FACULTEIT DIERGENEESKUNDE
accredited by EAEVE

ILVO
Flanders Research Institute for Agriculture, Fisheries and Food

UNIVERSITEIT GENT

INVITATION PUBLIC DEFENSE

Source-oriented strategies to mitigate ammonia emission from broiler production

Madri Brink

Thursday, the 22nd of September 2022
16:00

PROMOTORS

Prof. dr. Ir. G.P.J. Janssens
Faculty of Veterinary Medicine, UGent

Dr. Ir. Evelyne Delezie
Flanders Research Institute for Agriculture, Fisheries and Food (ILVO)

Curriculum Vitae

Madri Brink was born on the 8th of June 1993 in Bloemfontein, South Africa. She obtained a Bachelor of Science Agriculture degree, direction Animal Science, in 2015 as well as a Bachelor of Science Honours in Agriculture, majoring in Animal Science with specialisation in Animal Nutrition in 2016 (both with distinction) at the University of the Free State in Bloemfontein, South Africa. In 2016, she continued with a Master of Bioscience Engineering in Agricultural Sciences, direction Animal Production at the KU Leuven in Belgium.

In 2018, she started her PhD research at the Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) and Ghent University, Faculty of Veterinary Medicine, in 2018. Her research focussed on source-oriented nutritional and management strategies to reduce ammonia emission from broiler production.

Madri is the first author of several publications in international peer-reviewed journals and has given oral and poster presentations at several national and international conferences.

How to attend

The defense will take place on **Thursday, the 22nd of September 2022 at 16:00h**. After the defense, a reception will follow.

Flanders Research Insitute for Agriculture, Fisheries and Food (ILVO)
Caritasstraat 39
9090 Melle

The defense can also be followed online via Microsoft Teams. The link will be shared with registered individuals.

Register

If you would like to attend, please register before Friday the 16th of September 2022, by using the following **link**

Members of the Jury

Prof. dr. An Garmyn
Chair of the Jury
Faculty of Veterinary Medicine, UGent

Prof. dr. Gunther Antonissen
Faculty of Veterinary Medicine, UGent

Prof. dr. Ir. Stefaan De Smet
Faculty of Bioscience Engineering, UGent

Prof. dr. Markus Rodehutscord
Faculty of Agricultural Sciences, University of Hohenheim

Prof. dr. Ir. Johan Buyse
Faculty of Bioscience Engineering, KU Leuven

Summary

Globally, broiler production is an important source of animal protein. However, intensive broiler production contributes to ammonia emissions and the associated harmful effects on the environment and human health. Ammonia is the main gaseous pollutant from broiler production. Several regulations and policies have been developed (and are adapted) in order to reverse its adverse impacts. Therefore, mitigation strategies are needed to reduce ammonia emissions from broiler production facilities. Currently, farmers lack affordable, efficient techniques to reduce the production and emission of ammonia in the short term. Preference should be given to source-oriented strategies as they also improve the indoor air quality, which is beneficial to the well-being of the farmer and the animals.

The aim of this PhD research was to investigate how source-oriented nutritional and management strategies influence litter quality and ammonia volatilization from broiler litter. The effect of the strategies on other important parameters such as broiler performance, meat yield and quality, as well as foot- and hock lesions were also evaluated.

A study was set up to assess the effect of feed form (mash and pellets) and a reduction in dietary crude protein (while maintaining digestible amino acid to lysine ratios) on ammonia concentrations, litter composition and quality, and nitrogen utilization. It was found that, with the supplementation of essential amino acids, dietary crude protein can be decreased to 187.5 g/kg and 180 g/kg in the grower and finisher phases respectively without, impairing performance, meat yield and quality. A further reduction to 165.6 g/kg in the finisher phase reduced growth performance. A reduction in dietary crude protein significantly reduced ammonia concentrations at litter level at 5 and 6 weeks of age. When comparing the feed form, litter quality was better for mash treatments than pellet treatments, and broilers fed mash diets had a lower incidence of foot- and hock lesions than broilers fed pellets. However, mash diets could not maintain similar performance and slaughter yield to pellets. The ammonia concentrations at litter level tended to be lower for pellets at 5 weeks of age, possibly due to the worse litter quality of pellet treatments.

Another nutritional strategy studied in this thesis compared a 3- and 5-phase feeding program. Significantly lower ammonia concentrations were measured at litter level for the 5-phase treatment than the 3-phase treatment at 23 and 37 days of age. Despite no significant differences for nitrogen retention and excretion parameters, there was an indication of birds from the 5-phase treatment to have a higher nitrogen retention and lower nitrogen excretion, while maintaining performance and meat yield, although feed efficiency was slightly reduced.

Different types of bedding materials will have different physical and chemical properties that will affect the litter quality and ammonia volatilization throughout the rearing period. Six bedding materials were compared: wood shavings, flax, peat, corn silage, chopped wheat straw, and broken flax pellets. The ammonia concentrations at litter level did not differ significantly between the different bedding materials. The bedding materials such as flax, peat, corn silage, and broken flax pellets have the potential to reduce ammonia volatilization from the litter earlier in the rearing period (up to about 30 days of age). After that, the accumulation of excreta in the litter may outweigh the unique properties (natural acidity, friability, water absorption and ammonia adsorption capacities) of the individual bedding materials, which probably caused the increase in ammonia measured at 36 days of age. The studied bedding materials may each require specific preparation and individual management to optimise broiler performance and to mitigate risks of the development of foot lesions and ammonia release from the litter. Management techniques may include the mixing of different bedding materials, or the application of a higher amount of bedding material at the beginning of the rearing period, which may reduce the diluting effect caused by excreta accumulation in the litter. Considering all parameters measured in this experiment, corn silage and broken flax pellets performed quite well, however, more research is needed to find a more suitable bedding material which is beneficial to the environment as well as the welfare of broilers.

Finally, to study the effect of litter friability and compaction of the litter layer as well as litter moisture content on ammonia volatilization, an experiment was set up where the litter was regularly raked or left undisturbed, and the moisture content was increased by means of regularly spraying water over the litter surface. The higher ammonia concentrations measured for the raked litter treatments coincided with a higher litter pH and temperature as well as a lower uric acid and total nitrogen concentration in the litter at 37 days of age. This suggests higher microbial activity in the litter and conversion of nitrogen to ammonia. The addition of water to the litter resulted in lower litter quality scores and a higher incidence of foot lesions. The results from this study suggest that the effect of different litter parameters (moisture, nitrogen, and uric acid content, temperature, and pH) on the production of ammonia in the litter and the volatilization of ammonia from litter are interdependent. Furthermore, the physical properties of litter such as friability and compaction have a prominent impact on the chemical properties of the litter, and potentially the ammonia emissions from the broiler house.

To conclude, the source-oriented strategies studied in this thesis offer promising results with regards to ammonia reduction, though, the effect sizes vary between the strategies. Other parameters such as litter quality and composition also differ and are favourably or unfavourably influenced, depending on the strategy implemented. Except for very low crude protein diets, broiler performance is often maintained. The insights obtained from this thesis may assist the poultry sector towards a socially acceptable and more sustainable, low-emission farming system.