

ANALYSIS OF FACTORS AFFECTING AMMONIA AND METHANE EMISSIONS FROM PIG SLURRIES: SLURRY COMPOSITION AND DIETARY FACTORS

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ABSTRACT: Manure management system and diet modification are key options to mitigate gaseous emissions from pig slurry. In this study, feed and slurry samples from 72 commercial piggeries and from nutritional experiments were analyzed for chemical composition and NH₃ and CH₄ slurry emission potential.

For all samples emissions were related to slurry composition. NH₃ and CH₄ emissions from commercial farms were lower. Slurry degradation in pits might explain these differences. For commercial samples, it was not possible to relate gaseous emissions to diet characteristics, probably due to other factors driving the emission process (i.e. dilution, feed wastage, environmental conditions, etc.)

For slurries coming from experimental studies, clear relationships were found between diet and emissions. Feeds with higher crude protein and lower fibre contents led to lower NH₃ emission rates. An increase of 15% on crude protein and a reduction of 33% of acid detergent fibre led to a three-fold increase in NH₃ emissions. Energy balances mainly drove CH₄ emissions. If looking at the nutrient balance, the excess of nitrogen was excreted in urine leading to higher NH₃ emissions. The energy balance provided a similar picture. Animals retained similar amounts of energy, excreting as faeces the energy excess, thus increasing CH₄ emissions.

Keywords: Feeding strategies, NH₃, CH₄, Slurry, Nutrition balance

INTRODUCTION: Modifying pig slurry characteristics through diet management arise as a major technique to mitigate gaseous emissions (Aarnik and Verstegen, 2007). Several studies have reported the effects of changing diets on slurries nitrogen, volatile solids, pH, etc. The relationship between these parameters and ammonia (NH₃) and greenhouse gases (GHG) emissions is also evident. Moreover, when dealing with slurries under commercial conditions, many other factors arise as main drivers of emissions: dilution, feed wastage, removal frequency, pit depth, etc. The main aim of this work was to relate feed characteristics with NH₃ and CH₄ potential emissions from pig slurries with two different types of samples: commercial and experimental.

1. MATERIAL AND METHODS: A total of 109 pig slurry samples were evaluated in this study. Slurry samples were obtained from two origins: slurries obtained from slurry pits at commercial fatteners units (n=31) and reconstituted slurries obtained from experimental feeding assays of growing pigs (n=78). Commercial samples were obtained as follows: representative slurry samples were obtained by sampling a minimum of five two-liter aliquots at equidistant intervals during the discharge of slurry pits. The composite sample was thoroughly mixed and subsamples were taken for the corresponding analyses. Feed and

slurry samples were analyzed for chemical composition and emission potential (only for slurries). Reconstituted slurries were obtained from the assays described by Antezana et al. (2015); Beccaccia et al. (2015a, b), which analyzed the effect of different sources of protein, fiber and fat on nutrition traits, slurry composition and gaseous emissions. All diets tested in these assays were formulated according to commercial standards (FEDNA, 2006). Urine and feces were collected separately in metabolism pens for three days and then slurry was reconstituted according to the original excretion ratio.

1.1. Experimental procedures, sample preparation and chemical analyses: Slurries and feed were analyzed for dry matter (DM), ash, fiber fractions (neutral detergent fiber (NDF) and acid detergent fiber (ADF), ether extract (EE), and total Kjeldahl nitrogen (TKN). Organic matter (OM) was calculated from the difference between dry matter and ash contents. Additionally, pH was measured in fresh slurries (from commercial farms) or immediately after reconstitution (reconstituted slurries)

1.2. Potential gaseous emissions: For each slurry sample, Biochemical Methane Potential (BMP) was determined by triplicate in a batch assay using 120 mL glass bottles following the methodology described by Angelidaki et al. (2009). NH₃ emissions were determined using an *in vitro* acid wet trap system similar to that used by Ndegwa et al. (2009)

2. RESULTS AND DISCUSSION

2.1. Effect of slurry origin on emissions: Statistically significant differences were found for all slurry composition parameters analysed between commercial and experimental samples. Higher TKN and EE contents were found for commercial samples while DM, VS and fibre fractions were found at higher shares in experimental samples. NH₃ potential emissions were found to be lower for commercial samples while BMP was not different. Water and feed wastage in commercial conditions seems to play a role on slurry composition and potential emissions.

2.1. Effect of diet on nutrient balances and slurry emissions: Due to the high variability and the presence of crossed effects on slurries composition and emissions, commercial samples were not considered for this analysis. Thus presenting results from 78 experimental samples. Samples were classified according to their emission potential for each gas (NH₃ and CH₄) in three groups (high, average and low emitters) and the nutrient balance was assessed for each case.

Attending to the nitrogen balance (Figure 1), it can be clearly observed as, independently of N intake (higher for the higher emissions group), N retention (as g N/kg weight gain) remains similar between the three groups, thus resulting in higher N excretion (in form of urinary N) for the high emitting group. The relationship between urinary N content of slurry and emissions has been extensively documented before.

Mitigation strategies

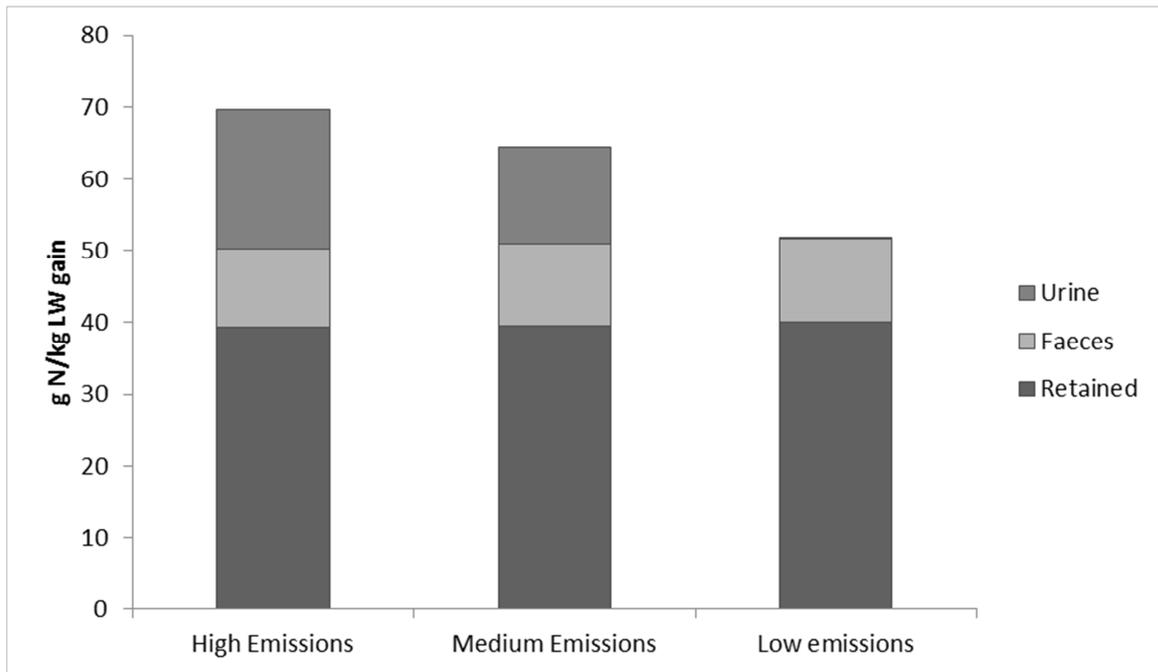


Figure 1. Use of Nitrogen by fattening pigs (g of N/kg of liveweight gain and NH_3 (g/kg liveweight) emissions from slurry).

A similar picture is found when looking at the energy (C) balance (Figure 2). Energy retention (MJ/ kg weight gain) is almost independent of intake and energy intake excess is excreted in slurry (mostly as manure), leading to a higher OM availability for methane emissions.

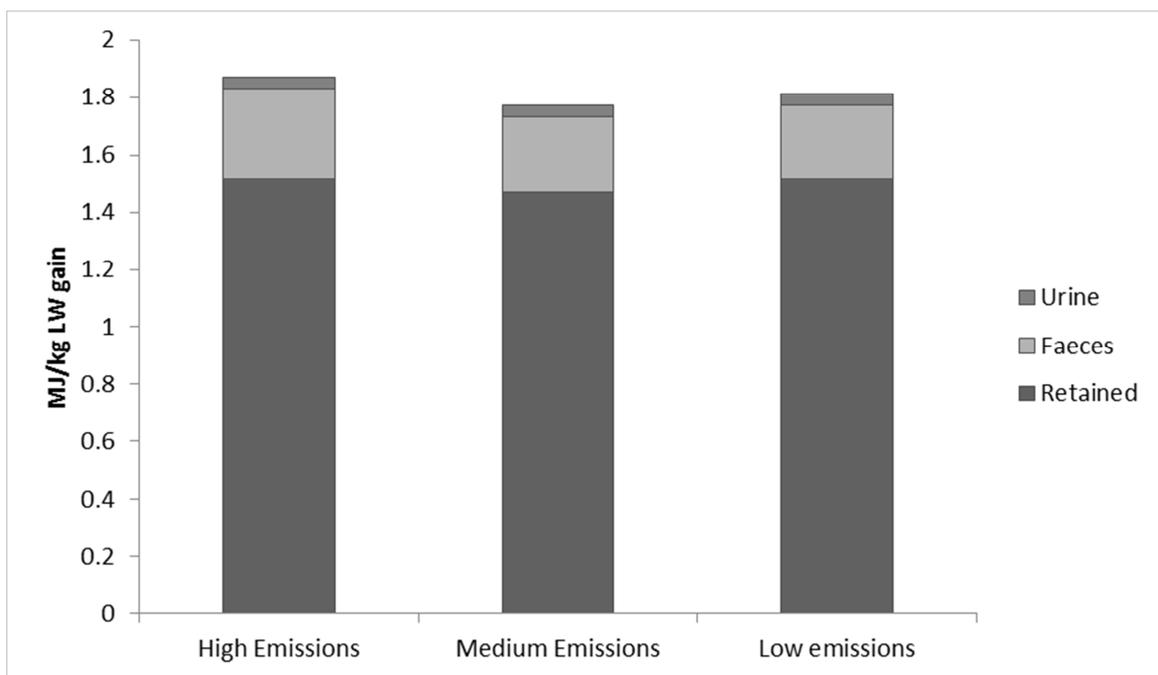


Figure 2. Use of Energy by fattening pigs (MJ/kg of liveweight gain and CH_4 emissions (L/MJ) from slurry).

3. CONCLUSION: Despite it is complicated to assess the effect of diets on emissions under commercial conditions, it can be concluded that adjusting feed composition to animal needs and maximizing nutrient digestibility is key to reduce slurry emissions.

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