USE OF ERGOT AFFECTED SORGHUM IN LAYER DIETS: QUALITY ASSURANCE OF EGGS

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Summary

Dihydroergosine (DHES) is the principal alkaloid produced by sorghum ergot (Claviceps africana). DHES in animal feed can cause significant production losses in cattle and pigs, but chickens are more tolerant. Hens were fed diets containing up to 19 mg DHES/kg for six weeks and eggs were collected daily. Eighty eggs from ergot-fed birds and 80 from control birds were assayed by an ELISA that is specific for DHES. The ELISA had a detection limit of 0.005 mg DHES/kg, but DHES was not detected in any egg. Forty eggs from the ergot-fed birds were also assayed by HPLC with fluorescence detection, also with negative results (<0.02 mg DHES/kg). Only 45% of ingested DHES was recovered in the excreta, suggesting that DHES was rapidly degraded in the stomach or intestine. The regulatory limit for ergot in feed for laying hens might be raised from 0.3% to 1% (about 1 mg DHES/kg to about 5 mg DHES/kg) without significantly increased risk of residues in eggs.

I. INTRODUCTION

Sorghum ergot (Claviceps africana) is a fungus that invades sorghum flowers preventing the development of the grain while developing a fungal body (the sclerotia, or ergot) that is of similar size to a sorghum grain. The fungus has recently become widespread in sorghum growing areas of Australia but its incidence varies depending on environmental conditions during flowering.

Livestock consuming ergot-contaminated sorghum develop various conditions caused by the alkaloids produced by the fungus. These alkaloids are dihydroergosine (DHES), which usually constitutes over 80% of total alkaloids, festuclavine and dihydroelymoslavine. The two minor alkaloids lack the peptide side chain of DHES. In turn, DHES differs from the main rye ergot (C. purpurea) alkaloid, ergotamine, in that the 9,10 position in the ergosine nucleus is saturated in DHES (hence dihydro-), and in a small difference in their peptide side chains. Ergotamine has been known for centuries to cause vasoconstriction in humans (St Anthony's fire) and its less toxic 9,10 dihydro-derivative (dihydroergotamine) is used pharmacologically as a treatment for migraine. Although sorghum ergot was previously considered non-toxic due to the dihydro-nature of its alkaloids, recent studies have shown that the sorghum ergot alkaloids have at least some actions in common with rye ergot alkaloids (Blaney et al., 2000).

As with rye ergot alkaloids, chickens are more tolerant than other livestock species to sorghum ergot alkaloids (Blaney et al., 1998). Effective use of ergot-infected sorghum might be achieved by feeding it to chickens or laying hens. However, if layers secreted any alkaloid in the eggs, this avenue could not be used. This trial tested whether laying hens fed ergot-infected sorghum would secrete ergot alkaloids into their eggs.

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II. METHODS

Four basal diets were formulated to contain sorghum as the sole grain with projected ergot alkaloid contents of 24, 12, 6 and 0 mg DHES/kg diet. Diet 1 was assayed and found to contain 19 mg DHES/kg. The nutrient content of the diets were 195 g crude protein, 12 ±0.6 MJ metabolizable energy, 3.7 g calcium, 3.8 g available phosphorus, 7.9 g available lysine, and 6.4 g methionine per kg of diet. Half of each of the basal diets was mixed with a binding agent, Mycosorb®, (Alltech Biotechnology P/L, Victoria) which had been found to decrease the effects of sorghum ergot alkaloids when fed to young chickens (Deo, 2000).

The eight treatment diets were each fed to 12 ISA Brown hens 60 weeks old, housed 2 per cage in 6 randomly allocated cages in a semi-controlled environment room for a period of 6 weeks. Average room temperature was 20 °C and light dark period was set at 16:8 hours. Eggs were collected daily for six weeks and stored in a refrigerator at 4 °C. At the end of the six weeks, dry matter digestibility was calculated by measuring dry matter consumption and dry matter excretion over 24 hours.

The presence of ergot alkaloids in whole egg contents was tested using ELISA and HPLC techniques. The competitive ELISA was based on DHES–specific mouse monoclonal antibody (Molloy et al., 2003). Eighty eggs from hens fed 19 mg DHES/kg and 80 eggs from hens fed the control diet were analysed by ELISA. Forty eggs from hens fed 19 mg DHES/kg and 10 from control hens were analysed for ergot alkaloids by reversed phase HPLC with fluorescence detection (Blaney et al., 2003).

III. RESULTS

None of the eggs contained any trace of alkaloid that exceeded the background non-specific interference level of 0.005mg DHES/kg in the ELISA, nor exceeded the detection limit of 0.02mg DHES/kg in the HPLC analysis.

The excreta of birds fed the high ergot alkaloid diet contained 38mg DHES/kg DM. The diet contained 21mg DHES/kg on a DM basis and the DM digestibility was measured as 76%, indicating that only 45% of the ingested DHES was present in the excreta.

IV. DISCUSSION

None of the ingested ergot alkaloid was found in eggs despite 55% of the ingested ergot alkaloid in the high ergot diet disappearing from the gut. This is similar to the result found with pigs (Whittemore et al., 1976).

The greater resistance of monogastrics, especially poultry, to the effects of DHES compared with ruminants might be related in part to the low pH and high pepsin activity of the monogastric stomach, which perhaps is able to attack the cyclopeptide part of the molecule leading to de-toxification prior to absorption, whereas it might be absorbed undissociated from the rumen. However, more investigations would be required to test this and other hypotheses. Another question that should be addressed is whether residues can be detected in any of the tissues of hens fed ergot.

There was a small but significant decline in egg production in the birds fed the highest alkaloid concentration. Birds fed the lower alkaloid concentrations did not produce differently from the controls. The highest concentration of DHES used in this trial would rarely be found in bulk grain in practice, so it appears that there is no justification for concern about egg residues from laying hens fed moderate levels of ergot affected sorghum. The results suggest
that the present regulatory limit for sorghum ergot for laying hens of 0.3% of the diet could be raised to at least 1% (i.e. from about 1 mg DHES/kg to about 5 mg DHES/kg) without significantly increasing the risk of producing eggs containing ergot alkaloid residues.

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REFERENCES


