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Copper and Nickel Accumulation and Translocation in Leafy Vegetables Irrigated with Metal-Containing Effluents

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The treated and untreated wastewaters are widely used for irrigation in many developing countries. They often contain not only organic compounds, but also various metals that are both essential (zinc, copper) and potentially hazardous (chromium, nickel) for human health. Since plants, including leafy vegetables, can accumulate metals both in their roots and edible parts, this can be dangerous when consumed by humans.
The laboratory experiment was performed to assess the accumulation and translocation of copper and nickel in the green and underground parts of lettuce (Lactuca sativa), green onion (Allium fistulosum L.), arugula (Eruca vesicaria) and chard (Beta vulgaris var. cicla) irrigated with metal-containing effluents. The concentration of metals in effluents, soil and vegetables was determined by inductively coupled plasma optical emission spectrometry.
The highest average content of copper in the edible parts of vegetables were determined in lettuce (8.34±2.35 mg/kg) and chard (9.79±1.85 mg/kg). The highest content of nickel was determined in arugula (16.8±3.53 mg/kg) and lettuce (24.1±6.13 mg/kg). The content of copper and nickel in the edible parts of plants irrigated with metal-containing wastewater was 5–15 and 25–91 times, respectively, higher than in the control plants irrigated with filtered water.
The bioaccumulation and translocation factors of copper and nickel for leafy vegetables were calculated to assess their capacity to accumulate metals from the soil and transfer them to the above-ground parts of plants. The values of bioaccumulation factors of copper and nickel varied from 0.6 (onion) to 1.0 (chard) and from 0.3 (arugula) to 1.5 (lettuce), respectively. The leafy vegetables showed a low capacity to transfer copper and nickel from underground to above-ground plant parts. Arugula and lettuce were the exceptions with the values of the translocation factors of 0.7 (nickel) and 0.8 (copper), respectively.
The estimated daily intake (EDI) of nickel and copper was determined based on their content in the edible part of leafy vegetables and their daily consumption. The obtained values were one or two order of magnitude lower than the established reference dose for nickel (0.02 mg/kg bw/day) and the nutritional requirements for copper (2-3 mg/day for adults; 0.5-0.7 mg/day for infants).

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