Reclaimed wastewater or surface water use in irrigation: the potential fate and impacts of pharmaceuticals

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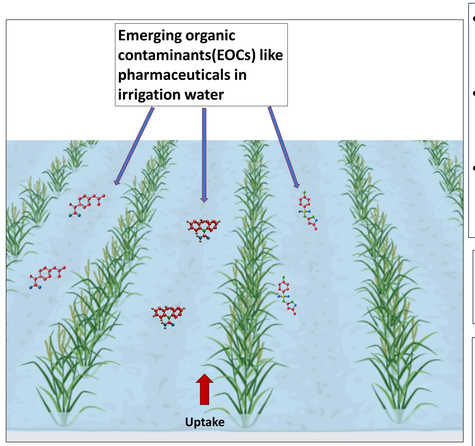
Introduction



- Use of alternative sources of irrigation water to avoid abstraction of groundwater for irrigational purposes.
- Alternative irrigation water sources :Surface water or treated wastewater are contaminated with EOCs.
- Current policies focus on heavy metals and microbial pathogens in irrigation water, neglecting the effects of organic contaminants.

Can irrigation with surface water or reclaimed wastewater be acceptable in terms of potential human health risks and food security?

Objectives

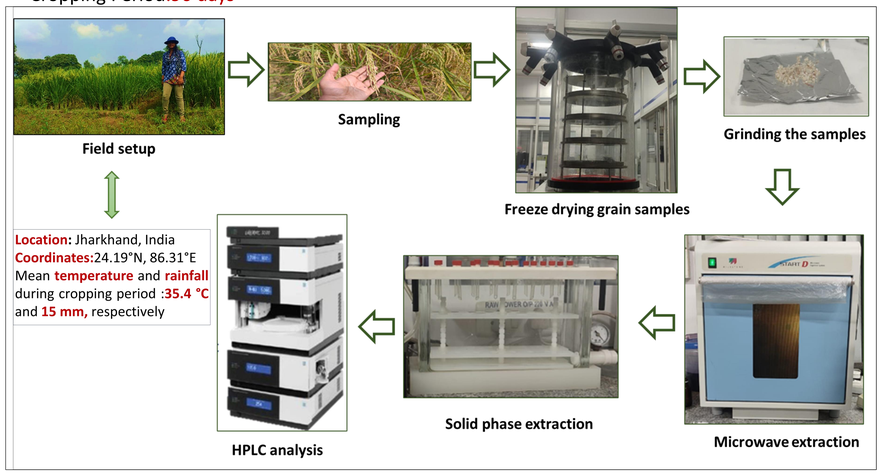
- Impact of pharmaceuticals on crop yield
- Pharmaceutical residues in rice grain
- Health Risk Assessment

Methodology

- Contaminants:

Carbamazepine (CAR)-Highly persistent antiepileptic drug
Sulfamethoxazole (SMX)-Frequently used veterinary antibiotic
Ibuprofen (IBRU)-Frequently used analgesic.

- Replica:3; Separate sub-plots were assigned to each contaminant
- Pharmaceutical doses: low (0.5g), medium (1g), and high (5g) irrigated at regular intervals
- Cropping Period:90 days



Field setup, sample extraction and analysis

Methodology(continued)

Health Risk Assessment

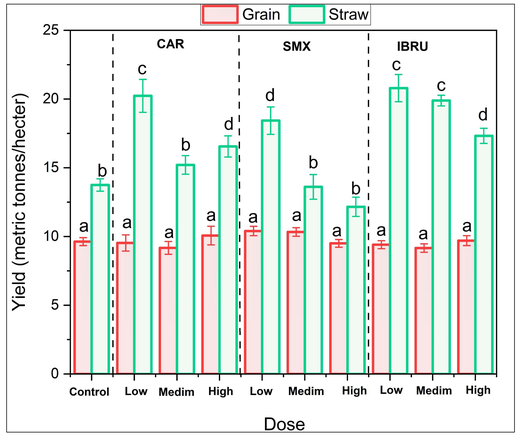
Hazardous Quotient (HQ)$=\frac{\text{EDI}}{\text{ADI}}$, where

Approved daily intake(ADI) $= \frac{\text{Lowest daily therapeutic dose}}{\text{f*BW}} * 1000$

Estimated daily intake(EDI) $= \frac{(C*Ing\ R*EF*ED)}{(BW*LE)}$

Conventionally, HQ< 1 is safe; By considering additional safety factors HQ<0.1 is safe

Results and Discussions



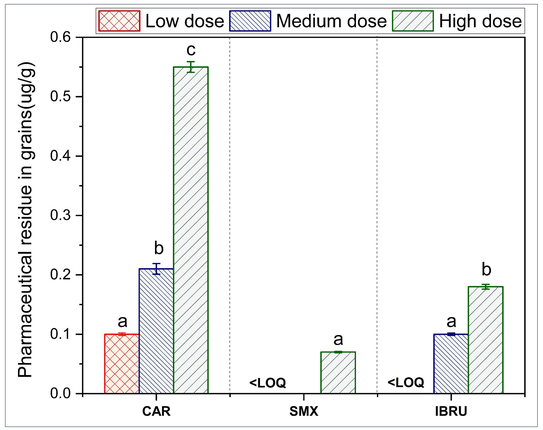
This figure shows post-harvest grain and straw yield.

- Mean grain yield did not vary significantly.
- Straw yield increased for low dose for all the contaminants low dose due to 'hormesis'.

Means with a common letter do not differ significantly($p<0.05$)[n=3]

This Figure shows concentration of pharmaceutical residues in rice grains.

- Pharmaceutical residues were detected in the grains, but were below the level of quantification(<LOQ) in some samples.
- Residue concentration increased with increase in contaminant dosage.



Results and Discussions(continued)

Table shows mean HQ of pharmaceutical residues in rice grains for adults

Contaminant	Dose	Hazardous Quotient(HQ)
CAR	Low	0.17
CAR	Medium	0.34
CAR	High	0.93
SMX	High	0.06
IBRU	Medium	0.05
IBRU	High	0.078

>0.1

Conclusion

- Overall grain yield remained significantly unaltered while straw yield increased significantly
- Pharmaceutical residue was present in the rice grains in the order: CAR>IBRU>SMX.
- HQ of all the contaminants were within safe limits according to the conventional rule. However, HQ for CAR exceeded the safety limit upon consideration of additional safety factor.

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