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GREENHOUSE GAS AND AMMONIA EMISSIONS IN BRAZIL SWINE PRODUCTION – A COMPARISON BETWEEN NATURAL AND MECHANICAL VENTILATION IN BARNs

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Abstract:

Greenhouse gas (GHG) and ammonia emissions from livestock sector can be influenced by several factors as housing and environmental conditions, animals, diets, and manure removal systems and its management. One of the most important factors influencing the emissions is the type of ventilation in the swine barns, specifically the mechanically, which air flow is controlled commonly by the temperature. In this sense, the aim of this study was to compare the type of ventilation in two swine rooms, one with natural ventilation and other with an automated system to control the environment (growing-finishing phase) at the west of Santa Catarina State in southern Brazil, determining the gas emission factors [carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and ammonia (NH₃)]. The experiment consisted in two treatments which cycles and environment in the rooms were representative of the field conditions with observations conducted in the four seasons of the year [treatment 1: room with natural ventilation; treatment 2: room with controlled environment, both rooms with length: 16.8 m; width: 13.05 m; ceiling height: 2.8 m; partially concrete slatted floor; 20 pens with a maximum capacity of five animals per pen - area of 1.35 m²/swine (length: of 3.0 m; width: 2.5 m), during 18 months, and considering four production cycles (100 pigs per cycle; housing average period: 98 days). Both rooms used were equipped with automated systems for: recording temperatures (Munters Sensor Temperature) and internal relative humidity (Munters RHS Humidity Sensor); measurements of CO₂ concentrations (Munters Rotem Sensor) and NH₃ (Dräger Sensor Polytron C 300); water supplied to the swines (Renova Hydrometer ¾"). To assess the quality of measurements of CO₂ and NH₃ gases it was used an infrared photoacoustic gas analyser INNOVA®1412 (LumaSense Technologies, Inc., Denmark). Table 1, shows the results observed at both rooms (natural and ventilated) considering the environmental conditions (temperature and moisture of air), and gas emissions estimated by mass balance. The results obtained showed that the GHG and ammonia emissions were similar between treatments. Nevertheless, CO₂, CH₄ and N₂O emissions were slightly higher at mechanical ventilation treatment probably due to the air frequency removal used in this room when compared with natural ventilation. However, NH₃ emissions were slightly higher at natural ventilation room.

Table 1. Environmental conditions and gas emissions, estimated by mass balance, at growing finishing phase with natural and mechanical ventilation.

Parameters	Natural Ventilation				Mechanical Ventilation			
	Mean	σ†	Max. ¹	Min. ²	Mean	σ†	Max. ¹	Min. ²
CO ₂ , kg swine ⁻¹ day ⁻¹	2.11	0.78	3.40	0.98	2.23	0.86	3.72	1.01
CH ₄ , g swine ⁻¹ day ⁻¹	16.71	7.50	29.24	4.83	18.17	8.14	33.11	7.21
N ₂ O, g swine ⁻¹ day ⁻¹	1.09	0.48	2.04	0.42	1.29	0.61	2.60	0.44
NH ₃ , g swine ⁻¹ day ⁻¹	2.37	1.60	6.39	0.68	2.25	1.23	5.23	0.79
T _{Int} , °C	21.6	3.6	26.3	14.7	21.0	1.9	24.6	17.8
T _{Ext} , °C	20.8	4.3	26.4	13.3	20.8	4.3	26.4	13.3
UH _{Int} , %	79.2	4.8	88.3	70.5	87.3	4.3	95.9	81.2

† Standard deviation; ¹ mean maximum temperature; ² mean minimum temperature.

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