Microcystin uptake by food crops

What's the risk?

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Introduction

Microcystin uptake by food crops has been on the radar for several decades

Increased use of recycled wastewater has heightened awareness

Does it pose a health risk to consumers?

Initial discussions with SA Health, with subsequent interest from the wider water industry through Water RA

Successful collaboration between Flinders University and SA Water

Cyanotoxin Risk in Recycled Water Used for Food Crop Irrigation – Water RA Project Number: #3049 2022 →

Cyanotoxin risk in recycled water

- Literature review - conduct comprehensive review of scientific literature. Shayne Faulkner – **published**
- SA Water - review the extent of recycled water use on crops and pasture in Australia, and worldwide. Martin Faulkner – **write up stage**
- Flinders Uni honours project - biodegradation of microcystin within soils. Paul Canala – **completed, first class**
- Flinders Uni PhD project - investigate the fate of cyanobacterial toxin in the journey from wastewater through to uptake by crops irrigated with recycled water. Shayne Faulkner – **experimental work completed**
- Flinders Uni, PhD Project: Determination of critical concentrations of cyanotoxins in commercial reclaimed wastewater in relation to supply of water for food crop irrigation. Paul Canala – **just started**

Fate of microcystin following irrigation

Source
- Surface water
- Recycled wastewater
- Groundwater

Spray

Hydroponics

Drip

Fertiliser

Cyanotoxin
- Intracellular
- Extracellular

Penetration depth

Soil Type/Chemistry

Biodegradation

Plant uptake

Partitioning
- Shoots / leaves / fruits
- Roots

Contamination:
- Internal
- External

Consumption
Risk assessment

Source: Paul Canala and Howard Fallowfield 2023

Preliminary risk assessment

Three values were used to assess risk to consumers

1. ABS median daily consumption of fruit and vegetables 2011-2012
2. WHO (2020) Tolerable daily intakes (TDI) for chronic exposure to microcystins
   - **$TDI_{chronic}$ = 0.04 ug/kg body weight/day – lifetime exposure**
3. Toxin levels measured in edible food crops from literature

Preliminary risk assessment

TDI $_{chronic}$ for Microcystin in 70kg adult = 2800 ng/day (WHO, 2020)	÷	Median daily consumption of food crop for an Adult (g) (ABS, 2014)	=	Maximum Allowable Microcystin Concentration (MAMC) in food crop, if sole source of toxin, before exceedance of TDI $_{chronic}$ (ng/g)

Preliminary risk assessment

Maximum Allowable Microcystin-LR Content (ng/g) for chronic exposure

Food Crop	$MAMC_{Chronic}$ (ng/g)
Leaf and stalk	114
Root vegetables	75
Tomato	74
Rice	17

Preliminary risk assessment

Summary of literature results - edible components only

Experiment type	No. of papers	Plant type tested	Toxin source	Plant showing exceedance of $MAMC_{Chronic}$
Field	4	Root veg, leafy greens, rice, fruiting veg	• 1 x ground water • 3 x bloom	All 4 papers - cabbage, dill, lettuce, parsley, spinach, rice
Laboratory hydroponics	3	Leafy greens	• 2 x cyano extract • 1 x pure toxin	1 paper - lettuce
Laboratory soil / water at base	10	Leafy greens, fruiting veg, root veg, rice, tomato	• 5 x pure toxin • 5 x cyano extract • 4 x bloom	4 papers - root veg, rice
Laboratory soil / water over plant	7	Leafy greens, root veg	• 3 x pure toxin • 3 x cyano extract	4 paper - lettuce

Summary

- General understanding of toxin uptake process
- Initial review suggests a potential for food crops irrigated with cyanotoxin to pose a health risk to consumers
- More information required to better understand the risk
  - Operational
  - Scientific
- **Cyanotoxin risk in recycled water used for food crop irrigation - Water RA #3049** will provide answers from an Australian perspective
- Outcomes can be used by health regulators and the agricultural industry to guide future policies and guidelines


Thank you


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