Animal Industry Report

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Ammonia Concentrations and Emissions of Aviary Hen Houses

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Summary and Implications

Ammonia (NH_3) concentrations and emissions were monitored in four aviary laying-hen houses for one year. The mean indoor NH_3 concentration of the four houses (mean ± SE) was 5.2 (±0.1) ppm. The NH_3 concentrations were below 25 ppm, the commonly recommended threshold, on all sampling days. Ammonia emission rate was 0.14 (±0.01) g/d-hen. The NH_3 concentrations and emission rate of the aviary houses were between those of manure-belt and high-rise cage houses reported in the literature.

Introduction

High NH_3 concentrations and emissions from livestock houses can adversely affect recipient health and atmospheric environment. Some occupational health agencies (OSHA, ACGIH, NIOSH) have recommended that indoor NH_3 level not exceed 25 to 50 ppm. The U.S. EPA regulation requires that the NH_3 emission be reported if a farm emits more than 100 lb/day for any 24-hour period.

Aviary hen housing system is an alternative egg production system designed to improve hen welfare that has received increasing interests in the US egg industry. Baseline data of NH_3 concentrations and emissions in such a housing system are quite limited under U.S production conditions. This study investigated NH_3 concentrations and emissions of four aviary houses in Iowa for one year.

Materials and Methods

Four aviary hen houses at a commercial farm in Iowa were monitored in this study. Each house measured 495×35×10 ft (L×W×H) with a capacity of 50,000 laying hens. Hen ages were identical within the same house, but were different among houses. Photoperiod was 16L:8D. Hens were allowed litter access for 10 hr/day. Manure on the belt was continuously dried with circulated air. During the experimental period, all four houses had a flock change, which took about two weeks. Ammonia concentrations were monitored at two locations in each house along with the ambient measurement, and the monitoring was made for two consecutive days every two weeks. Concentrations of CO_2 were measured concurrently and used to determine building ventilation rate (VR) using the CO_2 mass balance method. The emission of NH_3 was calculated by multiplying the NH_3 concentration by VR. Indoor and ambient temperature and relative humidity (RH) were continually monitored at 5-min intervals throughout the one-year monitoring period of 8/30/2011 to 8/30/2012.

Results and Discussion

Table 1 summarizes the indoor and ambient thermal environment, VR and indoor CO_2 concentrations of the monitored aviary houses.

Table 1. Summary of daily environmental conditions and VR.

Parameter	Unit	Mean±S.E.	Min[1]	Max[1]
Ambient temp.	°F	52.7±0.2	-16.1	103.8
Ambient RH	%	68±1	23	95
Indoor temp	°F	74.1±0.2	61.5	99.8
Indoor RH	%	64±1	28	95
VR	cfm/hen	2.2±0.1	0.4	6.5
CO_2 level	ppm	1520±44	452	3215

[1] Minimal or maximum value within the day

Indoor NH_3 concentrations averaged 5.2 ppm. The NH_3 concentration showed clear seasonal variations (fig. 1), being highest in winter (low VR) and lowest in summer (high VR). The mean NH_3 concentrations were below the commonly recommended threshold of 25 ppm.

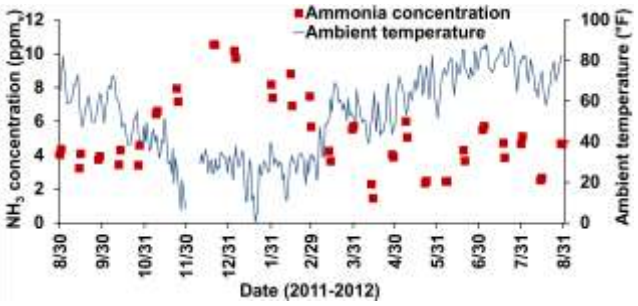

Fig 1. Mean NH_3 concentration of four aviary houses and ambient temperature.

Emissions of NH_3 from the hen houses averaged 0.14 (±0.01) g/d-hen. This value is between the NH_3 emissions reported for manure-belt cage houses (0.05 – 0.10 g/d-hen) and high-rise cage house (0.95±0.05 g/d-hen).

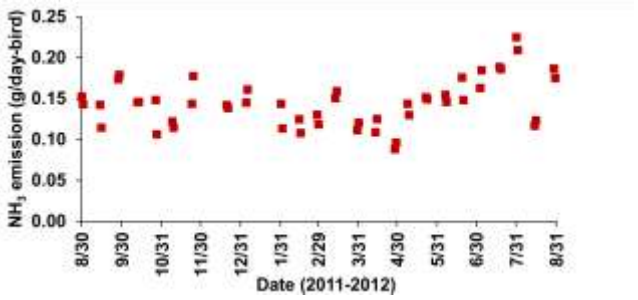

Fig 2. Mean NH_3 emission of four aviary houses.

Acknowledgments

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