Uptake, Translocation, and Accumulation of Pharmaceutical and Hormone Contaminants in Vegetables

A team led by Wei Zheng, senior research scientist at ISTC (Illinois Sustainable Technology Center), is investigating whether our food is at risk of accumulating PPCPs (Pharmaceuticals and Personal Care Products) when irrigated with wastewater from concentrated animal feedlot operations (CAFOs) and wastewater treatment plants (WWTPs).

The research simulated wastewater irrigation by introducing precise amounts of ten PPCPs (**caffeine**; **carbamazepine**; **naproxen**; **ibuprofen**; **gemfribrozil**; **triclosan**; **sulfamethoxazole**; **estrone**; **17β-estradiol**; **17α-ethinylestradiol**) into hydroponic gardens of lettuce and tomatoes. The scientists then measured the extent to which the contaminants were taken up by roots, translocated into leaves, and accumulated in the plant. All but one PPCP (triclosan) and one hormone (17β-estradiol) were detected in lettuce leaves. Of the eight compounds detected, caffeine, carbamazepine, and sulfamethoxazole had the highest concentrations in the leaves. Furthermore, caffeine and carbamazepine had significantly higher concentrations in the lettuce leaves than in the roots, indicating that they readily accumulate in the edible portions of the plant. The hormones, however, were detected at very low levels.

In the tomato plants, all 10 compounds were detected in the roots. Six of the seven PPCPs were found in the plants' leaves and stems (again caffeine and carbamazepine concentrations were highest in the leaves). None of the three hormones were detected beyond the roots. Five of the PPCPs (carbamazepine, naproxen, ibuprofen, gemfribrozil, sulfamethoxazole) were found in the tomato fruit in very low concentrations (1.8 to 140 µg/kg).

These studies indicate that there may be a possible risk of exposure to PPCPs such as caffeine, carbamazepine, and sulfamethoxazole through consumption of lettuce irrigated with wastewater. For tomato plants, because hormones do not go beyond the roots, the data suggests that irrigation of tomato plants with hormone-containing water is unlikely to cause significant contamination of the fruit. However, other PPCPs that were found in plants' leaves and fruits could be a source of PPCPs to humans and animals ingesting these foods.

The work "Uptake, Translocation, and Accumulation of Pharmaceutical and Hormone Contaminants in Vegetables" was published as Chapter 9 in *Retention, Uptake, and Translocation of Agrochemicals in Plants*; K. Myung, N. Satchivi, and C. Kingston, Editors; ACS Symposium Series 1171. Collaborators on the study were Nancy Holm and intern Kelsey N. Wiles of ISTC; and Nathan A. Deppe and Clinton R. Shipley of the U of I's Plant Care Facility.

Dr. Wei Zheng and Kelsey Wiles dose the hydroponics system with PPCPs and make adjustments for optimal growing conditions.

Meet the Scientists

- Wei Zheng

Publications

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