FARMING PRACTICE
MANURE PROCESSING TECHNIQUES

IMPACT: AIR POLLUTANTS EMISSIONS

Reference 11

Wang, Y; Xue, W; Zhu, Z; Yang, J; Li, X; Tian, Z;Dong, H; Zou, G; 2019 Mitigating ammonia emissions from typical broiler and layer manure management - A system analysis Waste Management 10.1016/j.wasman.2019.05.019

Background and objective

Much work in literature has been done to evaluate gas emissions or mitigations targeted at one specific gas or one emission stage from poultry production, while little research has considered them in a comprehensive way, especially for the mitigation from a system level perspective. The overall objective of this study is to make a quantitative assessment of ammonia (NH_3) emissions from the broiler and layer manure management systems and the effects of 14 mitigation options on the NH_3 emissions from the whole manure management chain using meta-analysis. Here the results concerning manure storage and treatment are reported.

Search strategy and selection criteria

The ISI Web of Knowledge database (www.isiwebofknowledge.com) and the Chinese journal database (www.cnki.net) were used to search all published datasets as of April 2018. Specific search terms were combined and used, depending on animal categories (broiler, layer, poultry, chicken), manure, in-house manure management (litter, cage, manure belt, high-rise, deep pit), outdoor manure management (compost, stockpile), land application (surface spread, incorporation), gaseous emission (NH_3, gas emission), and mitigation measures (diet, crude protein, additive, amendment, urease inhibitor, biofilter, biotrickling, cover, nitrification inhibitor, incorporation, reduce, mitigation). The literature sources used in this study were selected based on the following criteria: (1) The research object was broiler or layer; (2) the study included NH_3 emissions; (3) a gas emission flux or gas emission factor was available; and (4) for literature related to mitigation, only studies that reported at least one control group were selected so that the emission mitigation efficiency could be calculated.

Data and analysis

The Wilcoxon Signed-Rank test was used to determine if the median values of mitigation efficiency were significantly different from zero when there were sufficient results for specific measures.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
96	Broiler and layer production (chicken)	Manure additives for compost (mineral additives, e.g. H_3PO_4, alum, calcium superphosphate, zeolite; or biochar)	A reference litter based or layer manure belt based system (diet: conventional, in house: no treatment, outdoor: composting, land application: spreading)	Metric: NH_3 emission factor; Effect size: Ratio of the considered metrics in the intervention to the considered metrics in the control	62.5

Results

- When composting the manure, the NH_3 mitigation efficiency of biochar additive during composting was 28.5% ($p < 0.001$), while for mineral additives, it was 44.6% ($p < 0.001$). The manure characteristics influenced the efficiencies of the mitigation measures during outdoor composting: for the manure additives, NH_3 mitigation efficiency was linearly related to initial manure N content and manure C/N ratio.

Factors influencing effect sizes

- Manure characteristics : The higher TN content or lower C/N ratio of the initial manure both indicated higher NH_3 mitigation efficiency (1% increase in initial chicken manure TN increased the NH_3 mitigation efficiency by 7.07%; 1% decrease of C/N ratio of the initial chicken manure increased the NH_3 mitigation efficiency by 4.37%)

Conclusion

Overall, manure additives during composting (mineral additives, e.g. H_3PO_4, alum, calcium superphosphate, zeolite; or biochar) led to reduce NH_3 emissions of chicken manure treatment and storage in broiler or layer based systems.