

Ammonia Concentrations and Emissions of Aviary Hen Houses

A.S. Leaflet R2802

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Summary and Implications

Ammonia (NH₃) concentrations and emissions were monitored in four aviary laying-hen houses for one year. The mean indoor NH₃ concentration of the four houses (mean ± SE) was 5.2 (±0.1) ppm. The NH₃ 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 NH₃ 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 NH₃ 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 NH₃ level not exceed 25 to 50 ppm. The U.S. EPA regulation requires that the NH₃ 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 NH₃ concentrations and emissions in such a housing system are quite limited under U.S production conditions. This study investigated NH₃ 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 CO₂ were measured concurrently and used to determine building ventilation rate (VR) using the CO₂ mass balance method. The emission of NH₃ was calculated by multiplying the NH₃ 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 CO₂ 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 NH₃ concentrations averaged 5.2 ppm. The NH₃ concentration showed clear seasonal variations (fig. 1), being highest in winter (low VR) and lowest in summer (high VR). The mean NH₃ concentrations were below the commonly recommended threshold of 25 ppm.

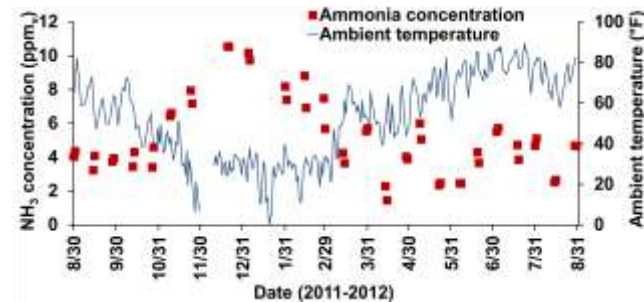


Fig 1. Mean NH₃ concentration of four aviary houses and ambient temperature.

Emissions of NH₃ from the hen houses averaged 0.14 (±0.01) g/d-hen. This value is between the NH₃ 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).

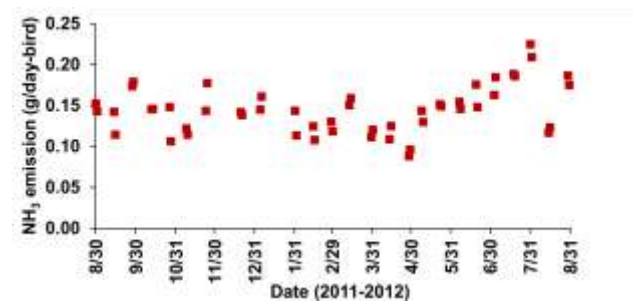


Fig 2. Mean NH₃ emission of four aviary houses.

Iowa State University Animal Industry Report 2013

Acknowledgments

Funding for the study was supported in part by the USDA-AFRI-NIFA Program (Award#:

201-67021-20223). We gratefully acknowledge the cooperation of the egg farm staff.