Technical Article

Mycotoxins: *Enzymatic inactivation of mycotoxins*

In the mid-seventeenth century it was already known that stomach secretions were responsible for meat digestion and that saliva was, partially, in charge of conversion of starch into sugar. However, the mechanism responsible for those transformations was unknown. Two centuries later (XIX), the enzymatic mechanism was discovered and, it was not until the 1930s that the first enzymes were isolated. Since that moment, different functions have been discovered; functions that go far beyond nutrients digestion.

In 1966, CIEGLERA et. al, tested approximately 1.000 microorganisms, among which were: yeasts, molds, fungal spores, actinomycetes, bacteria and algae, in order to evaluate their ability to destroy or transform the aflatoxin B1 and G1. Among all the agents studied, only one bacteria, Flavobacterium NRRL B-184, removed the aflatoxin from the solution. According to research studies on ducks (ducklings), the detoxification of aflatoxin solutions by B-184 was complete, without the production of new toxins.

With the growing relevance of mycotoxins control in the animal production chain, this was a great opportunity: enzymatic inactivation or detoxification of mycotoxins. The detoxification of mycotoxins has been studied for a long time; the first reports of mycotoxins biotransformation in microorganisms were published in the 1960s. From a practical perspective, the first important result was discovered in the mid-1980s, when the inactivation capacity of T-2 toxin was proved. It was also proved that some organisms secrete enzymes that can cleave mycotoxins in specific regions, generating sub products with no toxicity or with low toxicity.

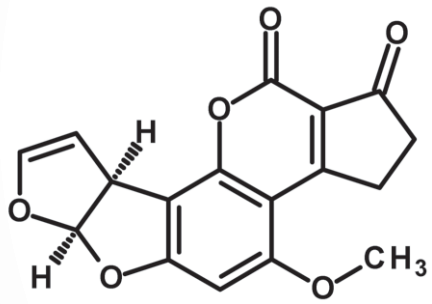
Enzymes are organic substances, with protein nature, with intra and extra cellular activity, which have catalytic functions. These allow the production of chemical reactions, making the metabolism of living beings possible. This capacity of catalyzing reactions stimulates the use of enzymes for different uses.

Since the study of these ruminal microorganisms, the first enzymatic products for mycotoxins control were developed. Through industrial fermentation methods, these enzymes started to be

produced on a large scale, with high performance and economic viability of the mycotoxin's detoxification method. Apart from its enzymatic functionality (pH, temperature, specialty, etc.), another important aspect in the development of a mycotoxin inactivator is the interference of microorganisms that produce the enzymes and their metabolites, which come from the biotransformation of sensory and nutritional properties of the final food ration.

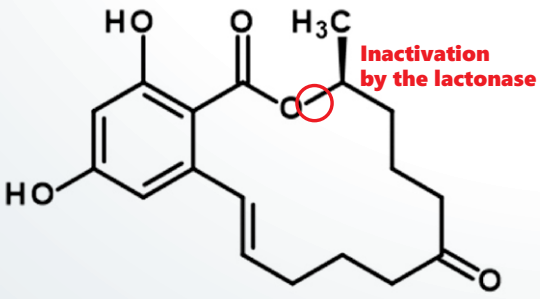
There are many groups of mycotoxins, but the most important ones can be divided into three: aflatoxins (AFLA), produced by fungus of the genus Aspergillus spp., such as A. flavus or A. parasitus; ochratoxins (OTA), produced by the Aspergillus ochraceus and different species of the genus Penicillium; and Fusarium toxins, whose main representatives are Trichothecenes (TCT), Zearalenone (ZEA), and Fumonisines (FUM), produced by different species of the genus Fusarium (PINTO & VAAMONDE, 1996).

Aflatoxins are formed by heterocyclic molecules, with oxygen atoms and difuran rings, which differ only by small variations in their basic molecular structure (MOSS, 1989). They are easily absorbed by clays, bentonites, aluminosilicates and yeast wall.



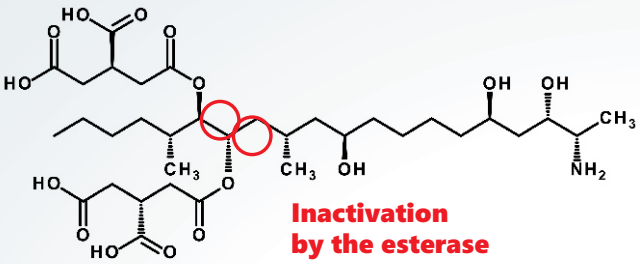
Molecular formula:	C17 H12 O6
Molecular weight:	312,277 g/mol
Polarity:	Polar

Zearalenone is a non-steroidal estrogenic mycotoxin, chemically described as a resorcyl phenolic acid lactone (GAUMY et al., 2001). It has good thermal stability and poor water solubility; however, it has a high solubility in organic solvents.



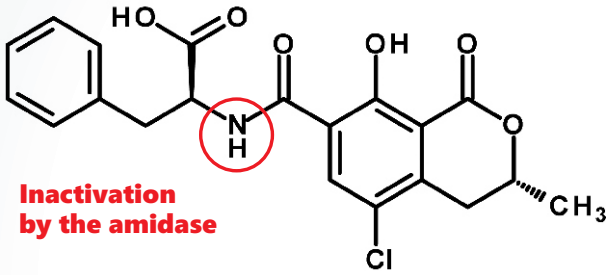
Molecular formula:	C18 H22 O5
Molecular weight:	318,369 g/mol
Polarity:	Apolar

Fumonisin B1 is the diester of 1, 2, 3-tricarboxylic acid propane and 2S-amino-12S, 16R-dimethyl-3S, 5R, 10R, 14S, 15R-penta-hydroxyeicosanne in which the C-14 and C-15 hydroxyl groups are esterified with the carboxy terminal group of propane-1,2,3-tricarboxylic acid. FB 2 - FB 4 show different hydroxylation patterns.



Molecular formula:	C34 H59 NO15
Molecular weight:	721,838 g/mol
Polarity:	Polar

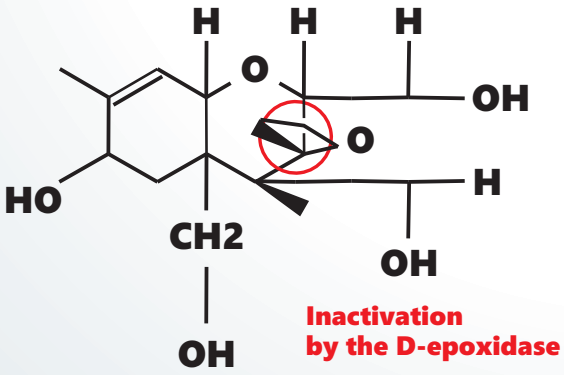
Ocratoxins are formed by a dihydro-isocumarin linked by the 7-carboxyl group to a molecule of L-β-phenylalanine, through an amide bond (RINGOT et. al., 2006).



Molecular formula:	C20 H18 ClNO6
Molecular weight:	403,815 g/mol
Polarity:	Média

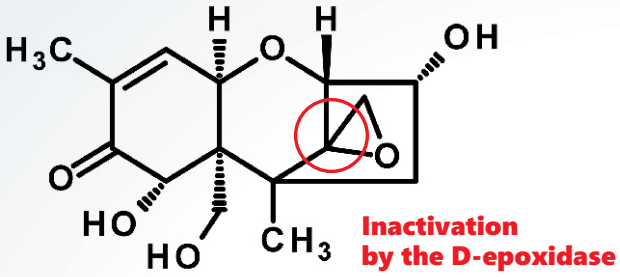
Trichothecenes are mycotoxins consisting of trichothecene rings that have a double bond between carbons 9 and 10 and an epoxy group at positions 12 and 13 of the structure.

T2



Molecular formula:	C24 H34 O9
Molecular weight:	466,527 g/mol
Polarity:	Polar

Deoxinivalenol – DON



Molecular formula:	C15 H20 O6
Molecular weight:	296,336 g/mol
Polarity:	Polar

In consequence, not only enzymes, but the total composition of products with an enzymatic base are important for the biological effect of the product on animals.