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SCIENTIFIC REVIEW | FEED SAFETY | CLIMATE CHANGE

MYCOTOXINS IN ANIMAL PRODUCTION: CO-CONTAMINATION, BIOLOGICAL EFFECTS AND THE POTENTIAL OF BREWER'S YEAST FOR RISK MITIGATION UNDER CLIMATE CHANGE

Liliana Elena Olariu Jurca[1], Daniela Moţ[1], Beatrice Ana-Maria Sîrbu[1], Cătălin Bogdan Sîrbu[1], Alexandra Grigoreanu[2], Sandra Antonia Mihailov[1], Andrei Alexandru Ivan[2], Adrian Olariu Jurca[2*]

[1] University of Life Sciences "King Mihai I" from Timişoara, Faculty of Bioengineering of Animal Resources, 300645, Calea Aradului, no. 119, Timişoara, Romania
[2] University of Life Sciences "King Mihai I" from Timişoara, Faculty of Veterinary Medicine, 300645, Calea Aradului, no. 119, Timişoara, Romania

ABSTRACT

Mycotoxins can contaminate feed before harvest or during storage, compromising animal health, performance and food-chain safety. This narrative review examines major and emerging toxins, co-contamination, climate-related risk and the potential of brewer's yeast (*Saccharomyces cerevisiae*) for mitigation. Mixture effects may be additive, synergistic or antagonistic; climate impacts are region- and toxin-specific. Yeast cell-wall fractions can adsorb selected toxins, but in vitro binding does not necessarily establish in vivo protection. Prevention, representative sampling and validated multi-mycotoxin analysis remain essential.

01 INTRODUCTION

- Contamination can develop in the field, during drying or in storage.
- *Aspergillus*, *Fusarium* and *Penicillium* produce distinct mycotoxins; visible mould is not a reliable measure of toxin concentration.



CO-CONTAMINATION



SPECIES SENSITIVITY



ONE HEALTH

02 MATERIALS AND METHODS

Narrative synthesis of experimental studies, reviews, and regulatory/institutional sources covering mycotoxins, biological effects, yeast adsorption and biotransformation.

- Evidence synthesis
- Thematic comparison
- In vitro / in vivo data
- Regulatory information

MAJOR MYCOTOXINS & BIOLOGICAL EFFECTS

TOXIN / MAIN PRODUCERS	ANIMAL-HEALTH RELEVANCE
AFLATOXINS *(Aspergillus)*	Liver toxicity, carcinogenic, immune suppression
DON *(Fusarium)*	Reduced feed intake, gut barrier impairment
ZEN *(Fusarium)*	Endocrine disruption, reproductive disorders
FUMONISINS *(Fusarium)*	Sphingolipid disruption, equine and pig risk
OTA *(Aspergillus / Penicillium)*	Nephrotoxicity, immune effects
T-2 / HT-2 *(Fusarium)*	Protein synthesis inhibition, skin and immune effects

04 CLIMATE, CO-EXPOSURE & THE FEED CHAIN

Risk changes with crop, geography, weather and storage conditions – not every toxin rises uniformly.

CLIMATE SIGNALS
- Heat and drought
- Rainfall patterns

FUNGAL ECOLOGY
- Aspergillus, Fusarium,
- Penicillium

FEED EXPOSURE
- Field to storage
- Mixed ingredients

MYCOTOXIN MIXTURES — ADDITIVE | SYNERGISTIC | ANTAGONISTIC

05 RESULTS AND DISCUSSION

MIXTURES	• Effects depend on dose, species and interaction. • Synergistic and antagonistic effects.
CLIMATE	• Higher risk with warmer and variable conditions. • Shift in toxin profiles and regional differences.
YEAST	• Adsorption capacity varies by preparation. • More effective for certain toxins and under specific conditions.

06 BREWER'S YEAST: MECHANISM & LIMITS



CELL-WALL BINDING
- **β-glucans and mannoproteins** with non-covalent adsorption
- Binding depends on toxin structure, processing, contact time and feed matrix.

IMPORTANT: Adsorption does not eliminate toxins. Proper use and feed management remain essential.

07 FROM BINDING TO VERIFIED EFFICACY

EVIDENCE PATHWAY

IN VITRO Adsorption → GI CONDITIONS Stability / release → IN VIVO Animal outcomes → SAFETY Residues

≈45% DON adsorbed in vitro by one tested yeast hydrolysate - yet no reduction in DON, OTA or ZEN in *vivo* (pig model).

08 INTEGRATED FEED RISK MANAGEMENT

PREVENT Harvest / storage | SAMPLE Representative lots | ANALYSE Multi-toxin (LC-MS/MS) | VALIDATE Species-specific tests

09 CONCLUSIONS

- Mycotoxin exposure must be assessed in context, not as single toxins.
- Climate change alters contamination risk unevenly across crops and regions.
- Brewer's yeast can contribute to risk mitigation, but needs product- and species-specific validation.

TAKE-HOME MESSAGE Brewer's yeast is a promising component of risk mitigation – not a universal mycotoxin detoxifier.