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Ammonia in the Atmosphere during Brooding Affects Performance of Broiler Chickens

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ABSTRACT Broiler chickens were exposed to 0, 50, 100 and 200 ppm of ammonia in the atmosphere during the 0- to 28-day brooding period; ammonia exposure was stopped after 28 days. Ammonia exposure adversely affected weight gains, feed conversion, and mortality during brooding. Birds exposed to ammonia weighed significantly less at market age even though ammonia exposure stopped at 28 days. The effect on feed conversion, however, reversed during grow-out so that ammonia-exposed birds had better feed conversions at 49 days than those not exposed, primarily because of reduced body size for exposed birds. When birds were kept additional time to compensate for the reduced growth, feed conversion increased to about the same as for non-exposed birds.

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INTRODUCTION

The practice of brooding chicks on litter on which chickens have been previously grown increases the chances that they will be exposed to ammonia in the environment very early in their life. The amount of ammonia exposure will depend on the concentration of ammonia-producing fecal material in the old litter, the moisture content and temperature of the litter, and the ventilation rate in the brooding space. Recent trends in poultry production, such as partial-house brooding—which increases chicken population density and provides for decreases in ventilation rate to reduce heating requirements—and reuse of litter materials have caused increased ammonia during brooding.

Ammonia in poultry houses, of course, has been recognized as a problem for many years. However, the problem has been most common in laying-hen houses and in the grow-out phase of poultry production. Charles and Payne (1966) showed that the feed intake of broiler chickens reared in atmospheres containing high concentrations of ammonia from 28 days of age was reduced, and, at 100 ppm of ammonia, growth rate was reduced. In work by Quarles and Kling (1974), 8-week body weights and feed efficiencies were reduced when broilers were exposed to ammonia at a concentration of up to 50 ppm during the 4- to 8-week growing period.

The effect of ammonia on broiler-chicken performance during brooding has not been well established. Caveny and Quarles (1978) reported that exposure of broiler chickens to ammonia at a concentration of up to 50 ppm of ammonia during the 0- to 28-day brooding period reduced their feed efficiency.

The work reported herein was conducted to determine the effect on the production efficiency of broiler chickens exposed to moderate to heavy concentrations of ammonia during brooding.

METHODS

Eighty commercial broiler chicks, 40 of each sex, were placed at hatch in each of the four environmental chambers described by Reece and Deaton (1969). Temperature in all chambers was 29.4 C the first week, 26.7 C the second week, 23.9 C the third week, and 21.1 C thereafter, with dewpoint temperatures of 10 C. Ventilation rate in each chamber was approximately 5100 liters/min. Light was continuous at 55 lx for the first 10 days and then 11 lx.

Litter material was about 10 cm of fresh hardwood shavings. Starter mash with 22.3% protein and 3200 kcal/kg of energy was fed *ad libitum* for the first 4 weeks, and a finisher mash with 20.2% protein and 3255 kcal/kg of energy was fed thereafter.

Anhydrous ammonia was metered into three of the chambers to maintain levels of 50, 100, and 200 ppm on a volume basis. No ammonia

TABLE 1. *Body weight gains and feed conversions for broiler chickens exposed to three levels of ammonia during brooding*

NH_3, ppm	Trial	Days 14 Wt., g	14 g feed/g gain	28[1] Wt., g	28[1] g feed/g gain	49 Wt., g	49 g feed/g gain	(Day nos. as shown) Wt., g	(Day nos. as shown) g feed/g gain
0	1	286x	1.37	742w	1.82	1723w	2.18	...	...
	2	270a	1.64	834a	1.79	1894a	2.10	...	...
	Average	278	1.51	788	1.81	1809	2.14	...	...
50	1	282x	1.41	657x	1.92	1573x	2.13	...	...
	2	240b	1.63	664b	1.80	1699b	2.04	1861	2.10(52 days)
	Average	261	1.52	661	1.86	1636	2.09	...	...
100	1	224y	1.80	447y	2.31	1444y	2.10		
	2	216c	1.72	589c	1.94	1648b	2.01	1870	2.03(53 days)
	Average	220	1.76	518	2.13	1546	2.06	...	...
200	1	185z	1.89	362z	2.43	1340z	1.90		
	2	178d	1.98	363d	2.04	1382c	1.95	1708	2.08(57 days)
	Average	182	1.94	363	2.24	1361	1.93	...	...

[a,b,c,d,w,x,y,z]In columns, values for each trial with same superscript are not significantly different (P>.05).

[1] Ammonia treatments were stopped after 28 days.

was added to the fourth chamber. Ammonia levels were checked daily with a Bendix/-Gastec[1] gas detector. Flowmeters were also used to monitor ammonia flow into the chambers. At 4 weeks, ammonia treatment was stopped and the chickens were grown to market weight with essentially no ammonia present.

Chickens were individually weighed and feed consumption determined at 2 weeks of age and at weekly intervals thereafter. They were vaccinated at 10 days of age for Gumboro disease. Two trials were conducted.

RESULTS AND DISCUSSION

As indicated in Table 1, results for the two trials were similar. At 14 days of age, all ammonia-treated chicks except those exposed to 50 ppm in trial 1 weighed significantly less than the controls; feed conversions were progressively worse as ammonia concentrations increased. At 28 days of age, when the ammonia treatment was stopped, all birds exposed to ammonia had drastically reduced body weights; those exposed to the 200 ppm treatment weighed only one-half as much as the controls. Although feed conversion was adversely affected by the ammonia exposure, all ammonia-treated birds had consumed less total feed by 28 days of age than the controls.

At 49 days of age, all birds that had been exposed to ammonia during brooding weighed significantly less than the controls (Table 1). However, the feed conversions tended to be better for the ammonia-treated groups primarily because of reduced body size for those exposed

TABLE 2. *Mortality of broiler chickens as affected by three levels of ammonia during the brooding period*

NH_3, ppm	Trial	Mortality, % 4 weeks	Mortality, % Total
0	1	5	6x
	2	1	1a
50	1	4	4x
	2	3	3a
100	1	8x	13y
	2	13a	14b
200	1	13x	16y
	2	26b	31c

[a,b,c,x,y]Values at a given age within the same trial with the same superscript are not significantly different (P>.05).

[1] Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty by the US Department of Agriculture and does not imply its approval to the exclusion of other products that may be suitable.

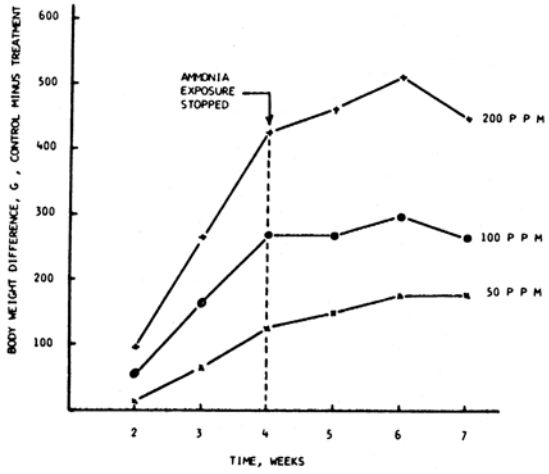

FIG. 1. Depression of body weight of broiler chickens exposed to three levels of ammonia during brooding.

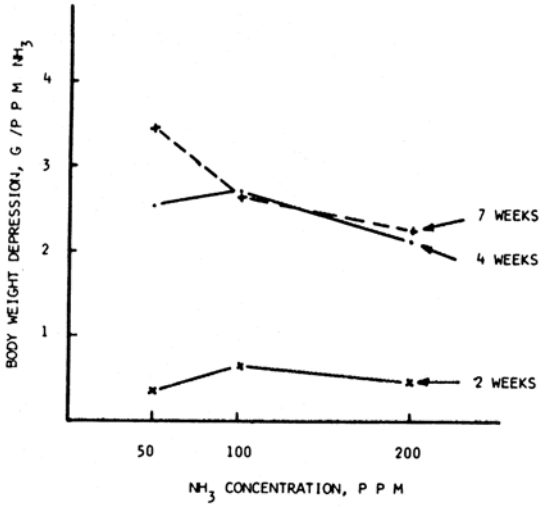

FIG. 2. Depression of body weight per unit of ammonia exposure during brooding for three chicken ages.

to ammonia.

The ammonia-treated birds in trial 2 were held several additional days to determine the time required for the birds to reach the approximate weight of the controls and to determine the final effect of the ammonia on feed conversion. About 3 days were required for those exposed to 50 ppm during the brooding to reach the 49-day weight of the controls, and 4 days were required for the group exposed to 100-ppm. However, 8 days later the group exposed to 200-ppm still had not reached the 49-day control weight. At the end of the additional time, feed conversions for the ammonia-treated groups were little different from those of the controls (Table 1).

The mortality for the two trials is shown in Table 2. Exposure to 50 ppm did not appear to affect mortality. However, the 100- and 200-ppm treatments caused a considerable percentage of mortality in both experiments.

The data were examined to determine whether the body weight depressions at the three ammonia exposure levels were linear. In Figure 1, the body weight depressions for the three exposure levels are plotted versus time. During exposure (up to 4 weeks) the rate of depression for all three levels was linear. After exposure stopped, however, the rate was no longer linear. The weight depression between levels also was not linear. At 4 weeks of age, the response at 100 ppm was about double that at 50 ppm., but the 200-ppm response was not double that at 100 ppm. At 7 weeks of age, the 50-ppm response was not one-half that at 100 ppm, and the 200-ppm response was not double that at 100 ppm. In Figure 2, body weight depression per part per million of ammonia was plotted versus ammonia concentration level for three chicken ages. At 2 weeks of age, weight depression differed little at the three levels. However, at 4 weeks weight depression per unit of ammonia tended to increase for the 50- and 100-ppm exposure levels. At 7 weeks the trend toward increased response at the lower exposure levels was pronounced. Therefore, these data seem to indicate that low levels of ammonia are more damaging to broiler chicken performance than high levels when expressed on a per-unit-of-ammonia basis.

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