

Manure Ammonia Emission Reductions Achieved by Feeding DDGS to Laying Hens Housed in a Production Environment

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Species: Poultry
Use Area: Animal Housing
Technology Category: Diet Modification
Air Mitigated Pollutants: Ammonia

Description:

Feeding a diet comprising 10% Dried Distillers Grains plus Solubles (DDGS) has been found to reduce manure ammonia emissions by up to 50% in a laboratory environment (Roberts, et al, 2006).

In order to determine the effects of a diet comprising 10% DDGS on manure ammonia emissions in a production environment, 80 laying hens were fed a 10% DDGS diet for a 6 week period. An additional 80 hens were fed a standard ration as a control. Both diets were nutritionally equivalent.

The effect of feeding a 10% DDGS diet on production was not determined in this study.

Mitigation Mechanism:

It has been posited that increased levels of fermentable fiber in the diet cause increased microbial production of volatile fatty acids, which reduces manure pH (Roberts, et al, 2006). The reduction in manure pH protonates ammonia (NH₃) produced during uric acid breakdown, forming ammonium (NH₄⁺). Ammonium is significantly less volatile than ammonia and remains in the manure, thus the observed reduction in emission rate.

Applicability:

Feeding diets containing DDGS is suitable for use in laying hens, kept in any type of housing system.

Limitations:

Virginiamycin is commonly used in the production of ethanol, and is expected to be present in DDGS at levels between 0.2 and 0.5 parts-per-million (ppm). Heat is used to dry DDGS, and Virginiamycin is reported as stable at 90 degrees Celsius. The effect of heat at varying temperatures above 90 degrees Celsius on Virginiamycin stability has not been sufficiently explored to conclusively state that all the Virginiamycin in DDGS is destroyed during the drying process.

The presence of detectable levels of Virginiamycin in dried DDGS has been reported (Hale 2008).

The US Food and Drug Administration (USFDA) prohibit feeding laying hens materials containing detectable levels of Virginiamycin. Because DDGS is produced in a batch process, each batch of DDGS considered for inclusion in a laying hen diet should be tested to insure that Virginiamycin is not present.

Excessive heat used to dry DDGS reduces metabolizable energy (ME), amino acid content, and amino acid digestibility (AAD) in DDGS (Batal, et al, 2006).

The lack of uniformity in DDGS processing from supplier to supplier and from batch to batch causes significant variability in ME, AAD, and amino acid content (Batal, et al, 2006), making feed formulation more difficult.

Care must be taken to determine whether DDGS being incorporated into feed contains mycotoxins. A recent study indicates that essentially all DDGS contains some level of mycotoxins, and usually more than one type of mycotoxin is present (Rodrigues, 2007).

Cost:

When laying hens were fed a diet containing 10% DDGS, feed consumption increased and egg production remained unchanged as compared to control (Roberts, et al, 2006). A comparison of the cost of amended feed versus standard feed was not given.

The economics of feeding DDGS as a method of controlling ammonia emissions has not been fully explored at this time.

Implementation:

In order to determine the effect of a 10% DDGS diet on manure ammonia in hens housed in a production environment, 80 hens were fed a diet comprising 10% DDGS, and an additional 80 hens acted as a control. The amended and control diets were formulated to be nutritionally equivalent. The diets were also formulated to be consistent with standard dietary requirements for the type and age of hen used in the study.

The hens were fed for a 1-week acclimatization period prior to removing manure for emission testing. Fresh manure was then collected on a weekly basis, and analyzed to determine the total amount of ammonia emitted over a 4-day period. The bulk of manure ammonia emissions affected by inclusion of DDGS in the diet are related to uric acid conversion to ammonia. The conversion begins immediately upon excretion, and is essentially complete within 4 days post-excretion.

The hens were housed in standard battery cages, 5 hens per cage, 20 hens per unit, and a total of 4 units were fed each diet (control, amended).

Manure samples were obtained by removing all manure under the caged hens. Three hours later, all manure was removed from under each unit, placed in a sealed glass jar, and transported to the laboratory. Manure samples from each unit were homogenized, and a 25-gram aliquot removed. Each aliquot was placed in a flask and air passed across it. The ammonia-laden air was bubbled through a 0.04N sulfuric acid solution to trap the ammonia. Every 24 hours for a period of 4 days, the solution was exchanged for fresh solution. At the end of the test, each solution was assayed to determine how much ammonia had been emitted over a given 24-hour period. The data was used to construct emission curves for each unit of hens. Average total emissions for each group (control, amended) was calculated and compared to determine what effect, if any the amended diet had on ammonia emissions.

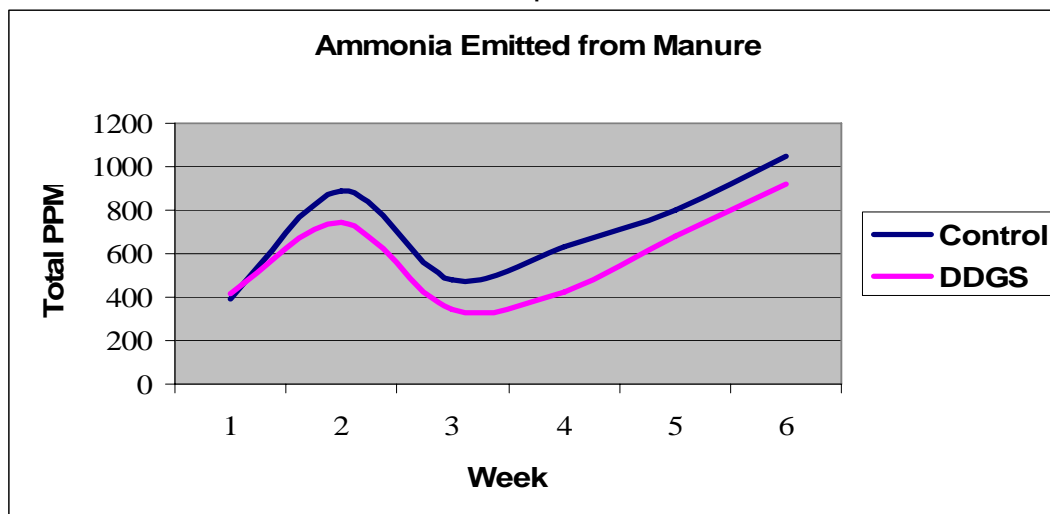
The trial was concluded after 6 weeks. Total average manure ammonia emissions and percent difference values for each group is shown on a per-week basis in Table 1 and Graph 1.

Table 1

Average total manure ammonia emissions over a 4-day period, data reported in ppm

	Control	10% DDGS	% Difference
Week 1	392.85	417.7	6.3
Week 2	887.7	741.0	-16.5
Week 3	475.6	340.7	-28.8
Week 4	630.9	421.1	-33.3
Week 5	799.1	681.0	-14.8
Week 6	1049.9	922.1	-12.2
Average	706.5	587.25	-16.9

Graph 1



Technology Summary:

A diet containing 10% DDGS can be fed to reduce manure ammonia emissions on average, with no apparent loss in productivity. The level of reduction appears variable.

When feeding DDGS to laying hens, care must be taken to insure compliance with FDA regulations regarding the presence of Virginiamycin.

When formulating a diet containing DDGS, care must be taken to insure that the variability of ME or AAD in DDGS from different sources and even different batches from a single source is considered.

Additional Resources:

Additional resources can be found on the internet.

References:

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