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Antioxidants protect turkeys against toxicity of aflatoxin

Roger A. Coulombe, Jr., Utah State University

Toxins stemming from mold in feed grains are unavoidable in poultry production. "Mycotoxins" such as aflatoxin B (AFB1) are among the most potent liver-damaging toxins known. AFB1 is also a probable human carcinogen.

Poultry are the most sensitive of all farm animals to the toxic effects of even small amounts of AFB1. Although poultry don't generally live long enough to develop cancers, AFB1-related diseases adversely affect their health. This aflatoxin can cause slowing of growth and decreased resistance to microbial pathogens that make poultry ill.

Because these toxins are so pervasive in feed grains, eliminating them has proved either impractical or prohibitively expensive. Mycotoxins cost the poultry industry more than $100 million annually in productivity losses and reduced product quality. These losses have been absorbed into the cost of production.

Aflatoxins such as AFB1—used in this study—are also known as "pro-toxins." That is, they are not toxic in their original state, but they become so only after being eaten and then reacting with liver enzymes.

But there are also protective enzymes in the liver. In some animals that are AFB1-resistant, the active form of AFB1 is efficiently detoxified by a group of enzymes called glutathione S-transferases (GSTs).

Utah Agricultural Experiment Station

Turkeys are extremely susceptible to the toxic effects of the mycotoxin aflatoxin B1.

Project Goals

With support from USDA's National Research Initiative (NRI) Competitive Grants Program, researchers at Utah State University are seeking to determine why turkeys are so sensitive to AFB1.

Additionally, the project was designed to find out if common and inexpensive FDA-approved food antioxidants, such as butylated hydroxytoluene (BHT) added to

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feed rations, could protect the birds. BHT is a common additive used by the food industry to preserve fats and oils in products such as potato chips.

Similar natural and synthetic compounds known as "chemoprotectants" have been shown to shield against the adverse effects of various toxins in rodents. Some are even being tested in clinical trials for their ability to reduce human risk of cancers caused by AFB1 and other natural toxins.

These chemoprotectants often work by either reducing activation or increasing the detoxification process in the livers of humans and animals.

The researchers determined that the extreme sensitivity of poultry to AFB1 appears to be due to an unfortunate combination of very efficient activation and deficient detoxification mechanisms in the poultry liver.

Several antioxidants were tested for their ability to either decrease activation or increase detoxification in turkey livers when added to the diet. Experiments confirmed that antioxidants – especially BHT – dramatically reverse nearly all the adverse effects of AFB1 in turkeys.

The protective mechanism does not appear to involve increasing the amount of GSTs or other AFB1 detoxifying enzymes, as first thought. Preliminary data indicate that BHT may protect turkeys by blocking the activation of AFB1.

Impact

This is the first study of its kind on turkeys. The results indicate that adding the inexpensive, FDA-approved food additive BHT to feed grains protects turkeys against an economically important toxin, AFB1.

More work is needed to determine the exact mechanism of chemoprotection in poultry and to determine precise doses that will ensure a protective effect.

In any case, this research may eventually provide poultry producers with a low-cost solution to health problems and stem financial losses associated with naturally occurring mold-produced toxins in poultry feed – and consumers should benefit from a better food product.

The author was assisted in this research project by graduate students Patrick J. Klein and John Guarisco.

Graduate student Patrick Klein checks turkey poults in a long-term chemoprevention trial.

The research reported in this factsheet was sponsored by the Animal Health and Well-Being Program of the Animals Division of the National Research Initiative Competitive Grants Program. To be placed on the mailing list for this publication or to receive additional information, please contact the NRI (202-401-5022 or NRICGP@reeusda.gov). The factsheet also is accessible via the NRI section of the Cooperative State Research, Education, and Extension Service website (http://www.reeusda.gov/nri).

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