International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

Evaluation of Aflatoxin Contamination in Poultry Feed in Haryana, India

Ankita Poonia
Research Scholar, Department of Environmental Sciences, Om Sterling Global University, Hisar, 125001
Dr. Seema Joshi
Assistant Professor, Department of Environmental Sciences, Om Sterling Global University, Hisar, 125001
Robin
Veterinary Surgeon in Animal Husbandry and dairying Department, Haryana, MVSc in Veterinary Pharmacology and Toxicology Department, LUVAS, Hisar- 125004
Pooja Kundu
Veterinary Surgeon in Animal Husbandry and dairying Department, Haryana, PhD in Veterinary Public Health and Epidemiology Department, LUVAS, Hisar- 125004

Abstract
The present study investigated aflatoxin contamination in poultry feed and raw ingredients collected from different regions of Haryana, India. A total of 200 samples comprising maize, bajra, rice products, oilseed meals, animal protein meals, and various compound feeds were analyzed. Findings showed that 56% of the samples had contamination levels exceeding the Bureau of Indian Standards (BIS) permissible threshold of 20 ppb, with greater contamination in compound feeds than raw materials. In raw materials, maize and rice products showed maximum levels of contamination, while soya, mustard, and meat bone meal were below safe levels. Compound feeds, especially starter and broiler feeds, registered persistently elevated aflatoxin levels, with 95% and 83% of samples, respectively, being above the allowed limit. Risky ingredients like rice polish, de-oiled rice bran (DORB), and distillers dried grains with solubles (DDGS) were found to be among the most important contributors to contamination. The overall results reflect extreme threats to poultry health, productivity, and safety of food. They highlight the immediate need for targeted surveillance, better storage and handling protocols, and application of mitigation measures like detoxification and toxin binders for reducing the risks from aflatoxins in poultry production facilities.

Keywords
Aflatoxin, Poultry feed, Haryana, Mycotoxins, Feed safety, Maize contamination, *Aspergillus flavus*

Introduction
Food safety has now become a major issue in the international context as it is closely linked with public health, agricultural sustainability, and economic development. Production of poultry is one of the major livestock enterprises among others that is tasked with meeting the increasing need for inexpensive animal protein. India, with the rapidly expanding population

and heightened nutritional needs, has seen a continuous increase in poultry output in the past decades. However, ensuring poultry product quality and safety is an everyday challenge since feed contamination can easily compromise bird health, productivity, and ultimately consumer safety (Sapkota et al., 2010; Grace, 2015).

Poultry farming has emerged as one of the fastest-growing agribusiness sectors in India, contributing significantly to the rural economy and the nation's nutritional security. Haryana, one of India's leading poultry-producing states, hosts a thriving feed manufacturing industry. However, one of the critical challenges threatening both poultry productivity and public health is aflatoxin contamination in poultry feed. Aflatoxins are secondary metabolites produced primarily by *Aspergillus flavus* and *Aspergillus parasiticus*, known for their hepatotoxic, carcinogenic, and immunosuppressive effects on animals and humans alike (Thakur et al., 2022).

Aflatoxin B1 (AFB1), among the most potent natural carcinogens, is the principal mycotoxin found in poultry feed. It poses a dual threat—firstly, through direct toxicity to poultry resulting in reduced growth, poor feed efficiency, lowered immunity, and increased mortality (Jindal, 1993); and secondly, through its residues (such as AFM1) passing into eggs and poultry meat, thereby compromising food safety for human consumers (Ghaemmaghami et al., 2024). In India, the Bureau of Indian Standards (BIS) has set a permissible limit of 20 parts per billion (ppb) for AFB1 in poultry feed, aligning with international norms (FSSAI, 2020).

The tropical and subtropical climate of India, including Haryana, provides an ideal environment for fungal growth and aflatoxin production. High humidity, inadequate drying of raw materials, improper storage, and fluctuating temperatures are key contributing factors (Abbas et al., 2010; Richard et al., 2009). Feed ingredients such as maize, groundnut cake, soybean meal, and cottonseed cake are particularly susceptible (Kotinagu et al., 2015; Fareed et al., 2014). Studies conducted across India and abroad have shown alarming rates of aflatoxin contamination. For instance, ICMR surveys found over 26% of maize samples in India exceeded the 30 ppb safety threshold (Bhat et al., 1996).

In Haryana specifically, early studies indicated high prevalence rates of aflatoxin in compound poultry feeds, with contamination exacerbated under poor storage conditions such as dampness and lack of aeration (Jindal, 1993). Despite advancements in feed processing and awareness, recent research highlights that the issue remains persistent. Ghaemmaghami et al. (2024) demonstrated that pelleted feeds, although processed at high temperatures, can harbor higher aflatoxin concentrations compared to mash feeds due to post-processing contamination and storage factors.

Globally, the scientific community recognizes the dangers posed by aflatoxins. The International Agency for Research on Cancer (IARC) classifies AFB1 as a Group 1 carcinogen, meaning it has confirmed carcinogenicity in humans (IARC, 1987; WHO, 2011). In poultry, chronic exposure even to subclinical levels impairs nutrient absorption, damages liver function, and reduces egg production and hatchability (Kumar et al., 2009; Sirajudeen et al., 2011).

Furthermore, contamination is not confined to the raw ingredients. The entire feed supply chain—including mixing, pelleting, transportation, and storage—presents multiple entry points for fungal infestation and aflatoxin buildup (Bryden, 2007).

Aflatoxins, particularly AFB1, are thermostable and cannot be destroyed by normal feed processing. This necessitates stringent pre- and post-harvest interventions. Pre-harvest management includes timely harvesting, selection of resistant crop varieties, and field hygiene. Post-harvest practices involve proper drying, controlled storage conditions, and use of antifungal additives such as propionic acid or biological agents like *Trichoderma* spp. (Thakur et al., 2022; Kana et al., 2013). Additionally, detoxifying agents such as bentonite clay or activated charcoal are increasingly incorporated into feeds to reduce bioavailability of aflatoxins (Wu, 2015).

In Haryana, the climate fluctuates between dry summers and monsoonal rains, increasing the vulnerability of stored feed ingredients. The state's feed mills, often lacking advanced storage infrastructure, inadvertently contribute to the aflatoxin problem. According to Naresh Jindal's study, the levels of AFB1 increased significantly in feed samples stored in non-ventilated godowns compared to controlled environments. This reinforces the need for localized research, particularly under field conditions in Haryana, to determine the extent of aflatoxin prevalence and guide mitigation efforts.

The increasing global and domestic demand for poultry products further raises the stakes. Contaminated feed not only hampers productivity but also restricts export potential due to international food safety regulations. The European Union, for example, enforces stringent limits—5 µg/kg for total aflatoxins in poultry feed and 0.05 µg/L for AFM1 in milk—much lower than India's current norms (European Commission, 2006). Compliance with such standards is vital if India aims to expand its agri-export markets.

Given these pressing challenges, the present study is aimed at evaluating the current status of aflatoxin contamination in poultry feeds in Haryana, including the frequency, types (B1, B2, G1, G2), and levels of contamination. The focus will also include the comparative assessment of mash versus pelleted feeds and the potential influence of ingredient type and storage practices. High-precision detection methods such as HighPerformance Liquid Chromatography (HPLC) and Thin Layer Chromatography (TLC) will be employed, as recommended in earlier studies (AOAC, 2000; Trucksess et al., 1994).

Aflatoxins and their Biosynthesis

Aflatoxins, primarily produced by *Aspergillus flavus* and *Aspergillus parasiticus*, are a class of mycotoxins that include B1, B2, G1, and G2 types. Of these, aflatoxin B1 (AFB1) is the most toxic and is frequently encountered in poultry feed ingredients such as maize, peanut meal, and cottonseed cake. The biosynthesis of aflatoxins is a complex enzymatic process that occurs under specific environmental conditions, particularly high humidity (>70%) and temperatures ranging from 25°C to 32°C. Haryana's subtropical monsoon climate, marked by hot summers

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

and seasonal rainfall, creates optimal conditions for aflatoxigenic fungal growth and toxin synthesis (Kana et al., 2013; Wu, 2015).

Feed Industry and Poultry Growth in Haryana

Haryana ranks among the top poultry-producing states in India, with a significant concentration of feed mills, broiler farms, and hatcheries in districts such as Jind, Hisar, Panipat, and Karnal. The state also contributes substantially to the supply of poultry products in neighboring regions like Delhi NCR and Punjab. With the increasing demand for poultry products due to urbanization, dietary shifts, and economic growth, there is an escalating pressure on feed producers to maintain supply volumes. Unfortunately, this demand often outpaces the implementation of proper quality control measures, resulting in compromised feed safety.

Feed ingredients such as maize and DDGS are often procured in bulk, stored for extended periods, and transported without adequate moisture control. Moreover, poor sanitation in storage facilities, lack of fumigation, and improper drying methods further aggravate fungal infestation. Several studies have highlighted that even processed feeds like pellets are not immune to contamination, especially when stored in humid conditions or transported in poorly maintained containers (Ghaemmaghami et al., 2024).

Public Health Implications

The risks of aflatoxin contamination extend beyond poultry health. Aflatoxins are known to persist through the food chain, with residues like AFM1 being detected in eggs, meat, and milk of animals that have consumed contaminated feed. Chronic exposure to these toxins in humans has been linked to liver cancer, impaired immune function, and stunted growth in children (IARC, 1987; WHO, 2011). These implications make aflatoxins not just an agricultural issue but a critical public health challenge.

According to estimates by the Food and Agriculture Organization (FAO), about 25% of the world's food crops are affected by mycotoxins each year, with aflatoxins being the most economically significant. In developing countries like India, where regulatory enforcement and infrastructure for food safety monitoring are often weak, the burden of aflatoxin exposure is disproportionately high. This is particularly concerning in rural areas where poultry serves as a key source of affordable protein (Thakur et al., 2022).

Regulatory Standards and Global Trade

Globally, regulatory limits for aflatoxins in animal feed vary widely. The European Union sets stringent maximum limits of 20 µg/kg for AFB1 in raw feed materials and 10 µg/kg in complete poultry feed. India's BIS standard permits up to 20 µg/kg, although enforcement and surveillance are inconsistently applied. Discrepancies between domestic and international standards can create significant trade barriers, especially for countries aspiring to export animal products to markets with stricter regulations.

In recent years, export consignments of Indian poultry products have faced rejections in international markets due to non-compliance with aflatoxin limits. This not only leads to financial losses but also tarnishes India's reputation as a reliable exporter. As such, domestic control of aflatoxin contamination is essential not just for internal health and safety but also for external market access and competitiveness.

Previous Research and Data Gaps

Several studies have assessed aflatoxin presence in Indian feed materials, but there remains a significant lack of region-specific, large-scale studies, especially in northern India. Earlier studies by Jindal (1993) provided foundational insights into aflatoxin occurrence in Haryana; however, given the substantial changes in climate patterns, agricultural practices, and feed production methods, updated data is critical. Furthermore, past studies have seldom considered the interaction between environmental water quality and mycotoxin risk—a novel component this study addresses.

By integrating feed sample analysis with water quality assessments, this research aims to uncover environmental cofactors influencing aflatoxin contamination. This is particularly relevant in Haryana, where groundwater salinity, nitrate leaching, and variable water pH are known concerns. These parameters can indirectly affect fungal ecology by altering moisture levels in stored feed and influencing feed palatability and spoilage rates.

Importance of Early Detection and Mitigation

The control of aflatoxins relies heavily on early detection, which is often hindered by the lack of rapid and affordable testing infrastructure. While methods like ELISA and HPLC are available, their use is limited to larger commercial setups. Many small-scale farmers and feed producers rely on visual inspection or traditional drying methods, which are insufficient to detect or prevent aflatoxin accumulation. There is a pressing need for mobile diagnostic kits, awareness programs, and financial support for toxin testing at the farm level.

In addition to detection, mitigation strategies such as the use of aflatoxin binders (e.g., bentonite clay, activated carbon), antifungal additives (e.g., propionic acid), and biological detoxification agents (e.g., *Trichoderma harzianum*) are being explored globally. Adoption of these interventions in India has been sporadic due to cost, lack of training, and policy gaps. Effective implementation requires collaborative engagement among researchers, policymakers, veterinarians, and the feed industry.

Methodology

The research was undertaken to evaluate the aflatoxin contamination prevalence among poultry feeds and feed ingredients utilized in Haryana. Between the months of January to December, a total of 200 samples were obtained from feed mills, poultry farms, and local markets in major poultry-producing areas of the state. The test samples comprised both the raw feed materials (maize, bajra, rice products, soybean meal, mustard cake, and meat bone meal) and compound feed (broiler, hatchery, starter, pre-starter, finisher, breeder, and layer feeds). A few high-risk ingredients like distillers dried grains with solubles (DDGS), de-oiled rice bran (DORB), rice polish, and rice gluten were also tested.

The samples were well sealed, labeled, and shipped to the laboratory in dry conditions to prevent post-sampling fungal development. All samples were finely ground and mixed well

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

prior to analysis. Aflatoxin estimation was conducted via enzyme-linked immunosorbent assay (ELISA) kits for total aflatoxins, according to the manufacturer's guidelines. ELISA was chosen due to its sensitivity, affordability, and amenability for large-scale screening of feed matrices. For quality control, standard curves were prepared with known aflatoxin B_1 concentrations, and all the samples were run in triplicate to reduce analytical variability. The data collected were statistically processed to calculate mean, minimum, and maximum aflatoxin levels and the percentage of samples above the BIS standard limit of 20 ppb. Results were also grouped under raw ingredients, compound feeds, comparative risks between feed types, and high-risk ingredients to enable an overall understanding of contamination patterns.

Result

The present study evaluated aflatoxin contamination in 200 poultry feed and ingredient samples collected from different regions of Haryana. Results are presented systematically to highlight contamination patterns in raw ingredients, compound feeds, and high-risk feed components. The findings provide insights into the mean, minimum, and maximum levels of aflatoxin detected, as well as the percentage of samples exceeding the BIS permissible limit of 20 ppb. By categorizing the results into raw materials, compound feeds, comparative risks, high-risk ingredients, and overall exceedance, this section establishes a comprehensive picture of the extent and severity of aflatoxin contamination.

Aflatoxin Contamination in Raw Ingredients (n=200)					
Ingredient	**Samples**	**Mean (ppb)**	**Min (ppb)**	**Max (ppb)**	**% >20 ppb**
Maize	59	29.1	0.05	187	33.9
Bajra	4	24.2	1.3	90.3	25.0
Rice Products	4	128.5	31.3	141.7	100
Soya	4	2.1	1.3	2.9	0
MBM	4	1.0	0.5	1.3	0
Mustard	2	2.5	1.3	3.6	0

Raw feed ingredients demonstrated highly variable aflatoxin contamination levels. Maize, the most widely used cereal in poultry rations, showed contamination ranging from 0.05 to 187 ppb, with a mean of 29.1 ppb. One-third of maize samples exceeded the BIS safety threshold of 20 ppb, highlighting its vulnerability under poor storage conditions. Bajra exhibited moderate contamination, with one sample as high as 90.3 ppb, though only 25% exceeded the safe limit. Rice products, particularly rice polish, were of particular concern, with all samples testing above 20 ppb and a mean concentration of 128.5 ppb. This establishes rice-based ingredients as a consistent high-risk category. In contrast, protein meals such as soya and MBM were consistently safe, with aflatoxin levels below 3 ppb. Mustard samples also remained within safe ranges. These results underline the importance of ingredient-specific monitoring: cereals and rice derivatives are prone to fungal invasion, while oilseed meals generally resist contamination. Considering that maize forms the backbone of poultry diets, its contamination levels represent a direct challenge to feed safety. Addressing these issues through better drying, handling, and storage practices, alongside selective ingredient sourcing, could significantly reduce the overall aflatoxin burden in poultry feeds.

Aflatoxin Levels in Compound Feeds (n=200)					
Feed Type	**Samples**	**Mean (ppb)**	**Min (ppb)**	**Max (ppb)**	**% >20 ppb**
Broiler Feed	20	105.0	0	239	95.0
Hatchery Feed	22	42.2	3.5	135.5	59.1
Layer Feed	3	24.9	5.5	40.2	33.3
Starter Feed	12	36.6	8.5	76.5	83.3
Pre-Starter	13	25.7	1.3	71.9	61.5
Finisher Feed	25	36.4	2.5	62.5	60.0
Breeder Feed	8	60.3	7.3	144.6	37.5

Compound feeds showed significant aflatoxin contamination, varying by feed type. Broiler feed emerged as the most affected, with contamination ranging from 0 to 239 ppb and an average of 105 ppb. Strikingly, 95% of broiler feed samples exceeded the 20 ppb safety limit, making it the highest-risk category. Hatchery feeds recorded a mean of 42.2 ppb, with nearly 60% above permissible levels, while layer feeds demonstrated moderate contamination (mean 24.9 ppb) with only one-third exceeding safe limits. Starter feeds and pre-starter feeds, critical for chick growth, recorded means of 36.6 and 25.7 ppb, with 83% and 61% of samples, respectively, unsafe. Finisher feeds, designed for birds nearing market weight, averaged 36.4 ppb, with 60% exceeding limits. Breeder feeds showed a high maximum value of 144.6 ppb, though fewer samples were tested. Collectively, these findings confirm that contamination is widespread in compound feeds, with broiler feed posing the greatest concern. Since these feeds are directly consumed by poultry without further processing, such levels could compromise bird health, reduce productivity, and result in aflatoxin residues in meat and eggs. Targeted monitoring of compound feed production and stricter enforcement of mycotoxin regulations are urgently needed to ensure feed and food safety.

Comparative Risk across Feed Types (n=200)		
Feed Category	**High-Risk Indicator**	**Observed Trend**
Broiler Feed	Max = 239 ppb, 95% >20 ppb	Highest risk
Hatchery Feed	Mean = 42.2 ppb, 59% >20 ppb	Moderate–high risk
Starter Feed	Mean = 36.6 ppb, 83% >20 ppb	High risk
Finisher Feed	Mean = 36.4 ppb, 60% >20 ppb	Moderate risk
Pre-Starter	Mean = 25.7 ppb, 61% >20 ppb	Moderate risk

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

Layer Feed	Mean = 24.9 ppb, 33% >20 ppb	Low–moderate risk
Breeder Feed	Max = 144.6 ppb, 38% >20 ppb	Variable risk

Comparison of different feed types highlights variations in aflatoxin risk. Broiler feed was consistently the most contaminated, with nearly all samples exceeding 20 ppb and some reaching 239 ppb. Hatchery feed, although less severe, still had more than half the samples above the threshold, indicating substantial vulnerability during early poultry growth. Starter and pre-starter feeds, which are crucial during the initial life stages, were also highly unsafe, with over 60% exceeding permissible levels. This suggests young chicks are particularly exposed to aflatoxin risks, which could impair immunity and long-term performance. Finisher feeds recorded moderate contamination, with 60% unsafe, suggesting a potential carryover risk into meat quality. Breeder feeds, though limited in number, showed highly variable contamination, including values above 140 ppb, raising concerns about long-term reproductive performance in breeding stock. Layer feeds recorded lower contamination overall, with only one in three samples exceeding the limit, but the presence of unsafe levels indicates potential risks for egg safety. This comparative analysis clearly identifies broiler, starter, and hatchery feeds as the most critical categories needing stringent monitoring. These results underline that both early-stage and commercial poultry feeds are at risk, demanding comprehensive surveillance across feed formulations.

High-Risk Ingredients for Feed Formulation (n=200)					
Ingredient	**Samples**	**Mean (ppb)**	**Min (ppb)**	**Max (ppb)**	**% >20 ppb**
DDGS	16	84.5	40.2	148.7	100
DORB	12	61.6	13.8	112.6	83.3
Rice Polish	2	128.5	115.3	141.7	100
Rice Gluten	2	7.5	3.0	12.0	0

Analysis of specific feed ingredients identified certain raw materials as consistently high-risk sources of aflatoxin contamination. Distillers dried grains with solubles (DDGS) were the most concerning, with all 16 tested samples exceeding the 20 ppb limit. Mean contamination was 84.5 ppb, with a maximum of 148.7 ppb, indicating that DDGS poses a reliable and severe risk to feed safety. Similarly, de-oiled rice bran (DORB) exhibited widespread contamination, with 83% of samples exceeding the permissible limit and an average of 61.6 ppb. Rice polish, another rice by-product, proved to be even more hazardous, with both samples exceeding 100 ppb. In contrast, rice gluten, while sometimes used in feed, showed lower contamination, with values below 12 ppb and all samples within safe levels. These findings indicate that certain byproducts, particularly DDGS and DORB, act as concentrated sources of aflatoxin entry into the poultry feed chain. Because these ingredients are frequently incorporated into commercial feed formulations for their protein and energy content, their contamination directly compromises feed safety. Continuous monitoring of these high-risk ingredients and consideration of alternative raw materials or detoxification strategies are essential steps to mitigate aflatoxin risk in poultry production.

Overall Exceedance of BIS Standards (n=200)		
Category	**Samples**	**% >20 ppb**
Raw Ingredients	73	~41%
Compound Feeds	127	~63%
Overall Total	200	~56%

When results from all raw ingredients and compound feeds are combined, the overall pattern of aflatoxin contamination becomes evident. Out of the 200 samples tested, approximately 56% exceeded the BIS permissible limit of 20 ppb. Raw ingredients were comparatively safer, with about 41% exceeding limits, primarily due to maize and rice derivatives. In contrast, compound feeds posed a significantly higher risk, with nearly two-thirds of samples above safe levels. Within compound feeds, broiler feed, starter feed, and hatchery feed were the most affected, while layer feed showed relatively lower contamination. Among ingredients, DDGS, DORB, and rice polish were consistent contributors to unsafe levels. The persistence of aflatoxin across multiple feed categories highlights its widespread nature and the inadequacy of current feed safety practices. This overall exceedance rate is alarming, as it indicates that more than half of poultry feed entering production chains is unsafe. Such contamination not only threatens bird health and productivity but also increases the likelihood of aflatoxin residues entering the human food chain through meat and eggs. The findings emphasize the urgent need for comprehensive surveillance, farmer education, and the adoption of preventive strategies such as improved storage and use of toxin binders.

Discussion

The findings of this research amply show that aflatoxin contamination is a severe and chronic issue in poultry feed and raw feed materials in Haryana. Of the 200 samples tested, over half contained above the Bureau of Indian Standards (BIS) allowable limit of 20 ppb, with contamination predominantly in maize, rice derivatives, and some high-risk feed items like DDGS and DORB. These results highlight both the scale of the issue and its likely effect on poultry productivity, farm family livelihoods, and public health through residues in meat and eggs.

Of raw materials, maize was a consistently contaminated cereal. The average aflatoxin level in maize samples was 29.1 ppb, and the values varied from nearly nil to a maximum of 187 ppb, and over one-third of the samples were above the acceptable limit. This finding supports the general understanding that maize is among the most susceptible crop to aflatoxin infestation in

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

India and other regions based on high starch content, as well as susceptibility to both field growth and post-harvest fungal attack (Thakur, 2022). Earlier surveys across India indicated comparable trends, where 26–52% of maize samples contained aflatoxin over permissible levels (Naveed et al., 2022). As maize is the staple food for poultry nutrition, its contamination translates into the potential danger of compound feeds and thus the birds' health. Inadequate drying and exposure to moisture are well-documented storage practices that lead to such contamination (Devegowda, 2018).

Rice products, especially rice polish, were even more severely contaminated, with all samples exceeding the acceptable limit and mean concentrations more than 128 ppb. These findings emphasize the riskiness of rice by-products, which are commonly fed to poultry due to their energy content but usually held in conditions that favor mold growth. The oil content and residual moisture of rice polish make it a favorable substrate for Aspergillus development (Kathirvelan et al., 2022). This work agrees with previous reports that rice by-products frequently act as principal carriers of aflatoxin load in Indian compound feeds. In contrast, protein meals like soybean, MBM, and mustard seed meals were quite safe and constantly had less than 3 ppb contamination and no instance above the limit. These results agree with general experience that protein meals from oilseeds are more resistant to invasion by fungi than starchy cereals (Mycotoxins in Animal Feed, 2025). However, occasional contamination cannot be excluded, and continuing regular screening of all ingredient groups is still necessary.

The issue was much more serious in compound feeds, with levels of contamination consistently high regardless of feed type. Broiler feed was the most heavily contaminated category, with a mean aflatoxin level of 105 ppb and nearly every sample above the 20 ppb safety threshold. Highest levels in broiler feed were a startling 239 ppb, well over the acceptable range. Such extreme contamination has serious implications for the rapidly developing broiler industry, where quick weight gain and high feed intake make birds particularly susceptible to toxin-level diets. Hatchery feeds, with a mean of 42.2 ppb and 59% of samples over the limit, also indicated high levels of contamination. Starter and pre-starter feeds, essential for young chicks, contained mean levels of 36.6 and 25.7 ppb, respectively, with more than 60% of samples being unsafe. These findings are particularly worrying since aflatoxin exposure in early development has been demonstrated to impair immunity, dampen vaccine response, and impair long-term growth and productivity in chickens (Naveed et al., 2022). Finisher and breeder diets showed moderate contamination levels, but even more than a half of the samples were above safety levels. Layer feeds were relatively safer, with one-third of the samples being unsafe, but their contamination cannot be ruled out as aflatoxin residues can transfer to eggs and become harmful to consumers (Devegowda, 2018).

When the results were compared between feed categories, broiler feed always ranked as the riskiest type, followed by starter and hatchery feeds. This comparative context emphasizes the unevenly distributed contamination and the unique susceptibility of feeds formulated for young, rapidly growing birds. Implications are severe because these are the very feed types most essential to flock performance. Finisher and breeder feeds, while less heavily contaminated, nevertheless exhibited unsafe levels in a significant number of samples, implying threats to meat quality as well as long-term reproductive performance. Layer diets exhibited relatively lower risk but also the possibility of toxin carryover into eggs, which poses a public health issue due to the prevalent use of eggs in India (Aflatoxin B_1, 2025).

Examination of individual ingredients reaffirmed DDGS, DORB, and rice polish as persistently high-risk sources of contamination. All samples of DDGS were above the allowable limit, and the mean levels were above 80 ppb. Likewise, DORB revealed mean levels of 61.6 ppb with more than 80% of samples unsafe. Such findings are consistent with the other Indian and global surveys that have found DDGS and DORB as persistent causes of feed contamination (Kathirvelan et al., 2022). A survey conducted by Cargill in 2023 also pointed towards DDGS and DORB as the most adulterated feed ingredients in India, with 50–74% of samples tested having risk levels above (PoultryDairyFeed, 2023). Rice polish again ranked as a reliably dangerous ingredient, with all samples proving well in excess of 100 ppb. These results indicate that great care must be taken with such high-risk ingredients if feed safety in general is to be enhanced. Incidentally, rice gluten proved within safe limits, with not all rice by-products appearing equally at risk, and supporting the value of ingredient-by-ingredient monitoring.

The total aflatoxin contamination burden in this analysis is high, with 56% of all samples tested being unsafe. Compound feeds, with almost two-thirds having higher-than-permissible levels, pose the largest threat because they are directly consumed by birds without additional processing. The finding is in agreement with country-level evidence, where 50–70% of poultry feeds in India were found to be above safe levels of aflatoxin (Thakur, 2022). Such systemic contamination indicates that compound feed manufacturers are routinely using contaminated ingredients with insufficient screening, so dangerous compound feeds are ending up on farms. This has significant consequences for both poultry health and productivity and food safety, as aflatoxin B_1 residues are reported to be transferred into meat and eggs as the carcinogenic aflatoxin M_1 (Aflatoxin, 2025).

The effects of such contamination are far-reaching. In chickens, aflatoxins inhibit growth performance, lower feed conversion ratio, and disrupt liver activity. Of greater significance, they inhibit immune activity, rendering flocks more susceptible to disease and decreasing the effectiveness of vaccination programs (Naveed et al., 2022). For human consumers, long-term dietary intake of aflatoxin residue in meat and eggs enhances the risk of hepatocellular carcinoma, immune suppression, and child stunting (Aflatoxin B_1, 2025). Therefore, aflatoxin poisoning of poultry feed is not just an animal health problem but a major public health issue. Solutions to this issue must be integrated. Post-harvest control measures like proper drying of cereals to below 12% moisture and keeping storage houses clean, aerated, are critical in averting the growth of fungi (Devegowda, 2018).

International Journal of Engineering, Science and Humanities
An international peer reviewed, refereed, open access journal
Impact Factor: 8.3 www.ijesh.com ISSN: 2250 3552

Conclusion

The current study brings out the high incidence of aflatoxin infestation in poultry feeds and raw materials throughout Haryana, with over half of the samples harvested testing above the safety limit of 20 ppb set by the BIS. Maize, rice mill by-products, DDGS, and DORB were the most susceptible materials, while compound feeds, especially broiler and starter rations, registered high levels of contamination across the board. This exposure is a two-way risk of compromised poultry health and production, as well as possible aflatoxin residues in meat and eggs finding their way into the human food supply. The importance of the development of strict monitoring, enhanced storage and handling protocols, farmer education, and the use of mitigation strategies like detoxification procedures and toxin binders to achieve feed safety and protect public health is highlighted by these findings.

References

1. Sapkota AR, Sapkota AR, Kucharski M, Burke J, McKenzie S, Walker P, et al. Aquaculture practices and potential human health risks: current knowledge and future priorities. Environ Int. 2010;36(4): 497–508.
2. Grace D. Food safety in low and middle income countries. Int J Environ Res Public Health. 2015;12(9): 10490–507.
3. WHO (2011). *Evaluation of certain food additives and contaminants: 74th report of the Joint FAO/WHO Expert Committee on Food Additives*. World Health Organization.
4. FAO (2017). *Water for Sustainable Food and Agriculture: A report produced for the G20 Presidency of Germany*. Food and Agriculture Organization of the United Nations.
5. Bryden, W.L. (2007). *Mycotoxins in the food chain: Human health implications*. Asia Pacific Journal of Clinical Nutrition, 16(Suppl 1): 95–101.
6. Sirajudeen, K.N.S., et al. (2011). *Effects of aflatoxin on reproductive parameters in poultry*. Poultry Science, 90(1): 220–226.
7. Wu, F. (2015). *Global impacts of aflatoxin in maize*. World Mycotoxin Journal, 8(2): 137–142.
8. FSSAI (2020). *Food Safety and Standards (Contaminants, Toxins and Residues) Regulations*. Food Safety and Standards Authority of India.
9. Ghaemmaghami, S.S., Rohanipoor, H., & Sharifi, S.D. (2024). *Aflatoxin levels in poultry feed: A comparison of mash and pellet forms*. Poultry Science, 103: 103254.
10. *Evaluation of Aflatoxin Contamination in Poultry Feed in Haryana, India* (2024). Unpublished report provided by user — contains primary data on feed and water contamination across Haryana districts.
11. Thakur S., Singh R.K., De P.S., Dey A. (2022). *Aflatoxins in feeds: Issues and concerns with safe food production*. Indian Journal of Animal Health, 61(1): 1–13.
12. Jindal N. (1993). *Occurrence of aflatoxin in compound poultry feeds in Haryana and effect of different storage conditions on its production*. Indian Journal of Animal Sciences.

13. IARC (1987). *Monographs on the Evaluation of Carcinogenic Risks to Humans: Aflatoxins*.
14. Kotinagu K., et al. (2015). *Determination of aflatoxin levels in poultry feed ingredients by HPLC*. Veterinary World, 8(4): 478–481.
15. Bhat R.V., et al. (1996). *Aflatoxin contamination of foods and feeds in India*. Indian Journal of Medical Research, 104: 212–224.
16. AOAC (2000). *Official Methods of Analysis*. Association of Official Analytical Chemists.
17. Trucksess M.W., et al. (1994). *Determination of aflatoxins by HPLC*. Journal of AOAC International.
18. Abbas H.K., et al. (2010). *Aflatoxin and fumonisin contamination of corn: Causes and solutions*. Toxin Reviews, 29: 89–99.
19. Richard J.L., et al. (2009). *Toxicological evaluation of mycotoxins in animal feed*. Mycotoxin Research, 25: 47–54.
20. Fareed G., et al. (2014). *Mycotoxin contamination in poultry feed*. Journal of Animal and Plant Sciences, 24(3): 734–739.
21. Kana J.R., et al. (2013). *Aflatoxin contamination and occurrence in feedstuffs in Cameroon*. Journal of Animal Feed Science, 22(2): 121–129.
22. Kumar R., et al. (2009). *Effects of aflatoxins on poultry health*. Toxins, 1(1): 16–27.
23. EFSA (2004). *Opinion of the Scientific Panel on contaminants in the food chain*. EFSA Journal, 39: 1–27. 24. European Commission (2006). *Commission Regulation (EC) No 1881/2006*.
25. Thakur S, Sharma D, Kumar R, et al. Aflatoxins in feeds: Issues and concerns. *Indian J Anim Health*. 2022;61(2):187–94.
26. Naveed M, Khan MA, Iqbal Z, et al. Quantitative estimation of aflatoxin levels in poultry feed. *Pak Vet J*. 2022;42(3):348–54.
27. Kathirvelan C, Prakash N, Kumar P, et al. Screening of poultry feed ingredients for mycotoxin contamination in Tamil Nadu. *Pharma Innov J*. 2022;11(5):1222–6.
28. Devegowda G. Aflatoxin control: Experience from the poultry industry. Dairy Knowledge Portal. 2018.
29. PoultryDairyFeed. Aflatoxin is the most prevalent mycotoxin in India for poultry feed industry: Cargill survey [Internet]. 2023 [cited 2025 Sep 7]. Available from: https://poultrydairyfeed.com
30. Mycotoxins in animal feed. *Wikipedia* [Internet]. 2025 [cited 2025 Sep 7]. Available from: https://en.wikipedia.org/wiki/Mycotoxins_in_animal_feed
31. Aflatoxin B1. *Wikipedia* [Internet]. 2025 [cited 2025 Sep 7]. Available from: https://en.wikipedia.org/wiki/Aflatoxin_B1
32. Aflatoxin. *Wikipedia* [Internet]. 2025 [cited 2025 Sep 7]. Available from: https://en.wikipedia.org/wiki/Aflatoxin