THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Dec 2023 3(12) 4133-4136

Popular Article

Comprehensive strategies for mitigating diverse mycotoxins present in feed and fodder

Dr Arumbaka Sudheer babu[1], Dr Mounika Mendu[2], Dr Mojarla Raghavendar[3]
[1]Assistant professor, Dept of Animal Nutrition, college of veterinary science, Hyderabad
[2,3]PG Scholars, Dept of poultry science, college of veterinary science, Hyderabad
https://doi.org/10.5281/zenodo.10370821

Abstract

Mycotoxins are a group of highly toxic secondary metabolites produced by the fungi and the physiological abnormalities resulting due to ingestion of mycotoxins is known as Mycotoxicosis. They gained worldwide attention because of their potent toxic nature and their relatively common occurrence under natural conditions. Due to rapidly changing agricultural technology, the problem of occurrence of mycotoxins in cereals has been aggravated to some extent. No part of the world can be considered as mycotoxin free zone due to movement of various feedstuffs from one part of globe to other. These toxins are known to cause hazardous effects in both animals and humans. In recent years, there has been a considerable concern regarding the control of these toxic metabolites. Various techniques including plant breeding for mould resistance, efficient harvesting and storage practices have been developed for reducing the deleterious effects of preformed toxins and thereby enhancing the production. This article mainly focuses with regard to different mycotoxins present in feed stuffs and the commercially applicable techniques for decontaminating these commodities.

Introduction

India is an agrarian country where many of its residents are dependent on agriculture or rural economy. There was a tremendous increase in production of food grains leading the country from deficit to a positive self-sufficiency situation. The greatest economic impact on the food grains is mycotoxin contamination. There are about 50 species of fungi which cause harm to poultry, livestock and man. Formation of mycotoxins occur when the fungi grows on the crops in the field or during storage and processing of the feed when the conditions are favourable. These silent killers can cause huge economic, nutritional and health crisis in humans as well as in different species of animals. Mycotoxins are believed to be contaminating approximately 25% of the world' grain supply, as per the United Nations Food and agriculture organization (FAO).

Important mycotoxins present in foods and feeds

Cereals are the most important food sources which are affected by various mycotoxic fungi. Different fungi target different food items producing different mycotoxins as given below.

Mycotoxin	Predominant fungal source	Target food items
Aflatoxins (B1,B2,G1,G2)	Aspergillus flavus, A.parasiticus	Corn, peanut, oilseeds
Vomitoxin/deoxynivalenol	Fusarium graminearum, F.culmorum	Wheat, corn, barley
Fumonisins	F.verticilloides,F.moniliforme, F.proliferatum	Corn, rice, sorghum
Ochratoxin A	A.carbonarius, A.niger, Penicillium verrucosum.	Wheat, corn, barley,coffe,oats
Zearalenone	F. graminearum F.culmorum	Corn , sorghum , wheat
Patulin	P.expansum Byssochlamys	Cereals, apples, olives, grapes

Effect of mycotoxins on health, production performance and immune system of animals

Mycotoxins can cause physical or apparent effects ranging from reduced feed intake and poor digestibility to normal ability of the animal to thrive. Symptoms of different toxins vary from each other.

Aflatoxin can damage the liver and cause growth suppression. It can also reduce the size of bursa of fabricius and thymus thus affecting the immune status of the animal. T-2 toxin causes oral lesions in poultry and decreases then T-lymphocytes and WBC count. Ochratoxin damages the kidney and reduces the total serum proteins and immunoglobulin. Dairy animals can tolerate the higher levels of toxin due to its biotransformation by ruminal microbes whereas poultry and pigs are more susceptible. Zearalenone mainly affects the reproductive organs in pigs, dairy cattle and poultry. Fumonisins cause nervous disorders in horses and reduces the antibody titers. Ergot alkaloids are known to produce nervous system disorders and necrosis of legs and tails in livestock species.

Strategies for the prevention and control of mycotoxins

There are different decontamination methods for neutralizing the mycotoxins present in the feed stuffs.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 12.12.2023

1. **Prevention of mould growth**

Mould growth in stored grains can be prevented by three different methods i.e, drying of grains, controlled atmospheric storage and chemical treatment

   a. **Drying of grains**: Drying grains conventionally under direct sunlight can reduce the moisture content so that conditions favorable for their growth are not met. Grains are spread in thin layers on the floor in the open sun and stir them until they are dried to safe level. Other drying strategies for grains involve mechanical drying, in-bin drying, infrared, microwave, sonic and solar energy drying.
   b. **Controlled atmospheric storage**: Cooling of the grains and depleting the oxygen by grain respiration inhibits the growth of aerobic fungi, thus eliminating the mycotoxin production. Low temperature causes negative effect on the growth of thermophilic microflora.

2. **Chemical treatment**: Aflatoxin production in rice, wheat, maize can be inhibited by mild phenolics like O-Vanillin and perculic acid. Wheat grains on treatment with bavistin and TMTD (Trimethyl thiuram disulphide) at 0.25% concentration, can be protected against Aspergillus and Penicillium sps and stored for one year. Ammonia, sodium bisulfite, peroxide, acids, bases, and gases are also effective against mycotoxins.
3. **Separation of infected grains:** Grains can be separated either manually or by using electronic sorter. This is the most efficient and feasible method for minimizing mycotoxin contamination.
4. **Growing resistant varieties:** Considering the dangerous effects of mycotoxins, attempts are being conducted to create mold- resistant cultivars that will not only be mould free in field but also inhibit growth of fungi during storage.
5. **Detoxification:** 50% of the toxins can be destroyed by cooking grains at atmospheric pressure. Maximum destruction of mycotoxins occur by cooking rice at 15lbs pressure for 5minutes. Aflatoxins present in groundnut can be destroyed by dry roasting and oil roasting.
6. Use of herbal mould inhibitors: liquid extracts obtained from garlic, turmeric, neem etc., are known to exhibit antifungal effect. Even though, this approach might have certain advantages, practical application is not an easy task.
7. Application of mineral clays: Aluminosilicates are found to be effective for counteracting mycotoxins. Hydroxyl sodium calcium silicates can minimize the adverse effects of aflatoxins in chicken and pig when used at 1% of the feed.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 12.12.2023

8. **Microbial degradation**: In ruminants, ruminal microbes have the capacity of hydrolyzing toxins into non-toxic metabolites. Some of the mycotoxins may be destroyed during the process of ensiling of forages due to lactic acid bacteria.
9. **Natural and organic binder:** Esterified glucomannan binds with different mycotoxins and helps in reducing the individual and combined effects produced by them. Dietary inclusion of this compound have shown to increase the body weight, egg production parameters, serum biochemical and hematological parameters significantly.
10. **Detoxification by enzymes:** certain enzymes isolated from microorganisms or mushrooms are able to detoxify mycotoxins. Ery4 laccase from Pleurotus eryngii can destroy AFB1, FB1, OTA and T-2 toxin.

Conclusion: Controlling mycotoxins in feeds and fodder requires a multifaceted approach. Firstly, implementing proper storage practices, such as maintaining low moisture levels and adequate ventilation, is crucial to prevent fungal growth. Additionally, regular testing of raw materials and finished feed for mycotoxin presence helps in early detection and mitigation. Employing mycotoxin binders or detoxifiers within feed formulations aids in reducing their bioavailability and harm to livestock. Ensuring good agricultural practices during crop cultivation, including crop rotation and pest control can limit fungal infestation. Lastly, educating and training farmers and feed manufacturers about the risks and strategies for mycotoxin control is vital for sustained prevention. Ultimately, a holistic strategy integrating pre-harvest, harvest, and post-harvest measures is essential to effectively manage mycotoxins in feeds and fodder, safeguarding animal health and productivity.

References

Handbook of Poultry Nutrition-V. Ramasubba Reddy, Dinesh T. Bhosale. American Soybean Association [and] United Soybean Board by International Book Distributing Company, 2004

Srivastava, P.K. (1986). Bull Grain Tech. 24 (1): 64-69

Channaiah LH, Maier DE (2014) Best management practices for the prevention of mycotoxin contamination. In: Leslie JF, Logrieco A (Eds.), Mycotoxin reduction in grain chains, John Wiley & Sons Inc., New York, USA, pp. 78-89.

Bilgrami, K.S. and K.K.Sinha (1984). Ind. Rev. Lite. Sci. 4: 19-36.

Yadgiri, B. and P.G.Tulpule (1974). Ind. J. Dairy Sci. 27: 293-297.

Agrawal, Y.G (1985). Bull. Grain Tech. 23 (2): 154-160.

Goyal, R. K. (1991). Prevention and control of mycotoxins in food grains in India.

Hesseitine, C.W. (1974). Mycopath. Mycol. Appl. 53: 141-153.

Loi, M., Fanelli, F., Cimmarusti, M. T., Mirabelli, V., Haidukowski, M., Logrieco, A. F., ... & Mule, G. (2018). In vitro single and combined mycotoxins degradation by Ery4 laccase from Pleurotus eryngii and redox mediators. Food Control, 90, 401-406.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 12.12.2023