Minimizing Pollution from Poultry Manure: 1. Nitrogen

Poultry FACTSHEET

Environmental pollution from nitrogen (N) in animal manure is a major issue in areas such as the Lower Mainland of BC because of the concentration of animals and a limited land base for disposal. New technology exists that allows the protein content of diets to be reduced. This technology can be applied in poultry production units to reduce the quantity of N excreted in the manure, thus enhancing the sustainability of poultry production.

Concept

Poultry do not have a specific need for protein. They require amino acids (AA) contained in protein or from commercial AA products. Therefore the protein content of the diet can be reduced, provided the AA requirements are met. Previous research has shown that this often results in a more satisfactory AA profile in the diet, with a minimum of AA and a lower N excess that has to be excreted.

Research Conducted

Work at the University of British Columbia Avian Research Centre, in collaboration with the Pacific Agriculture Research Station, Agassiz, BC has shown the benefits of using reduced protein diets supplemented with AAs for both layers and broilers. Researchers involved in the study include Drs Bob Blair, Jacqueline Jacob, Mary Bohman and Tom Scott, and graduate students Sami Ibrahim and Edson Mypisi.

Two broiler and one layer experiments were conducted in which the crude protein content of the diet was reduced by 3-4 percentage units. The diets used consisted of practical ingredients and the supplementary AAs lysine, methionine, threonine and tryptophan. Each broiler experiment employed 2400 birds and the layer experiment employed 1350 birds. All diets supplied nutrient levels to meet or exceed the recommended National Research Council (1984, 1994) levels.

Results

The growth of market broilers was unaffected significantly by reduction in the crude protein level of the starter diet from 25 to 21% and of the grower diet from 21 to 18%, when the correct levels of AAs were maintained. These dietary changes resulted in a 27.2% reduction in the total amount of N excreted during a six week rearing period.

Reduction in the crude protein level of laying hens from 17 to 13.5% had no significant effect on egg production as long as the dietary levels of limiting essential AAs were maintained. There was a slight reduction in egg size but the amounts of egg albumen and shell were higher with the reduced protein diet. Reduction in the dietary protein level resulted in a 30-35% reduction in daily N output per layer.

It was concluded that reduced-N diets supplemented with essential AAs could play a significant role in helping to reduce N pollution from poultry manure.

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Broiler Experiment 1.

For the first 3 weeks all the birds received an industry standard starter diet. During the grower period the diets were formulated to current industry protein standards (21%), or to a reduced protein level (18%). Commercial AAs (lysine, methionine, threonine, and tryptophan) were used to obtain the correct AA profile in the 18% and 21% diets.

RESULTS (3-6 WEEKS)

Protein % in diet	42 Day wt. grams	Feed Conversion 3 - 6 wks.	N output/day grams	N % in manure DM*
21	2221	2.26	3.07	5.25
18	2201	2.31	2.37	4.72

*Dry matter basis.

Broiler Experiment 2.

In the starter (0-3 week)/grower (3-6 week) periods the birds received diets formulated with 25/21% protein and 21/18% protein. Commercial AA products were used to obtain the correct AA profile in the 25/21% and 21/18% diets.

RESULTS WITH BROILERS FED REDUCED PROTEIN STARTER AND GROWER DIETS

Protein % in diet	42 Day wt. grams	Feed Conversion 0 - 6 wks	N output/day grams	N % in manure DM
25/21*	2458	1.85	2.70	5.04
21/18*	2422	1.91	1.98	3.98

* Starter and grower diet, respectively.

Layer Experiment.

Two diets were fed to 33 week old layers for a test period of 8 weeks. One diet contained 17% protein and the other 13.5% protein. Commercial essential AAs were used to obtain the correct AA profile in both diets.

The reduction of the overall dietary protein level had no significant effect on egg production or egg quality, as long as dietary levels of limiting essential AAs were maintained. A reduction in the dietary protein level was accompanied by a reduction in N content of the manure and a 30-35% reduction in daily N output.

PRODUCTION

Protein % in diet	Egg production	Feed/doz eggs, kg	Egg wt. g
17	89.0	1.88	63.3
13.5	87.7	1.92	62.8

EGG QUALITY

Protein % in diet	% Yolk	% Albumen	% Shell
17	28.9	61.9	9.2
13.5	26.3	64.1	9.6

DAILY N OUTPUT OF LAYERS AND N CONTENT OF MANURE

Protein % in diet	N output/day g	N % in manure DM
17	2.30	5.84
13.5	1.39	4.60

Conclusions

Technology exists for the efficient handling of manure after it has been produced. The technology also exists to minimize nitrogen in manure before it is produced. Both technologies may be used for pollution abatement. Producers need to consider the costs/returns in making a decision to use reduced protein diets. The overall effect on profitability and sustainability of the enterprise need to be assessed.

Using reduced protein diets is only one component of a feeding/management strategy to complement the manure handling and disposal strategy. A complete feeding/management strategy is as follows:

1. Use superior stock that grows fast and converts the dietary nutrients efficiently.
2. Formulate diets as close as possible to requirements, and avoid excesses that will show up in the manure.
3. Use highly digestible feeds.
4. Keep the animals as healthy as possible and raise them with adequate space and in a good environment.
5. Use approved growth promoters.
6. Optimize the inclusion of essential AAs in diets to allow the dietary protein (nitrogen component) to be minimized.
7. Use supplemental enzymes in the feed to increase digestion of the nutrients and thereby reducing their loss as manure.
8. Use a life-cycle feeding approach, i.e. use diets tailored to the stage of production. This avoids over-feeding and the excretion of excess nutrients in the manure.

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