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Review

Fumonisins: Toxicokinetics, mechanism of action and toxicity

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Abstract

Fumonisins are mycotoxins produced by *Fusarium verticillioides* and *F. proliferatum*. They occur worldwide and are found predominantly in maize and in maize-based animal feeds. Of the fumonisins, fumonisin B_1 (FB_1) is the most common and the most thoroughly studied. FB_1 causes the same toxicities in animals as *F. verticillioides*- and *F. proliferatum*-contaminated feeds including equine leukoencephalomalacia (ELEM) and porcine pulmonary edema (PPE), diseases long associated with the consumption of mouldy feed by horses and pigs, respectively. FB_1 is toxic to the liver in all species and the kidney in a range of laboratory and farm animal species, causing apoptosis followed by mitosis in the affected tissues. FB_1 is also toxic to the cardiovascular system in pigs and horses. FB_1 and other fumonisins inhibit ceramide synthase in all species including laboratory and farm animals and disrupt sphingolipid metabolism, a process underlying the mechanism of toxicity and pathogenesis of fumonisin-related diseases. The USFDA has set guidances for fumonisin concentrations in animal feeds that range from 1 to 50 ppm in the formulated rations depending upon the animal species. The European Union Commission has recommended guidance levels for fumonisins B_1 plus B_2 in feed materials and formulated feedstuffs. The levels also vary according to species and range from 5 ppm for horses, pigs, rabbits and pet animals to 50 ppm for adult ruminants and mink. Awareness of fumonisin-related animal diseases, monitoring feed and feed components, and adherence to guidance

Abbreviations: AUC, area under the curve; CSL, complex sphingolipids; FB_1, fumonisin B_1; ELEM, equine leukoencephalomalacia; HFB, hydrolyzed fumonisin; PPE, porcine pulmonary edema; Sa, sphinganine; So, sphingosine; TCA, tricarballylic acid; USFDA, United States Food and Drug Administration

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recommendations are important for reducing fumonisin-induced diseases in agriculturally important species.
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Keywords: Fumonisins; Equine leukoencephalomalacia; Porcine pulmonary edema; Toxicity; Mechanism of action; Bioavailability

Contents

1. Introduction

Fumonisins are produced by *Fusarium verticillioides* (formerly = *F. moniliforme*), *F. proliferatum*, and other *Fusarium* species (Gelderblom et al., 1988; Bolger et al., 2001; Glenn, 2007). While these mycotoxins are found in other commodities (da Silva et al., 2000; Seefelder et al., 2002; Kritzinger et al., 2003; Binder et al., 2007), animal and human health problems related to these mycotoxins are almost exclusively associated with the consumption of contaminated maize or products made from maize (Bolger et al., 2001; Marasas, 2001). The human health effects of fumonisins are uncertain. However fumonisins

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