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Individual and Combined Ecotoxicity of Albendazole, Metronidazole and Ibuprofen in Freshwater Algae and Agricultural Plants

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INTRODUCTION & AIM

Increasing global use and environmental persistence of pharmaceuticals, rises concerns about ecotoxicological effects on non-target organisms.
Albendazole (ABZ), Metronidazole (MTZ), Ibuprofen (IBU) are antiparasitic pharmaceuticals frequently detected in soil and aquatic environments.

Knowledge gap

Limited understanding of effects on non-target organisms, particularly in mixtures.

This study aimed to assess ecotoxicological effects of ABZ, MTZ, and IBU, individually and in binary mixtures.
Test organisms with ecological and agricultural relevance:
Chlorella vulgaris | Lactuca sativa | Triticum aestivum

METHOD

Ecotoxicity assays using single compounds and binary mixtures

Chlorella vulgaris

Single compound: ABZ (1–500 µg/L) |
MTZ & IBU (0.5–100 mg/L)

Mixtures: ABZ+IBU (500 µg /L+ 100mg/L), MTZ+IBU (50mg/L+100mg/L) (25:75, 50:50, 75:25)
OECD 201-Endpoints: Growth rate, EC50 (120 h)

Lactuca sativa & Triticum aestivum

Single compound: ABZ| MTZ & IBU (5–160 mg/L)

Mixtures:
ABZ+IBU, MTZ+IBU (160 + 160 mg/L)
(25:75, 50:50, 75:25)
OECD 208 - Endpoints: Germination, root and epicotyl growth

FUTURE WORK

Study chronic effects: Evaluate long-term exposure and sublethal impacts on organisms.Test more complex mixtures: Include ternary or multi-compound combinations to better reflect real environmental conditions.

RESULTS & DISCUSSION

	C. vulgaris	Inhibition	Mixture effects with IBU
ABZ	Highly toxic EC_{50} = 17.7 µg/L	>80% at 72 h (5–10 µg/L)	Reduces toxicity (antagonistic)
MTZ	Dose-response relationship EC_{50} = 6.3 mg/L	>50% at 72 h NOEC = 0.5 mg/L LOEC = 5 mg/L	No enhancement of effects
IBU	Biphasic effect EC_{50} = 78.5 mg/L	40% at 120 h Inhibits (50–100 mg/L) Stimulates (1–5 mg/L)	—

L. sativa	Germination	Root Growth	Epicotyl Growth
ABZ	Inhibition at >10 mg/L	Inhibition at> 10 mg/L	Significant inhibition at 40 and 80 mg/L
MTZ	Inhibition at 20 and 160 mg/L	Inhibition only at 160 mg/L	No significant differences
IBU	Inhibition only at 160 mg/L	Stimulation at 5–40 mg/L; inhibition at 160 mg/L	No significant differences
ABZ + IBU	Significant inhibition in all ratios	Significant stimulation in all ratios	Significant stimulation in all ratios
MTZ + IBU	Inhibition in all ratios	Stimulation at 50:50 ratio	Inhibition at 50:50 ratio

T.aestivum	*Germination*	*Root Growth*	*Epicotyl Growth*
ABZ	*Significant inhibition at 5, 40 and 160 mg/L*	*Stimulation (5–10 mg/L); inhibition (40–160 mg/L)*	*Inhibition at 5, 40 and 160 mg/L*
MTZ	*No significant differences*	*Inhibition at all concentrations; dose–response effect*	*Inhibition at 160 mg/L*
IBU	*Inhibition only at 160 mg/L*	*Stimulation at 5 mg/L; inhibition at 80 and 160 mg/L*	*Inhibition at 80 and 160 mg/L*
ABZ + IBU	*Significant inhibition at 25:75 and 75:25*	*Inhibition only at 50:50 and 75:25*	*No significant changes*
MTZ + IBU	*Initial inhibition, recovery up to 120 h*	*No significant differences*	*No significant differences*

CONCLUSION

These findings demonstrate that ABZ, MTZ, and IBU can significantly affect aquatic and terrestrial organisms and that mixture effects are not predictable from single-compound data, highlighting the importance of considering chemical interactions in environmental risk assessment.