EC3066

Use of Mycotoxin-Contaminated Feed for Animals

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Purpose of this Extension Circular

The purpose of this Extension Circular is to provide guidelines for animal owners, principally livestock and poultry, who wish to use mycotoxin-contaminated feed for their animals. Details about the commercial marketing of mycotoxin-contaminated feed are outside the scope of this document.

What are mycotoxins?

Mycotoxins are toxic chemicals naturally produced by fungi that grow on plants or grains used as feed. Mycotoxins can produce adverse health effects when animals ingest contaminated feed. The adverse health effects produced differ because mycotoxins differ.

Mycotoxin production depends upon favorable growing conditions for the mycotoxin-producing fungi, which may occur before or after harvest. Before harvest, growing conditions that stress plants, such as drought or insect damage, increase the possibility of mycotoxin production. After harvest, high moisture content, kernel damage, or poor storage conditions increase the possibility of mycotoxin production.

The most common source of mycotoxin contamination in feed is contaminated grain, which includes barley, corn (maize), millet, oats, rice, rye, sorghum, triticale, and wheat. Products derived from grains—including grain screenings, distillers' grains, and brewers' grains—may also be contaminated. Forage or silage may be contaminated. Processed feeds made from contaminated components may be contaminated.

Mycotoxins commonly found in grains or feeds used in Nebraska are aflatoxins; deoxynivalenol (DON), commonly called vomitoxin; ergot alkaloids; fumonisins; and zearalenone. The Extension Circular titled "Understanding Mycotoxins" contains more information about those mycotoxins.

Use of mycotoxin-contaminated feeds

It is safest NOT to use mycotoxin-contaminated feed, but that is not always possible; uncontaminated feed may be unavailable or too expensive to use. Faced with using mycotoxin-contaminated feed, animal owners should use available feed safely so the performance and health of their animals are not adversely affected. What follows are management strategies that can help reduce the risk of adverse effects to acceptable levels in animals consuming mycotoxin-contaminated feed.

What mycotoxins are present, and at what levels?

Management decisions about using feed require knowledge of the presence or absence of mycotoxins in feed. Unfortunately, the presence or absence of visible fungal growth on feed or grains is not a reliable indicator of the presence or absence of mycotoxin contamination. Chemical analysis is the best way to detect the presence of known mycotoxins in grains and feeds.

Detecting mycotoxins present in feed is challenging, because mycotoxin distribution in feed is heterogeneous;

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some areas of the feed may contain detectable amounts of known mycotoxins, whereas other areas may contain no detectable amounts. Tests cannot detect mycotoxins in samples taken from uncontaminated areas, and the greater the amount of feed, the more challenging it is to find mycotoxin-contaminated areas in it. The Extension Circular titled *Sampling and Testing Feed for Mycotoxins*, EC3069 contains information about sampling feed for mycotoxin testing.

Mycotoxin tests that can detect mycotoxins are available at commercial, and some veterinary diagnostic laboratories. The Extension Circular titled *Sampling and Testing Feed for Mycotoxins*, EC3069 contains information about mycotoxin tests and how to select a laboratory for mycotoxin testing.

What are safe levels of mycotoxins for feeding?

The risk of adverse health effects depends upon the mycotoxin present in the feed, its level, and the amount of contaminated feed ingested; the higher the level present or the greater the amount ingested, the greater the risk. The risk also depends upon the kind of animal ingesting the feed; some animals are more resistant to adverse effects than others are. Generally, ruminants are more resistant to mycotoxins than are monograstric animals. For example, the relative sensitivities to the acute adverse effects of aflatoxin, from most to least sensitive are cats, swine, dogs, sheep, turkeys, and chickens.

National governments regulate the levels of some mycotoxins in foods and feed to protect the health of animals and humans consuming contaminated food or feed. Regulations vary by mycotoxin, type of feed or foodstuff, the kind of animals consuming the feed, and the country or regulating body (e.g., the U.S. Food & Drug Administration (FDA) or European Union.). Regulatory mycotixin limits can serve as target levels for mycotoxin content in owner-formulated animal feed or diets.

FDA regulatory limits for mycotoxins in food or feed

In the US, the Center for Veterinary Medicine (CVM), which is a branch of the FDA, regulates animal feed that contains any poisonous or deleterious substances, which includes mycotoxins. Feed that contains mycotoxins at or in excess of regulatory limits are 'adulterated" and the FDA can remove them from commerce.

The FDA uses three phrases for regulatory limits for mycotoxins: "action level," "guidance level," and "advisory level." The definitions of those terms and their applicability to mycotoxins follow.

Action levels for aflatoxins

FDA action levels exist for aflatoxins, including those for animal feeds and milk (Table 1).

Action levels are limits for a poisonous or deleterious substance intended to control levels of unavoidable contaminants in human food and animal feed. They do not represent permissible levels of contamination where contamination is avoidable. The FDA will take legal action to remove products from the market that contain aflatoxin exceeding an action level.

The FDA regulates the amount of aflatoxin M_1 in milk, because of the adverse health risks to humans who consume dairy products containing that mycotoxin. Aflatoxin M_1 is produced in dairy animals' bodies from ingested aflatoxin B_1. Dairy farmers cannot legally sell milk with aflatoxin M_1 concentrations that exceed the 0.5 ppb action level.

Guidance levels for fumonisins

Guidance levels exist for fumonisins in animal feeds (Table 2).

Guidance levels published in FDA documents apply to a specific poisonous or deleterious substance and represent the FDA's current opinion about the substance. They are used for contaminates with no established action levels. Guidance levels are achievable using existing good agriculture and manufacturing practices. They "do not operate to bind FDA or the public" as do action levels, but FDA may still take action to remove contaminated products from the market.

Stakeholders may use approaches other than guidance levels to satisfy the relevant law and regulations. Contact the FDA Center for Veterinary Medicine (CVM) at (240) 402-7002 for assistance with alternative approaches

Advisory levels for deoxynivalenol

"Advisory levels" is the phrase used by the FDA for deoxynivalenol-contaminated feed in its guidance document. Deoxynivalenol (DON) is commonly called vomitoxin.

Table 3 lists FDA advisory levels for DON in animal feed. DON occurs predominantly in grains such as barley, corn, oats, rye, and wheat.

Ergot, ergot alkaloids, and fescue grass poisoning

Ergot is an infection of grain and grasses by *Claviceps* species of fungi. That disease is exceptional because it produces visible ergot bodies, which are dark elongated fungal fruiting bodies called sclerotia (plural of sclerotium). Sclerotia grow in the seed heads replacing grain or seed kernels

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and are visible to the naked eye. They can range in size from a fraction of an inch to more than an inch long. They fall to the ground, overwinter, and then germinate the next spring, producing spores that infect the next year's crop. Sclerotia may be difficult to see if they are broken apart or ground up.

Sclerotia contain ergot alkaloids, which are the mycotoxins that produce adverse health effects when sclerotia are ingested.

The specific ergot alkaloids and their concentrations in sclerotia varies. So, risk assessment based on sclerotia content without knowledge of ergot alkaloid content is challenging. It is safest not to use ergot-contaminated feed.

The FDA has no established regulatory limits for ergot alkaloid content in feeds, but the USDA Agricultural Marketing Service's Federal Grain Inspection Service (FGIS) sets standards for sclerotia content in grains, which apply to the grading of grains. Table 4 lists FGIS standards for sclerotia content in grains. Grains that contain sclerotia amounts in excess of the standards are graded as "ergoty." Do not feed ergoty grain to animals.

Mechanical screening can remove larger sclerotia, damaged kernels, and other debris from grain. The relative amount of sclerotia present in the screenings will likely be higher than in the original grain. Do not feed screenings, because the risk of adverse health effects from ergot alkaloids in such cases is very high.

Table 5 lists the European Union (EU) regulatory limits for ergot alkaloid content in feed, and although they are not directly applicable to feed in the United States, they serve as target concentrations to help reduce the risk of adverse health effects from ergot alkaloids. The ergot alkaloid content that is the basis for the EU regulations is the sum of 12 ergot alkaloid concentrations present in feed. Use of EU ergot alkaloid regulatory limits to formulate feed is difficult because U.S. laboratories that analyze feed for ergot alkaloids usually do not include all 12 alkaloids in the EU regulations.

Fescue grass poisoning is another form of ergot poisoning specific to feeding fescue grasses. Although seeds of fescue grasses may contain sclerotia, fescue grass poisoning is caused by the endophyte fungus *Neotyphodium coenophialum*. The endophyte lives within fescue plant tissue in a symbiotic relationship that improves the survival of the endophyte and the fescue plant. The endophyte produces ergot alkaloids. Avoid using the Kentucky 31 variety of tall fescue grass, which usually contains the endophyte. Instead, use Kentucky 32 bred to be endophyte-free and safe for animals to consume. Fescue is not used prevalently in Nebraska as a forage crop. Livestock owners considering its use can seek advice from UNL Extension livestock or forage experts.

Zearalenone

Zearalenone, once called F-2 toxin, is a non-steroidal estrogenic mycotoxin produced by *Fusarium* fungi. Those fungi may also produce alpha-zearalenol (α-zearalenol, zeranol), which is a more potent estrogenic compound than is zearalenone. Merck Animal Health markets zeranol as RALGRO® to promote growth in beef cattle. The FDA regulates use of zearalenol as a growth promoter.

The FDA does not regulate zearalenone content in feed, but the EU has issued recommendations for zearalenone content in animal feeds, which can serve as target levels for animal feeds. Table 6 lists the EU recommendations.

Use contaminated feed for less-sensitive animals

The susceptibility of animals to the adverse effects of mycotoxin varies by the kind of animal that ingests the mycotoxin. Use contaminated feed for less-sensitive animals. Generally, ruminants are more resistant to the toxic effects of mycotoxins than are non-ruminants; however, any animal may suffer from adverse effects, if it ingests feed containing high amounts of mycotoxins. Governmental regulations or guidelines for using mycotoxin-contaminated feed can help identify less-sensitive animals

Blend feeds to reduce mycotoxin concentrations

Blending of feed containing aflatoxin concentrations in excess of FDA action levels with other feed to reduce the aflatoxin content is illegal if the blended product is marketed commercially, regardless of the aflatoxin level attained after blending. That applies to products placed in intra- or interstate commerce. It does not apply to the feed blended by animal owners for feeding to the owner's animals.

Marketing blended feed made from other mycotoxin-contaminated components is not regulated as rigorously as for aflatoxins, but the FDA may take action against such blending if it deems actions necessary to protect the health of animals or humans.

You may obtain information about blending mycotoxin-contaminated grain from the Nebraska Department of Agriculture, 402-471-2351.

Under certain circumstances, FDA may issue a blending waiver for aflatoxin-contaminated grain. The waiver is limited and applies to states that request the waiver. The 2012 corn harvest serves as an example.

In 2012, the states of Kansas, Illinois, Indiana, Iowa, Nebraska, and Oklahoma requested and received exemptions from US federal "no-blending" rules for aflatoxin-

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contaminated corn, because of the increased prevalence and concentrations of aflatoxins present in the 2012 corn crop. The exemptions helped mitigate losses to corn producers and restrained rising animal feed prices for animal producers. The Nebraska Department of Agriculture oversaw the exemption in Nebraska.

The exemptions allowed corn harvested in 2012 with up to 500 ppb aflatoxin to be blended with corn containing no more than 20 ppb aflatoxin to produce blended corn containing aflatoxin for mature poultry, breeding swine, finishing swine over 100 lbs, breeding cattle, and finishing (feedlot) cattle. Aflatoxin concentrations in the blended product had to comply with aflatoxin action levels for those types of animals (see Table 1).

The exemptions required blended corn to be labeled clearly that it was for use as animal feed only and the label had to include the blended aflatoxin concentration and the type of animals to which it could be fed.

The exemptions required the use of USDA-GIPSA-approved sampling and aflatoxin tests to determine the aflatoxin concentration in the blended product.

Buyers had to acknowledge in writing to which type of animals the blended product could be fed.

Ratio of contaminated to non-contained grain for blending

To reduce the mycotoxin concentration of contaminated feed by blending to an acceptable concentration, the following information must be known:

1. Target mycotoxin concentration in the blended product that meets requirements for a specific kind of animal.
2. The mycotoxin concentrations of the contaminated and uncontaminated components.
    a. Ideally, the uncontaminated component should contain no detectable amount of the mycotoxin. If it does contain the mycotoxin, it must be at a concentration lower than the contaminated component's concentration..
    b. The mycotoxin concentration in the blended product will be less than the concentration in the contaminated component and greater than the concentration in the uncontaminated component.
    c. The mycotoxin concentrations should be determined using appropriate sampling and analytical protocols.

Use the following formula to calculate the percentage of contaminated feed in the blended product to achieve the target mycotoxin concentration: F = 100 x (C—L)/(H—L)

Where:

F = fraction of contaminated feed in the final blend expressed as a percentage

C = target mycotoxin concentration in the final blend

L = mycotoxin concentration in the uncontaminated component

H = mycotoxin concentration in the contaminated component

NOTE: The target concentration (C) is the mycotoxin concentration in the blended product deemed acceptable for the product's intended use. "H" must be greater than "L;" "C" must be less than "H;" and "C" must be greater than "L."

For example, a blended product intended for feedlot cattle containing no more than 300 ppb aflatoxin is to be made by blending contaminated corn containing 400 ppb aflatoxin with corn containing no more than 20 ppb aflatoxin.

C = 300 ppb, L = 20 ppb, and H = 400 ppb.

F = 100 x (300 ppb—20 ppb)/(400 ppb—20 ppb)
= 100 x 280/380 = 73.7%

To simplify the mixing, let us round the percentage of contaminated corn down to 70%. Mixing 70 parts of contaminated corn with 30 parts of uncontaminated corn will produce a blended product with about 285 ppb aflatoxin (300 ppb x 70.0/73.7), which is less than the target 300 ppb aflatoxin.

Use of mycotoxin binders

Mycotoxin binders are chemicals that prevent or reduce risk of excessive mycotoxin exposure by binding mycotoxins in the gut after feed is ingested, decreasing the absorption of mycotoxins into the blood stream. No one binder is effective for all known mycotoxins, nor do they bind only mycotoxins. They may also bind some available nutrients in the feed, thereby decreasing nutrient absorption into the bloodstream and increasing cost of gain.

The FDA regulates the use of binders in the U.S. under provisions of the Federal Food, Drug, and Cosmetic Act. No mycotoxin binder has been approved by the FDA for use, so it is illegal to market such chemicals as mycotoxin binders in the U.S. If they are, they may be subject to regulatory action by the FDA.

Some mycotoxin binder approved for use in other countries are marketed in the US as feed additives that enhance animal performance by improving feed efficiency, digestive health, or disease resistance. Return on investment for use of binders to enhance animal performance may be difficult to determine.

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Using mycotoxin-free grains may be more cost effective than using binders. If mycotoxin-contaminated grain must be used in the ration, blend it to reduce the risk of excessive exposure, as described above, before it is incorporated in the total mixed ration.

SILAGES

Grain crops during poor growing conditions may be harvested and ensiled for use as animal feed. Ensiling may not reduce mycotoxin contamination. Mycotoxins in silages may originate prior to harvest through plant infections with *Fusarium, Penicillium*, or *Aspergillus* species of mold, or after ensiling if those molds grow on the silage. Assume any moldy silage could contain mycotoxins and avoid feeding it. If moldy silage must be fed, get a sample of the moldy silage tested for mycotoxins before feeding it. The Extension Circular *Sampling and Testing Feed for Mycotoxins*, EC3069 contains information about sampling and testing feed for mycotoxins.

It is imperative to properly pack and seal silages, because molds grow best in wet feeds under aerobic conditions. Mold growth most often occurs at the margins of the silage pile, which are more readily in contact with air where the proper anaerobic state for ensiling is not achieved, and oxygen is not limited.

Mycotoxins reportedly found in silage include aflatoxins, fumonisins, mycophenolic acid, roquefortine C, tricothecenes, and zearalenone. The prevalences of mycophenolic acid and roquefortine C in silages used in Nebraska are not known. Tricothecenes other than DON are rarely, if ever, detected. During the feed-out of silage, new fungal spores can be produced on the face of the silage pile or dormant spores can become active due to oxygen exposure. Those events will likely occur if feed-out speed of silage is slow. If moldy hot spots or blue/green lumps of fungal biomass are noticed, it is advised to remove these portions. However, removing these visible fungal spots does not entirely eliminate all mycotoxins from silage.

Decontaminate mycotoxin-contaminated feed

CHEMICAL AND ENZYMATIC DECONTAMINATION

Chemical and enzymatic agents convert mycotoxins in contaminated feed ideally into chemicals that are not toxic. The use of those agents must be technically and economically feasible and they must:

1. Effectively remove the mycotoxin.
2. Not produce or leave toxic or carcinogenic residues in the treated feed.
3. Not significantly alter properties of the feed important to feed processing methods.
4. Not significantly alter the nutritional value of the feed.

Additionally and ideally, they should destroy fungal spores and fungal parts that could re-infect the feed later.

CHEMICAL DECONTAMINATION

Acids, bases/alkalines, reducing agents, and oxidizing agents have been studied as chemical decontaminants for mycotoxins. Their effectiveness depends upon the targeted mycotoxin, concentration or amount of chemical decontaminant used, decontamination treatment time, moisture content of the decontaminated feed, and temperature during treatment. We mention decontamination of aflatoxin-contaminated feed by ammoniation.

Decontamination of aflatoxin-contaminated feed using ammonia gas, ammonia-containing solutions, or an agent capable of releasing ammonia can be effective. Disadvantages of ammoniation include the need for equipment that resists the corrosive properties of ammonia; potential flammability of gaseous ammonia, if it is used; the adverse health risks of ammonia and ammonia-producing chemicals; discoloration of the treated feed; effect of treatment on total nitrogen and non-protein nitrogen content; and degradation of some amino acids, especially lysine. The University of Georgia Cooperative Extension Circular 885 titled "Treating Aflatoxin-Contaminated Corn with Ammonia" by Hammond and Sumner contains detailed information.

ENZYMATIC DECONTAMINATION

In August 2022, the US FDA approved the use of the enzyme fumonisin esterase as a feed additive to degrade fumonisins present in swine and poultry feeds. It is the first enzyme approved for use in the US for mycotoxin decontamination.

Fumonisin esterase used as a feed additive is an enzyme produced by the non-toxigenic and non-pathogenic yeast *Komagataella phaffii* genetically engineered to produce the enzyme by inserting the fumonisin esterase gene from the bacterium *Sphingopyxis* sp into its genes. The enzyme added to the feed changes fumonisins to non-toxic chemicals in the digestive tract of the animal.

Approved uses of the feed additive are published in the Code of Federal Regulations, Chapter 21, Sec. 573.485. The following restrictions are included. It cannot have any viable genetically modified *K. phaffii* yeast cells in it. It cannot be added to complete swine feeds containing more than 10 parts per million (ppm) total fumonisins or to complete feeds containing more than 50 ppm total fumonisins for poultry being raised for slaughter. It cannot be added to complete feed containing more than 15 ppm total fumonisins for breeding

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poultry and laying hens producing eggs for human consumption.

The enzyme's trademark name is FUMzyme® and it is marketed in the US solely by DSM in two products: Biofit® Plus with FUMzyme® and Biofit® Select with FUMzyme®. The Plus product is reportedly for use in feeds for breeding stock and the Select product for use in feed for non-breeding stock. At the time of publication of this circular, information about those products on DSM's website was difficult to find and we could not find either a vendor selling either product, or product costs.

Conclusions

Mycotoxins are naturally occurring toxic chemicals made by molds growing on plants or grains. The most common sources of mycotoxin contamination in feed are grains. Mycotoxins commonly found in feeds used in Nebraska are aflatoxins; DON, commonly called vomitoxin; ergot alkaloids; fumonisins; and zearalenone.

It is safest NOT to use mycotoxin-contaminated feed; however, if contaminated feed must be used, the mycotoxin and its concentration in that feed should be determined by chemical analysis. The absence of visibly moldy feed does not mean that the feed is mycotoxin-free, nor does the presence of visible mold indicate that a mycotoxin is present. The risk of experiencing adverse health effects after ingesting mycotoxin contaminated feed depend upon several factors: the concentration of mycotoxin in and the amount of contaminated feed ingested, the kind of animal ingesting it, and the length of time the feed is ingested.

Governments regulate the levels of some mycotoxins allowed in feeds to protect the health of animals and humans. Regulations usually apply to feed placed in commerce, and regulated levels depend upon the mycotoxin, type of feed, and the kind of animal consuming the feed. Governments may regulate blending contaminated with uncontaminated feed to reduce mycotoxin levels, and blended products may be restricted with respect to commerce.

The efficacy of mycotoxin decontaminate methods vary by mycotoxin and method. Silages made from contaminated forage may remain contaminated or become contaminated after ensilation is complete. Chemicals or enzymes that chemically destroy mycotoxin may be effective.

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Table 1: Action Levels for Aflatoxins in Animal Feeds and Milk

Mycotoxin	Commodity	Animal	Action level	Reference
Aflatoxin	Animal feed containing corn and peanut products	Finishing (i.e., feedlot) beef cattle	300 ppb	U.S. Food and Drug Administration staff, 2000, *Guidance for Industry: Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed*, FDA Center for Food Safety and Applied Nutrition document
		Finishing swine of 100 pounds or greater	200 ppb	
		Breeding beef cattle, breeding swine, or mature poultry	100 ppb	
	Animal feed containing cottonseed meal	Beef, cattle, swine, or poultry (regardless of age or breeding status)	300 ppb	
	Animal feed containing corn, peanut products, and other animal feeds and feed ingredients, excluding cottonseed meal	Immature animals	20 ppb	
	Animal feed containing corn, peanut products, cottonseed meal, and other animal feed ingredients	Dairy animals, animal species or uses not specified above, or when intended use is unknown	20 ppb	
	Milk	Humans	0.5 ppb (aflatoxin M_1)	

Table 2: Guidance Levels for Fumonisins in Animal Feeds

Mycotoxin	Commodity	Animal	Guidance level (total fumonisins, $FB_1 + FB_2 + FB_3$)	Reference
Fumonisins	Corn & corn by-products	Equids and rabbits	5 ppm (no more than 20% of diet on dry wt basis)	U.S. Food and Drug Administration staff, 2001, *Guidance for Industry: Fumonisin Levels in Human Foods and Animal Feeds*
		Swine and catfish	20 ppm (no more than 50% of diet on dry wt basis)	
		Breeding ruminants, breeding poultry, and breeding mink; lactating dairy cattle and hens laying eggs for human consumption	30 ppm (no more than 50% of diet on dry wt basis)	
		Ruminants older than 3 months being raised for slaughter, mink being raised for pelts	60 ppm (no more that 50% of diet on dry wt basis)	
		Poultry being raised for slaughter	100 ppm (no more than 50% of diet on dry wt basis)	
		All other species or classes of livestock and pet animals	10 ppm (no more than 50% of diet on dry wt basis)	

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Table 3: Advisory Levels for Deoxynivalenol (DON) in Animal Feeds

Mycotoxin	Commodity	Animal	Advisory level	Reference
DON	Grains and grain by-products (on an 88% dry matter basis)	Ruminating beef & feedlot cattle older than 4 month	10 ppm (total ration DON content not more than 10 ppm)	U.S. Food and Drug Administration staff, 2010, *Guidance for Industry and FDA: Advisory Levels for Deoxynivalenol (DON) in Finished Wheat Products for Human Consumption and Grains and Grain By-Products used for Animal Feed*
		Ruminating dairy cattle older than 4 months	10 ppm (total ration DON content not more than 5 ppm)	
	Distillers' grains, brewers' grains, gluten feeds & gluten meals derived from grains (on an 88% dry matter basis)	Ruminating beef & feedlot cattle older than 4 months	30 ppm (total ration DON content not more than 10 ppm)	
		Ruminating dairy cattle older than 4 months	10 ppm (total ration DON content not more than 5 ppm)	
	Grains and grain by-products	Chickens	10 ppm (contaminated ingredients do not exceed 50% of the diet)	
		Swine	5 ppm (contaminated ingredients do not exceed 20% of diet)	
		All other animals not listed above	5 ppm (contaminated ingredients do not exceed 40% of diet)	

Table 4: U.S. Grain Grading Standards for Ergot Sclerotia in Grains

Commodity	Maximum level[1]	Reference
Barley	0.10 % ergot sclerotia	U.S. Department of Agriculture staff, 2020, *Grain Inspection Handbook, Book II: Grain Grading Procedures*
Mixed grains	Predominately wheat or rye: 0.30% Predominately other grains: 0.10%	
Oats	0.10%	
Rye	0.30%	
Triticale	0.10%	
Wheat	0.05%	

[1] Commodities with ergot sclerotia content in excess of the maximum level are classified as ergoty (ERG).

Table 5: European Union's Ergot Alkaloid Regulatory Standards for Certain Foodstuffs

Commodity	Maximum level[1]	Reference
Milling products of barley, wheat, spelt, and oats with ash content less than 900 mg/100g	100 µg/kg until Jul 1, 2024, then 50 µg/kg	The European Commission, 2021, Commission Regulation (EU) 2021/1399 (2021)–Amending Regulation (EC) No 1881/2006 as Regards M*aximum Levels of Ergot Sclerotia and Ergot Alkaloids in Certain Foodstuffs*
Milling products of barely, wheat, spelt, and oats with ash content at or greater than 900 mg/100 g	150 µg/kg	
Barley, wheat, spelt, and oat grains placed on the market for the final consumer		
Rye milling products	500 µg/kg until Jul 1, 2024, then 250 µg/kg	
Rye placed on the market for the final consumer		
Wheat gluten	400 µg/kg	

[1] Ergot alkaloid content in the commodity is the sum of the concentrations of 12 ergot alkaloids: ergocornine/ergocorninine, ergocristine/ergocristinine, ergocryptine/ergocryptinine (α- and β-forms), ergometrine/ergometrinine, ergosine/ergosinine, ergotamine/ergotaminine.

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Table 6: Guidance values for zearalenone in products intended for animal feed in the European Union

Product	Component	Guidance value for feedstuffs with a moisture content of 12%	Reference
Feed materials[1]	Cereals and cereal products except maize by-products[3]	2 mg/kg (ppm) [2]	The Commission of the European Communities, 2006, Commission Recommendation 2006/576/EC on the Presence of Deoxynivalenol, Zearalenone, Ochratoxin A, T-2 and HT-2 and Fumonisins in Products Intended for Animal Feeding
	Maize by-products	3 mg/kg (ppm) [2]	
Product	Animal class	Guidance value for feedstuffs with a moisture content of 12%	
Compound feed[4]	Piglets, gilts for reproduction	0.1 mg/kg (ppm)	
	Sows and fattening pigs	0.25 mg/kg (ppm)	
	Calves; dairy cattle; sheep, including lambs; goats, including kids	0.5 mg/kg (ppm)	

[1]The EU definition of "feed materials" are products of vegetable or animal origin in their natural state, fresh or preserved, and products derived therefrom, to be used for oral feeding to animals.

[2]The combined dietary zearalenone exposure from feed materials fed directly to livestock and from compound feed should not exceed the guidance value for compound feed.

[3]Cereal grains include barley, maize (corn), millet, oats, rice, rye, sorghum, triticale, wheat, cereal grain screenings, distillers' grains, and brewers' grains and products derived from any of them. Forage or roughage obtained from cereal grains should also be included.

[4]The EU definition of "compound feed" is a mixture of at least two feed materials producing either a complete diet or feed supplement intended for oral feeding to animals.

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