



AMMONIA EMISSIONS FROM A NATURALLY AND A MECHANICALLY VENTILATED BROILER HOUSE IN BRAZIL

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Background

Studies on ammonia (NH₃) emissions from confined animal operations such as broiler housing systems have been carried out around the world ever since at least 30 years, and the countries that first started their studies are now at either of the following stages (1) conducting emissions inventories, (2) developing mitigation techniques and (3) setting regulations. In a global scale, Brazil is the country that has the third biggest production, ranked as the first exporter of broiler chicken meat; however even with the considerable magnitude of the Brazilian animal production systems, very little effort has been given to estimate NH₃ emission factors from poultry houses under the unique Brazilian conditions: tropical and subtropical climate, uninsulated broiler houses that are usually opened, with ventilation strategies that can be either mechanically or naturally driven.

Objective

Simultaneously monitoring NH₃ emissions from a typical mechanically and also a typical naturally ventilated Brazilian broiler houses (MVB and NVB, respectively), and calculate their ammonia emission factor (f_{NH₃}).

Materials & Methods

- Two commercial broiler barns: a negative pressure barn (NPB) with dimensions of 120.0m L x 14.0m W x 2.5m H housing 23,100 male Cobb® chicks; and a naturally ventilated barn (NVB) with dimensions of 75m L x 12m W x 2.75m H housing 10,000 female Cobbs®; The barns are both situated in the same farm, placed side by side, with birds of the same age and origin.
- Emissions were monitored on a weekly basis in both barns for 6 weeks (till pre-slaughter).
- Ventilation rates were calculated from metabolic CO₂ concentrations, following the CIGR (2002) protocol.

Results

Ammonia emission rate data (g bird⁻¹ day⁻¹) was regressed against bird age (d) according to Equation 1.

$$NH_3ER = y_0 + a \cdot x + b \cdot x^2 \quad \text{Eq. 1}$$

TABLE 1. Results from analysis of variance (ANOVA) for the relationship between bird age (x, d) and NH₃ emission rate (NH₃ER, g bird⁻¹ day⁻¹), according to Eq. 1.

Parameter	y ₀	a	b
MVB	-4 ± 2 (p=0.08)	0.3 ± 0.1 (p=0.06)	-0.04 ± 0.002 (P=0.09)
NVB	-3.8 ± 0.7 (0.0005)	0.25 ± 0.04 (p=0.0005)	-0.0034 ± 0.0007 (p=0.001)

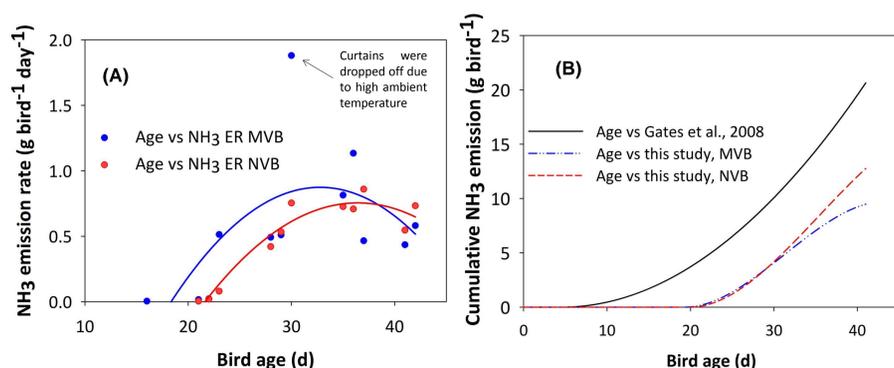


FIGURE 1. Relationship between bird age (d) and NH₃ emission rate (NH₃ER, g bird⁻¹ day⁻¹) for both the mechanically and naturally ventilated buildings (MVB and NVB, respectively) (A), and modeled cumulative NH₃ emission (g bird⁻¹) also as a function of bird age (d) (B).

TABLE 2. Ammonia emission factors estimated from this study and other studies

Reference*	Type of ventilation system	Stocking density (birds m ⁻²)	NH ₃ ER (mean ± SE, g bird ⁻¹ day ⁻¹)	Local
This study	Mechanical	13	0.38 ± 0.12	MG/Brazil
This study	Natural	11	0.32 ± 0.08	MG/Brazil
Lima et al. (2011)	Mechanical	15	0.78	SP/Brazil
Burns et al. (2007)	Mechanical	13	0.47	KY/USA
Wheeler et al. (2007)	Mechanical	12	0.63	KY & PN/USA

*For comparison purposes, we only considered broiler barns with new litter.

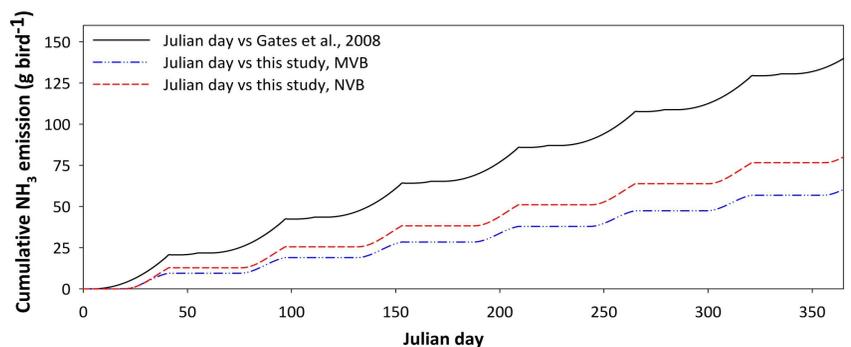


FIGURE 2. Cumulative ammonia emission over a year, from multiple flocks, for the studied mechanically and the naturally ventilated barns (MVB and NVB, respectively), calculated with Eq. 1 and assuming a resting period between flocks of 14 days. The black line represents the model of Gates et al. (2008) for broilers reared on new litter.

Conclusions

- Estimated f_{NH₃} on yearly basis were 109 g bird⁻¹ year⁻¹ and 91 g bird⁻¹ year⁻¹ for the MVB and NVB, respectively.
- The results obtained with this study help providing reliable methodology for the determination of a solid database on NH₃ emission factors for tropical conditions that can be used for future inventories, when performed in a sufficient number of barns that is representative for Brazilian scenario.

References

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