ANTIBIOTIC-DRIVEN CHANGES IN THE ELEMENTAL STATUS OF CULTIVATED SOILS

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Antibiotics represent a real advance in medicine, and their discovery has led to the modification of old therapeutic concepts in human and animal health care. Their overuse and wrong application have led to contamination with antibiotics, with large quantities of them being present in manure, soils, wastewater, and water basins. Among the most widely used antibiotics are fluoroquinolones and β-lactam antibiotics.

Soil microbiota—bacteria, fungi, and archaea is crucial for the soil health including cycling of essential elements into plant-available forms. They decompose organic matter, release inorganic compounds, aggregate soil particles, and regulate nutrient bioavailability, effectively acting as the belowground engine for nutrient cycling and carbon sequestration.

Antibiotics in the soil environment may induce its degradation by impacting microbial activity and diversity. It is known that the occurrence and accumulation characteristics of antibiotics in soil may affect the carbon and nitrogen cycles, but there is a lack of information about their impact on the elemental content of the soil.

For the present study two representative antibiotics were selected: ampicillin, a β-lactam antibiotic, one of the most consumed antibiotics for the treatment of infections with Gram-negative and -positive bacteria and ciprofloxacin, a synthetic fluoroquinolone antibiotic, globally used for the management of bacterial infections in both humans and animals.

The antibiotics were dissolved in 200 mL of ultrapure water and used for the cultivation of lettuce under controlled laboratory conditions. Three concentrations were used: 7.5 mg kg^{-1}; 15 mg kg^{-1}; 30 mg kg^{-1} for ampicillin; 5 mg kg^{-1}; 10 mg kg^{-1} and 20 mg kg^{-1} for ciprofloxacin.

The soil samples, including noncontaminated ones, was taken for analysis when the lettuce was harvested 6 weeks after planting. Control soil was not contaminated with antibiotics. The elemental content was determined by Neutron Activation Analysis at IBR-2 reactor.

Gradual increases in the concentration of applied penicillin in soil did not reveal significant changes in the elemental composition, while changes in ciprofloxacin content correlated to varying degrees with the levels of 10 elements in the soil. Aluminum show the highest strength of association with the antibiotic content in soil, but while Al has a positive association, K, Ca and Br show antagonism.