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Zearalenone Concerns in Reproducing Livestock

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Introduction

Mycotoxins in corn and other grains can reduce performance in both ruminants (cattle, sheep, goats) and non-ruminants (swine, poultry) and can have detrimental effects on both finishing animals and reproducing males and females. For the reproducing animals, the mycotoxin zearalenone (ZEA) is of the greatest concern. Zearalenone is produced by the fungus that causes gibberalla ear rot, *Fusarium graminearum*, and often co-exists with the mycotoxin deoxynivalenol (DON), also known as vomitoxin. Zearalenone has many profound impacts on reproductive function due to its estrogenic actions. This document will discuss zearalenone's actions on reproductive systems and the reproductive consequences of feeding swine and cattle grain that is contaminated with the mycotoxin zearalenone (summarized in Table 1).

Actions of Zearalenone

Zearalenone competes with the naturally produced hormone estradiol-17β for binding sites (estradiol receptors) in various organs in the body of both males and females. Although the efficiency that ZEA will bind to the estrogen receptor is low (< 10% the affinity), it can interfere with normal reproductive functions. By mimicking the actions of estradiol, ZEA can cause estrogenic effects even when natural estradiol concentrations should be low. Additionally, ZEA can obstruct normal steroid hormone (estradiol, testosterone, progesterone) synthesis in the ovaries and testicles of livestock.

Zearalenone in Swine

Swine are very sensitive to ZEA concentrations in their feed. In swine, the cycling of blood between the liver and intestine prolongs the retention of ZEA in the body and therefore prolongs its adverse effects.

Table 1. Effects of zearalenone on livestock reproduction

Swine	Level of ZEA in the Diet	Symptoms
Young, immature gilts	1–5 ppm	Swelling of the vulva, some estrus activity
Pubertal gilts / sow breeding period	5–10 ppm	Increased postweaning interval and extended interval between cycles
Gestating sows	25+ ppm	Small litters, low farrowing rate, and pseudopregnancy
Lactating sows	50+ ppm	Abnormal estrous cycles, ovarian atrophy
Boars	5–10 ppm	Decreased sperm motility
	20+ ppm	Decreased libido and testes size
Cattle		
Developing heifers	5 ppm	Swelling of mammary gland, vagintitis, reduced conception
Cows, breeding season	10 ppm	Reduced conception rates, abortions
Cows, non-lactating	20 ppm	Abortions

As in finishing animals, ZEA toxicity in feed of reproducing animals will result in reduced feed intake, reduced growth performance, and increased digestive disorders. The amount of ZEA that can directly negatively impact the reproductive performance of swine is dependent upon the age of the animal, stage of the estrous cycle, or pregnancy, as well as level and duration of exposure. Because pre-pubertal gilts (birth to 150 days of age) lack a fully developed reproductive endocrine system, they are the most sensitive to the estrogenic actions of ZEA. As little as 1 to 5 ppm of ZEA in the diet of pre-pubertal gilts can induce clinical signs such as swelling of the vulva, vaginal and rectal prolapses, and alterations within the uterus. Additionally, ZEA can induce infertility by altering normal ovarian function, follicular development, and normal uterine function.

In sows and pubertal gilts, ZEA concentrations in the diet of 3 to 10 ppm can cause abnormal estrous cycles. Sows may frequently display heat, show heat and fail to ovulate, or fail to show heat due to pseudo-pregnancy. Exposing pregnant sows or gilts to ZEA can cause embryonic mortality and causes genitalia defects of the offspring exposed to ZEA while *in utero*. It has been demonstrated that sows fed a diet contaminated with ZEA (60+ ppm) will have increased resorption of embryos and decreased litter sizes.

Zearalenone can also have deleterious effects on males, especially juvenile boars. Concentrations of 100+ ppm in the feed can reduce testicular size and may suppress endogenous testosterone production and libido, and may reduce sperm production and viability. The effects of ZEA on swine reproduction are not permanent, and animals will typically return to normal reproductive function two to three weeks after ZEA withdrawal from the diet.

Zearalenone in Cattle

Cattle are not as sensitive to ZEA-contaminated feed as swine. However, exposure of breeding stock to ZEA still has the potential to negatively impact reproductive performance. Prolonged exposure to ZEA through consumption of contaminated grain is a concern in heifers. Effects of extended exposure to ZEA may be similar to the effects of implanting heifers at birth or at weaning with estrogenic implants and may negatively impact subsequent reproductive function. Therefore, both beef and dairy producers should be cautious when feeding ZEA-contaminated corn (5+ ppm) to developing heifers, since the estrogenic activity of ZEA can compromise normal endocrine function and uterine development. Heifers consuming as little as 1.5 ppm of ZEA in the feed have exhibited swelling of the mammary gland and increased incidences of vagintitis. This would also include creep rations for beef calves. In cycling females, ZEA concentrations greater than 10 ppm in the feed can result in failure to conceive and increased incidences of abortions. Diets of non-lactating cows in late gestation should not contain more than 20 ppm of ZEA.

Dealing with Zearalenone Contaminated Corn and Corn Co-products

Both swine and cattle are sensitive to ZEA-contaminated feed. Producers should not only evaluate corn available for feeding the breeding stock to determine if ZEA is present, but also corn screenings, distiller's grains (DGS), corn gluten feed (CGF), and silage. Moldy kernels shatter more easily than normal kernels and the resulting fines will contain higher levels of ZEA. Therefore, if ZEA contamination is a concern, avoid feeding corn screenings to breeding stock. Similarly, the toxin levels in DGS and CGF are not destroyed during the fermentation process and are concentrated three times compared to the original corn that entered the process.

When feeds are suspected of containing higher levels of toxins, an analysis for ZEA may be justified. If ZEA is present, dilution is the solution. Blending is not an approved practice by the USDA for interstate commerce; however, blending can be used to reduce mycotoxin levels in fed grain for on-farm use. For breeding sows and gilts, the final diet should not exceed 2 ppm ZEA, and for pre-pubertal gilts and boars the diet should not contain over 1 ppm ZEA. For cattle, virgin heifers are of greatest concern and the diet should not contain over 5 ppm of ZEA in the total ration. Non-lactating pregnant cows can be fed diets containing up to 20 ppm ZEA, but lactating cows, especially during and immediately after the breeding season, should not receive diets containing more than 10 ppm ZEA. In addition to blending, other options are available to reduce the effects of ZEA in feed. Stored grain can be treated with a mold inhibitor such as proprionic acid. However, this only inhibits the development of new mold and does not reduce the amount of mycotoxin already present in

the feed. The addition of mycotoxin binders in the feed is another option. These additives can be used to bind the mycotoxin and render them less detrimental. However, many of the commonly used binders are not completely effective with ZEA.

Resources and Additional References

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