peto-Prentice test, $\chi^2(1)=7.4$, p -value=0.007], which might be logical as this metal is associated with traffic density. This would be supported by the enrichment factors calculated for rural topsoils (EF=0.101), which suggests minimal anthropogenic influence. Moreover, significant differences (p -value=3E-05) were found between the four ordinal directions dividing the Leicestershire region monitored to study the distribution of Cu, showing the following distribution SW (51.345) > NW (43.827) > SE (37.262) > NE (20.052; all medians in mg/kg), suggesting a wide distribution in Leicestershire. Toxic risks derived from oral, inhalation and dermal exposure to Cu from topsoils in the urban four ordinal directions and in all rural topsoils monitored were <1, suggesting minimal non-carcinogenic risks from the exposure to Cu present in topsoils.

Conclusions: Thus, the presence and distribution of Cu in Leicestershire's topsoils would not represent a significant risk for the population. In general, the range of Cu found (9.580-101.229 mg/kg) would suggest that the monitored topsoils were not polluted, if we consider the threshold proposed by the Finnish and Swedish legislations to denote unpolluted soils (100 mg/kg). However, a continuous monitoring would be recommended to protect the public.

Keywords: copper, topsoils, presence and distribution, human risks, Leicestershire.

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