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MANAGEMENT

RESEARCH INSIGHT:

PENICILLIUM MYCOTOXINS

Impact on the immune system

If a cow ingests feed contaminated with Penicllium mycotoxins, clinical signs of toxicity are seen in the kidney and liver. But scientists also know that most mycotoxins can also exert an effect on the animal's immune system.

"Studies have shown the immuno-modulatory effect of PMs, specifically the fact that they can differentially affect some of the biological activities of macrophages. Macrophages are important cells of the immune system that are formed in response to an infection or accumulating damaged or dead cells. Consequently, any changes in the function of macrophages could potentially predispose cattle to secondary diseases," points out Alexandros Yiannikouris from Alltech.

"Animal scientists were first able to investigate (using an in vitro model) this immune system effect over 20 years ago by working with bovine macrophages (BoMacs) isolated from the peritoneal region and those present along the intestinal gut lining. Peritoneal macrophages may come into contact with mycotoxins even before detoxification occurs within the liver and kidney, which makes these cells a biologically relevant population to study and try and understand how mycotoxin combinations affect them."

METHODOLOGY

Yiannikouris was recently involved on a team that used a BoMacs cell line to assess interactions between binary mixtures of PMs. The same group also investigated (in the same in vitro model) the attributes of modified yeast cell wall at counteracting the effect of PMs.

“There are several methods for determining the interaction of compounds in a mixture. For all methods, mixture toxicity data is compared to a predicted mixture effect that assumes no interactions between chemicals.

“The two basic toxicity concepts for estimating the combined effects of mixtures, include independent action (IA) and concentration addition (CA). The IA concept assumes that compounds in a mixture have a completely different mode of action that affects a common endpoint, while the CA concept assumes that compounds have a similar mode of action; both concepts assume that the chemicals do not interact.”

By using these two toxicity concepts scientists have a statistical means of re-analysing previous research data and distinguishing whether various PM mixtures have a synergistic or antagonistic effect on the proliferation of BoMacs, as the only endpoint to be commonly affected by PMs.

PROJECT FINDINGS

IA interactions

- Synergism was observed for the mixtures of ochratoxin (OTA) with citrinin (CIT), patulin (PAT) and penicillic acid (PA), which resulted in greater inhibition of BoMacs proliferation pf 1.4, 1.6 and 2.4 fold higher inhibition than expected, respectively.

- Antagonism was observed for the mixtures of PA with PAT or mycophenolic acid (MPA), which resulted in lower inhibition of BoMacs proliferation by 0.8 and 0.7 fold inhibition than predicted, respectively

CA interactions

- The only mixture with synergistic effects in this model was OTA and PA, with a 2.5 fold higher observed effect.

- Antagonistic interaction was observed between PAT and PA with a 1.5 fold lower observed effect.

Prevention of toxic effects

- Interaction between modified yeast cell wall and PMs decreased the toxicity of OTA and CIT in an acidic environment.

- Incubation time, pH, mycotoxins concentrations and idose response of the modified yeast cell wall are factors that modulate the efficacy of the latter at preventing the toxicity of some PMs towards BOMACS.

FOUR TAKE OUT MESSAGES

Defining the synergisms between combinations of different Penicillium mycotoxins is extremely important if the feed industry is to develop effective mitigation strategies. These evaluations call for the development of robust testing models adapted to biological systems, such as, but not exclusively the bovine macrophages cell line proliferation assay.

1

Both this latest trial and previous studies show that ochratoxin and penicillic acid mixtures create a synergistic effect on the proliferation of bovine macrophages (up to 2.5 times greater), whereas patulin and penicillic acid have an antagonistic effect.

2

Interactions between different toxins differ depending on the relative concentrations of Penicillium mycotoxins (PMs).

3

The toxicity of most binary PM mixtures follow additive behaviour (7 out of 10) described by either IA or IC concepts, whereas only one PM mixture (citrinin + ochratoxin A) showed synergistic interaction by both concepts.

4

Modified yeast cell wall can interact with some PMs and decrease the toxicity response seen in BOMACs proliferation.

REFERENCES

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