Natural Clay Product to Reduce Ammonia Emissions During Broiler Production

Poultry FACTSHEET

INTRODUCTION

Ammonia emissions from litter during poultry production can be a major stressor, resulting in poor flock health and reduced economic performance. Ammonia vented from the barn can contribute to air pollution.

The use of adsorbent materials such as natural minerals reduces ammonia emission not only by adsorbing the ammonia, but by keeping the litter dryer, thus preventing ammonia production. A series of tests of a natural clay product was tested at the Pacific Agriculture Research Centre-Agassiz, to determine its ability to reduce ammonia concentrations during broiler production. The tests were run in 4 independently ventilated rooms. The clay product was added at concentrations of 0, 2, 4 and 8% (weight of clay product/weight of litter) to a wood shaving based litter, which had already been used as litter for another flock. The amount of clay added on an area basis was 0.15, 0.31 and 0.63 kg clay per square meter of floor. Each room housed 270 male Pedersen x Arbor Acre broiler chicks to provide 0.8 square feet per bird for a six week production cycle. The birds were fed a 23% protein starter crumble for the first 3 weeks, then a 20% grower finisher pellet for the last three weeks. Ammonia concentrations in the rooms were measured twice weekly using a Kitigawa air sampling device and ammonia indicator tubes.

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RESULTS

The average bird weight, mortality, feed consumption and feed conversion ratio for all rooms were within industry standards. There was no statistically significant difference in bird growth or feed conversion between birds on the various clay level treatments. (Table 1).

Table 1. Bird growth, feed consumption and feed conversion ratio at 6 weeks

	Room 1 (0% clay)	Room 2 (2% clay)	Room 3 (4% clay)	Room 4 (8% clay)
Bird weight (kg. 6 wk)	2.32	2.29	2.34	2.35
Feed consumption (kg/bird)	3.23	3.23	3.29	3.27
Feed conversion ratio	1.95	1.95	1.94	1.94

Ammonia concentrations in each of the rooms increased over time (Table 2). Increasing amounts of clay resulted in lower ammonia concentrations during the first three weeks. Between 3 to 6 weeks there was no real trend towards decreasing ammonia concentrations with increasing amounts of clay. However, the estimates of the ammonia emmissions leaving the barn, calculated by taking the concentration in the rooms and multiplying it by the vented air volume, indicated that higher clay content in the litter reduced ammonia emission from the barn (2490, 2370, 2260, 2030 g NH_3 loss from rooms 1 to 4, respectively). This calculation was based upon the assumption that the ammonia concentration at the fan was the same as that in the room.

Table 2. Average ammonia concentrations during the six week broiler experiment

Week	Room 1 (0% clay)	Room 2 (2% clay)	Room 3 (4% clay)	Room 4 (8% clay)
	Ammonia concentration (uL L^{-1} or ppm)			
1	1.3	0.6	0.5	0.2
2	1.5	0.6	0.4	0.5
3	1.7	1.4	1.3	1.3
4	3.3	3.4	3.4	3.3
5	6.8	5.8	8.0	5.5
6	22.5	24.0	16.5	18.0

The litter, pH, moisture content, total and ammoniacal N increased during the six week production cycle (Table 3). The increased pH resulted from degradation of uric acid to ammonia. More than 50% of the total N in the litter at the end of the six weeks was in the form of ammonium. At a litter pH of >8.5, a significant amount of the ammonia would be expected to volatize either in the barn or following barn cleanout.

Table 3. Litter pH, moisture content, total and ammoniacal N content of the litter during a broiler production cycle.

Litter characteristics	Week	Room 1 (0% clay)	Room 2 (2% clay)	Room 3 (4% clay)	Room 4 (8% clay)
pH	0	6.41	6.41	6.49	6.49
	1.5	6.29	6.30	6.31	6.26
	3	6.74	6.74	6.68	6.63
	4.5	8.08	8.32	8.34	8.35
	6	8.75	8.79	8.58	8.54
Moisture (g/kg)	0	75	75	68	68
	1.5	99	93	103	89
	3	119	119	136	131
	4.5	219	211	209	210
	6	260	218	218	217
Total N (mg/kg)	1.5	8.93	26.2	23.8	18.5
	3	33.8	17.8	36.4	37.3
	4.5	44.7	47.7	47.7	48.0
	6	50.2	50.7	46.2	51.1
Ammonium N (mg/kg)	1.5	6.6	5.5	6.1	4.7
	3	9.6	11.5	7.7	7.3
	4.5	27.8	26.5	24.4	23.4
	6	27.3	27.2	28.0	27.4

The nitrogen fed that was lost to the atmosphere as ammonia during bird production was 13.1, 12.5, 12.2 and 10.4% of the excreted N from the birds in rooms receiving 0, 2, 4 and 8% clay, respectively. The nitrogen use efficiency (N in birds sold as a percentage of feed N consumed) was 42%. (Table 4).

Table 4. Nitrogen balance				
N balance (kg N room)	**Room 1 (0% clay)**	**Room 2 (2% clay)**	**Room 3 (4% clay)**	**Room 4 (8% clay)**
Chicks in	0.35	0.35	0.35	0.35
Feed consumed	36.59	35.78	36.73	36.78
Birds sold	15.37	14.77	15.27	15.51
Ammonium N lost	2.49	2.37	2.26	2.03
Manure N	18.73	18.64	18.2	19.24

Following the broiler experiment, additional clay product (same amount as the 8% clay treatment) was mixed with the litter in one of the the rooms to determine if a reduction in ammonia concentrations would occur. This was repeated twice and in all cases the reduction in ammonia concentration was negligible. Ammonia concentrations in the room were 25 uL/L (ppm). This indicates that this amount of clay product is not enought to reduce ammonia concentrations significantly when the ammonia concentrations are high.

Natural clay products have the potential to reduce ammonia emissions during poultry production. However, the only incentive is to reduce ammonia in barns from an animal health and production standpoint. It would require incentives to reduce ammonia emissions and increase the value of the litter to make the use of clay products more cost effective. If clay product is used, it is recommended that a granulated form of clay be applied as the fine powdered form used in these tests resulted in excessive dust.

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