

Characterization of the zearalenone degrading enzymes

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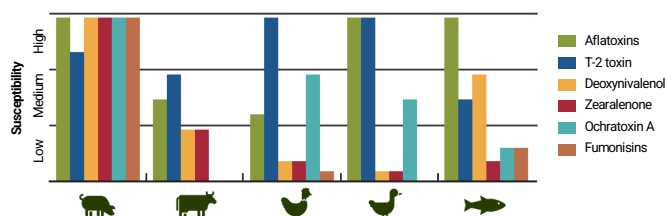
Mycotoxins

– Impact on a global scale –

Mycotoxins are secondary metabolites produced by fungi or molds.

A 10-year global survey showed that 88% of the tested feed samples were mycotoxin-contaminated and in 64% of the samples the toxins co-occurred.^[1] Every year, around 1.2 billion tonnes of feed are produced, and their contamination results in huge economic losses to the agricultural industry.

The mycotoxin incidence varies depending on the region, and the type of grains, feed, and food it contaminates. Most frequently, maize, wheat, barley, etc. are affected by fungal infection. According to a 2020 global analysis, the most prevalent mycotoxins are the *Fusarium* mycotoxins: deoxynivalenol at 65%, fumonisin at 64%, and zearalenone at 48% occurrence.^[2] The nature of their toxic effects depends on their chemical structure. Their acute and chronic dietary exposures can induce various adverse health effects in humans and livestock.

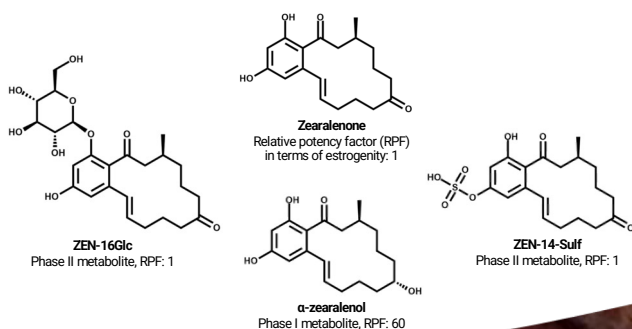


The further danger of mycotoxins is that they can accumulate in the food chain. To prevent this, strict guidelines regulate their maximum dosage. Several methods have been developed to process contaminated feed to comply with these limits. Instead of discarding the mycotoxin-containing grains, they can be used as animal feed by binding the toxins onto different adsorbents.

Chemical or physical detoxification often influences the nutritional composition of food and feed, and it is unsuitable for large-scale detoxification. Because of this, enzymatic inactivation possesses an alternative solution with excellent repeatability, a simple and environmentally friendly operation, and high safety while keeping the nutritional value of the grains.^[3]

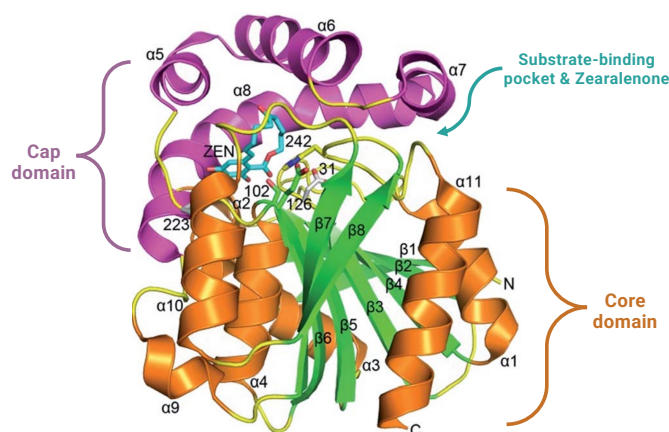
Zearalenone

Zearalenone is predominantly produced by *Fusarium graminearum*. It is one of the most prevalent estrogenic mycotoxins, by binding to estrogen-receptors it causes reproductive health problems. Zearalenone has also been found to be hematotoxic, hepatotoxic, immunotoxic and genotoxic.^[4] Among livestock swine is the most susceptible to the toxin and its metabolites.^[5,6]

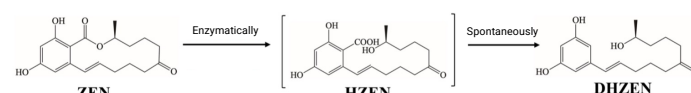


Enzymatic degradation

The zearalenone-lactonohydrolase ZHD101, from *Clonostachys rosea*, was one the first enzymes identified with a zearalenone-specific detoxifying capability. Most of the known zearalenone-lactonohydrolases are part of the alpha/beta hydrolase fold family. Their structure consists of 6 α-helices and 8 β-strands.

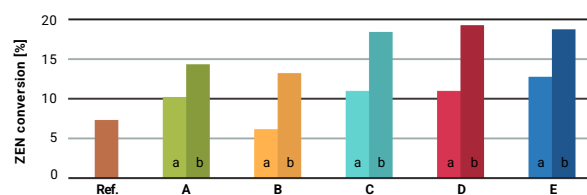


The ZHD101 structure can be divided to two main parts: the catalytic core domain and the cap domain. Its substrate-binding pocket deeply located between the core and cap domains. This allows the enzyme to form a complementary and firm binding with zearalenone. The hydrolytic reaction mechanism based on a Ser-His-Asp catalytic triad and the oxyanion hole.^[7,8]



Enzyme immobilization

The aim is to develop an efficient enzyme-based feed additive for the detoxification of zearalenone. To achieve this, the enzyme was immobilized on different agricultural by-products, in different ratios. Then the enzyme activity measurement was carried out using HPLC-FLD method.



Immobilized enzyme on five types of carriers, in different enzyme:carrier ratios (a: 1:1, b: 2:1). Reference: enzyme solution in the same dilution as the immobilized enzyme samples.

References:

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