

Impact of Mycotoxin on Gut Health in Poultry



Dr. B C Dutta
Poultry Consultant & Author

Mycotoxins in feed pose a constant threat to the poultry industry globally. The common feed ingredients for feed formulation can be contaminated by many mycotoxins.

Mycotoxins are secondary metabolites of

common moulds/fungi produced during their growing period. Some fungi produce mycotoxins on the field, while other produce mycotoxins during the harvest or storage of grains and in finished feed. The most common feed ingredients that can be contaminated by mycotoxins are maize & its by-products, wheat & its by-products, rice & its by-products, soybean meal, barley and groundnut cake.

Two Mycotoxin Surveys done by two leading poultry feed additive manufacturers, Biomin & Trouw, reveal the terrible condition the Asian poultry Industry is facing.

Poultry have heterogeneous sensitivity to mycotoxins; ducks and turkeys are more sensitive than chickens. Young chickens are more sensitive to mycotoxins. The effects of mycotoxins in poultry are complex and vary greatly according to their mechanism of toxicity affecting different organs which may lead to death in case of high contamination level. Presence of mycotoxins in combination in feed may have synergistic or additive effects. Even low levels of mycotoxins in feed, during sensitive period of production cycle or when exposed for longer periods, can impair the immune system leading to the immune-suppression.

- Aflatoxins (AFB1), ochratoxin (OTA), trichothecenes, and fumonisins (FB1) are known to induce immune suppressive effects in chickens, enhancing their susceptibility to diseases (Singh et al., 1990, Ghosh et al., 1991). Low level of mycotoxins can have an antimicrobial effect and can cause feed passage (Devegowda and Murthy, 2005).

Trouw Nutrition Survey from samples taken between January to August 2020

Table 1. Number of Analysis performed and Percent contamination (Global & Asia)

Mycotoxin/Parameter	AFB1	DON	FB1	ZEA	OTA	T2	Total
Global No.	6232	3066	2741	1790	764	700	15293
Asia No.	491	128	194	115	199	109	1236
Asia % Contamination	70	73	90	72	67	2	

Table 2. Mycotoxin Distribution in Asian countries

Country	AFB1	DON	FB1	ZEA	OTA	T2
India	98 (31)	0 (0)	98 (2101)	67 (30.3)	93 (13.3)	0 (0)
Indonesia	60 (8.9)	65 (213)	85 (2144)	75 (40)	20 (1.0)	1 (0.36)
Bangladesh	56 (4.2)	82 (2214)	67 (3283)	63 (101)	80 (2.7)	0 (0)
China	48 (3.3)	95 (603)	90 (1386)	65 (41)	50 (2.8)	6 (1.80)
Myanmar	47 (5.8)	100 (150)	75 (804)	100 (55)	NA	NA

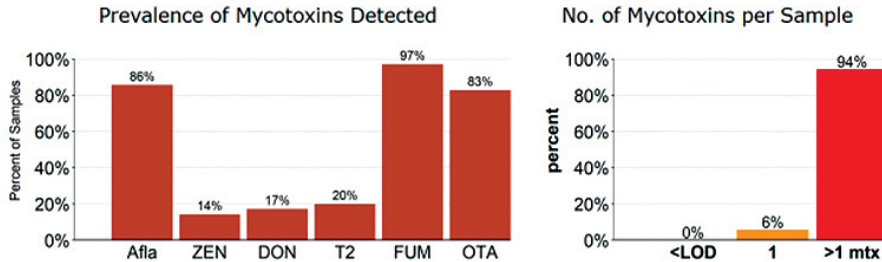
Table 3. Mycotoxin concentrations (ppb) in various commodities in Asia

Commodities	AFB1	DON	FB1	ZEA	OTA	T2
By-products	9.3	1717	613	76	3.4	1.4
Cereal Grains	17	144	1956	29	0.74	0.13
Protein sources	12	472	356	64	13	1.3
Poultry Feed	19	259	2571	40	9.5	0.74
Pig Feed	7.7	125	580	44	1	0
Ruminant Feed	18	NA	1000	NA	4	NA

- The presence of multiple mycotoxins today, particularly in complete feed, is a rule and not an exception. When occurring together, many mycotoxins act in a synergistic or additive manner inside the animal's body leading to unexpected and high toxicity.
- Unlike microbes, mycotoxins are heat resistant and survive common feed processing operations such as pelleting and extrusion. As a result of all these, the exposure of animals to mycotoxins is unavoidable today and hence pre-

India Finished Feed Jan 2020 to Mar 2020

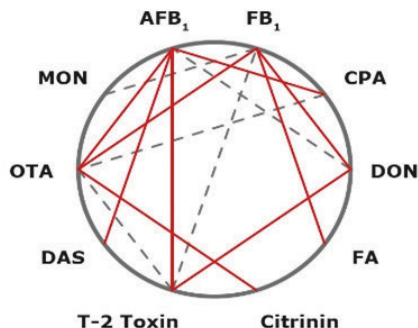
Total Risk Level: 97%*	Afla	ZEN	DON	T2	FUM	OTA
Number of samples tested	35	35	35	35	35	35
% Contaminated samples	86%	14%	17%	20%	97%	83%
% Above risk threshold	86%	9%	17%	0%	57%	37%
Average of positive (ppb)	84	100	385	30	889	14
Median of positive (ppb)	26	87	380	32	559	9
Maximum (ppb)	1252	261	480	37	4939	43



vention strategies should be applied at crop production, feed production and at animal facility levels

Impact of Mycotoxin on Gastrointestinal Tract (GIT) Function

- The two survey reports reveal that almost 98% feed ingredients are contaminated with AFB1 & FB1 and 93% with OTA. Further, finished feed were worse than ingredients with 100% contaminated with mycotoxins and 94% with more than one mycotoxin.
- Gastro Intestinal Tract (GIT) is the biggest organ surface exposed to foreign materials including feed, Mycotoxins.
- GIT is responsible for digestion & absorption of all feed materials including water and its ability to function is directly linked to poultry productivity.



Additive (dashed black line) and synergistic (red line) effects of different mycotoxin in poultry (Source: Biomin website)

- GIT is the biggest Immune organ in the chicken's body.
- Any mycotoxins present in feed are delivered straight to the GI tract of the birds; the organ most affected by mycotoxins.

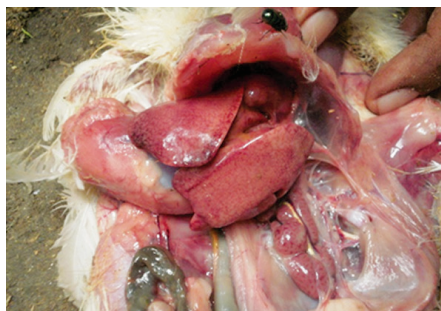
Among the major mycotoxins, DON (deoxynivalenol), ZEN (zearalenone) and FUM (fumonisins) are often overlooked because their impact on poultry health and productivity is not clearly visible. However, many scientific and commercial trials prove that these Fusarium mycotoxins are closely related to some important poultry diseases.



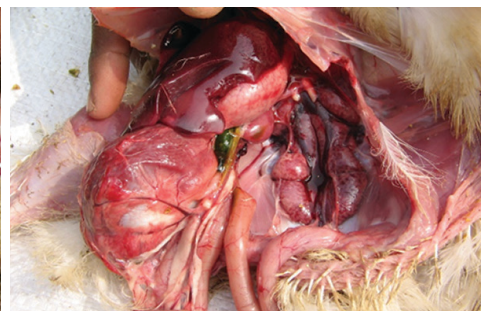
Pic 1. Damage of Intestinal Mucosa



Pic 2. Gizzard Erosion



Pic 3. Fatty Liver

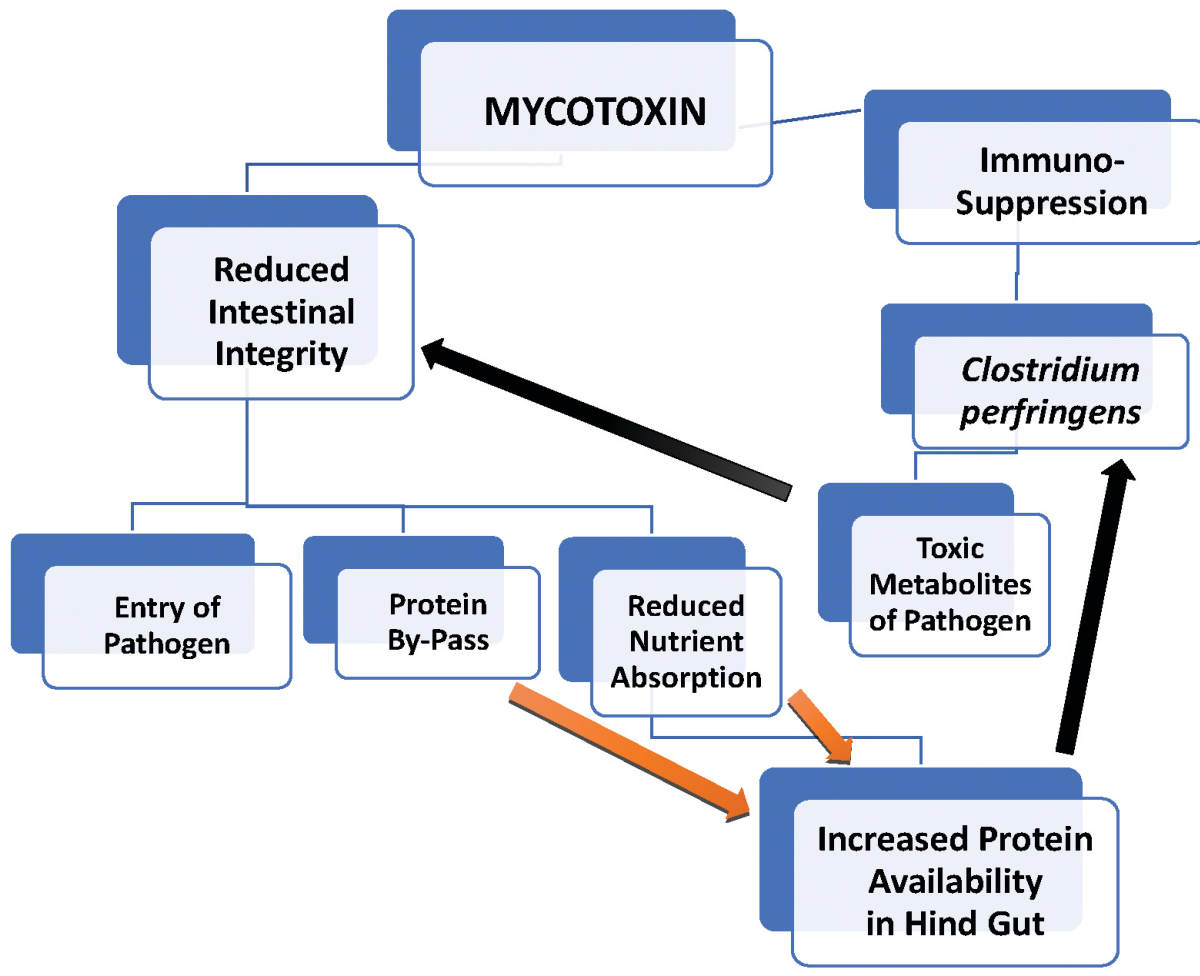


Pic 4. Swollen & damage Kidney

- AFB1 causes Fatty Liver and malabsorption due to reduced production of

- bile salts.
- AFB1 damages the Tight Junction Integrity of intestinal epithelial cells resulting in leakage of nutrients and facilitates entry of pathogen through damaged mucosa.
- AFB1 reduces the size of bursa, spleen & thymus and thus affects production of both B cells & T cells, leading to immunosuppression, which ultimately results in increased susceptibility to other enteric diseases like Salmonellosis, E coli, Necrotic Enteritis, Coccidiosis, Adenovirus, Rotavirus, Astrovirus infections.
- By damaging epithelial cell integrity, AFB1 directly damages the gut associated lymphoid cells (GALT) and indirectly making the passage open by destroying the barrier to facilitate entry of many more infections.
- AFB1 reduces enzyme activity of digesting starch, protein & lipids in chicken.
- FB1 affects proliferation of Intestinal epithelial cells, reduces villi height & villus to crypt ratio and thus affects the normal atmosphere of intestinal epithelium and intestinal microbial homeostasis resulting in increased incidence of NE & Coccidiosis.
- FB1 reduces functional activity of intestine resulting in nutrient leakage, diarrhoea, poor digestive output, etc.

- OTA impacts tight junction integrity, damages intestinal mucosa and af-



- affects digestive functions
- T2 Toxins disturbs intestinal epithelial cell proliferation, mucous production & immunoglobulin production and thus affects intestinal health & nutrient utilization.
- DON impairs nutrient absorption and affects tight junction integrity of intestinal epithelial cell.

Present Mycotoxin contamination scenario compels us to conclude that:

- Almost 100% of common feed ingredients & finished feed in this subcontinent are contaminated with one or more mycotoxins, and the contamination has become a rule now due to unseasonal rains, draught, hot & humid weather, crop damage by insect and storage inefficiencies.
- Most mycotoxins damage gut epithelium & tight junction integrity even in suboptimal level, which usually has been neglected at the feed manufacturing point due to the absence of distinct clinical signs
- Combination of bare minimum level of

mycotoxin (combined mycotoxicosis) may not produce any clinical signs but can damage Intestinal epithelium & tight junction integrity leading to poor gut health; which is a fact but not considered.

- Mycotoxin negatively impacts of both humoral & cell mediated immunity,

damages GALT to further deteriorate immunity, damages gut barrier to facilitate entry of pathogens into the system and hence the major, if not the main predisposing factor for all enteric & other diseases resulting not only poor gut health but also mortality leading to huge loss in poultry business.

