Analysis of the maximum potential of ammonia emission, from laying hens manure, through the dynamics of systems.

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INTRODUCTION

- Brazil is largest egg producer in Latin America. It produced 39.51 billion units in 2015.
- This production is possible due the Vertical cage production systems have a greater efficiency in laying hens per area unit.
INTRODUCTION

- However, a greater number of laying hens per area causes the generation of a larger volume of manure leading to greater environmental concerns.
INTRODUCTION

- The nitrogen content in laying hens excreta has become a concern to the poultry industry.
- North (1975) reported that fresh excreta of chicks contains:
  - 75% water;
  - 1.25% total nitrogen;
  - 1.15% phosphate, and
  - 0.6% potassium.
INTRODUCTION

- The main reaction of ammonia generation by the laying hens waste utilization of uric acid ($C_5H_4O_3N_4$) as a source of nitrogen.

$$C_5H_4O_3N_4 + 1,5O_2 + 4H_2O \rightarrow 5CO_2 + 4NH_3$$
INTRODUCTION

- More than 60% of the nitrogen present in the manure is lost through ammonia volatilization processes.

- The release of ammonia into the environment has potential for:
  - Acid rain;
  - Eutrophication of lakes and rivers;
  - Soil acidification;
  - Formation of some types of inorganic aerosols in the atmosphere.
INTRODUCTION

- Environmental factors that influence the rate of uric acid excretion of laying hens:
  - such as temperature
  - relative air humidity,
  - such as crude protein levels and feed energy.

- These factor influences may be modeled with their interactions through mathematical equations describing their physical relationships.
MATERIAL AND METHODS

- System Dynamics (System Dynamics) is above all, a language allowing to express, more properly, existing chains of events in nature. Through the use of diagrams it is possible to define a production system.

- VenSim® is a computer program that was used to generate the desired diagrams.

- The database for Vensim was developed from a literature review of pre-existing studies, which are summarized below.
According to Vogels and Drift (1976), the increase of the ambient temperature allows higher values for the decomposition rates of uric acid.

The variation of moisture content of laying hens manure on the degradation of uric acid.
MATERIAL AND METHODS

- The effect of variation of the moisture content was presented by Groot Koerkamp (1994).

- Koerkamp showed the effect of temperature associated with pH on the rate of ammonia generation.
Maximum values were used to estimate the potential for ammonia generation.

These values were taken from the literature, as in previous studies (influence of temperature on uric acid degradation, moisture content of waste, pH, among others).

The results provide an estimate of the the worst possible situation where the maximum amount of Total nitrogen in the manure, was converted to ammonia.
The data gathered from literature reviews were entered in the causal diagram constructed in Vensim. Then we generate a new diagram, termed a ‘flow-stock’.
The simulation predicted that a maximum of 64% of manure total N has the potential to be converted to ammonia.

While this condition is hypothetica, it can provide a means of estimating the maximum potential emission.

More evaluations, including a senstivity analysis, are needed however.
CONCLUSION

- The system dynamics is presented as a tool to combine the factors affecting the generation and emission of ammonia from the manure of laying hens and to predict the maximum quantity of ammonia that can be generated for a set of conditions.
- Additional studies to adjust the displayed flow model and inventories are being conducted.
- By using this tool, we can predict how much will be the maximum emission of ammonia using the local environmental and management conditions, and to assess potential emissions reduction strategies.
Thank you
REFERENCES


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