INFLUENCE OF ADDING 0.5 OR 1% OF BENZOIC ACID TO THE FEED OF GROWING-FINISHING PIGS ON AMMONIA EMISSION AND PERFORMANCE

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Key words: benzoic acid, pigs, ammonia, performance

Introduction

Recent evolution of French regulation obliges pig breeders to annually declare ammonia emitted by their activities. In the calculation of emission, some techniques like scrubber, covers or additives are identified leading to the application of abatement factor. In a global program of studies concerning reduction of ammonia, ITP conducted an experiment concerning benzoic acid and the effects on ammonia and pig performance. Benzoic acid, naturally present in many fruits and berries, has been used under codes E210 as preservative in pharmaceutical formulas, a wide range of foodstuffs and soft drinks. Several studies have been already conducted in European countries but not under our French conditions of pig breeding.

Material and Methods

Two experiments with growing-finishing pigs from 30 to 115 kg live weight were conducted in ITP experimental farms. In the first study, two diets were compared: a control diet (C) versus one with 0.5% benzoic acid (0.5%BA). In the second study, three diets were compared: a control diet (C) versus two diets with 0.5 (0.5%BA) or 1% benzoic acid (1%BA). Formulation of diets with benzoic acid was slightly different to the control diets but comparable in term of NE and crude protein concentration. The dietary crude protein levels were 16.5 and 15% respectively for the growing and the finishing feeds. At the average weight of 30 kg live weight, littermates were allocated by weight and sex to conventional rooms (totally slatted floor, 0.65 m^2/pig). Pigs were weighted at the start of each study, at the feed change and just before departure for slaughterhouse. Feed consumption was recorded per pen during the whole fattening period. Data concerning ambience (in and outdoor

temperatures, ventilation rate) were recorded during the whole period of fattening for both experimental rooms. Measurements of ammonia concentration (expressed in ppm) in the ambience were carried out every week by using diffuse passive tubes at four areas and two heights (0.3 and 1 meter above the floor). Measurements of ammonia concentration in the exhaust air (expressed in mg/m^3) were realized every week by using bubbling method. Multiplying the ammonia concentration by the ventilation rate permits to obtain ammonia emission (expressed in $g.d^{-1}.p^{-1}$). Urinary pH was measured every two weeks during the whole fattening period. Urinary samples were taken in two pens per room in order to obtain 10 samples per room. Measurements were achieved just after collecting urinary samples with a pH meter.

Results

In the first study, Average Daily Gain (ADG) of pigs consuming the control diet and 0.5% benzoic acid diet were 829.7 ± 88.2 and 877.5 ± 67.7 $g.d^{-1}.p^{-1}$ respectively. Adding 0.5% benzoic acid to the feed of growing-finishing pigs led to a significant increase of ADG by 48 grams. The Feed Conversion Ratio (FCR) of pigs consuming the control diet and 0.5% benzoic acid diet were 2.81 ± 0.2 and 2.67 ± 0.2 $kg.kg^{-1}$ respectively. The FCR was significantly reduced by 0.14 point with the incorporation of 0.5% benzoic acid into the feed. In the second study, effect of benzoic acid on ammonia was clearly observed. Ammonia concentrations in the ambience were respectively 4.5 ± 1.2 and 3.4 ± 1.1 ppm in the control room and in treated rooms respectively. In the room accommodating pigs consuming 1% BA diet, ammonia emission was 6.14 grams per pig per day versus 8.08 grams per pig per day in the control room (Fig. 1). The global quantity of ammonia emitted per pig during the whole fattening period can be calculated by multiplying the ammonia emission per day by the times of presence of pigs. The ammonia emitted per pig was 826.6 grams for pigs in the control room and 628.1 grams for pigs consuming 1% BA diet. Adding 1% benzoic acid in the feed led to reduced ammonia emitted per pig by 200 grams or by 600 grams per pig place. Urinary pH was 7.3 ± 0.2 for pigs consuming the control diet, 7.0 ± 0.5 for pigs consuming 0.5% BA diet and 6.4 ± 0.6 for pigs consuming 1% BA diet (Fig.2). Adding 1 % benzoic acid to the feed significantly reduced average urinary pH by 1 point.

Figure 1: Ammonia emission (expressed in grams per day per pig)

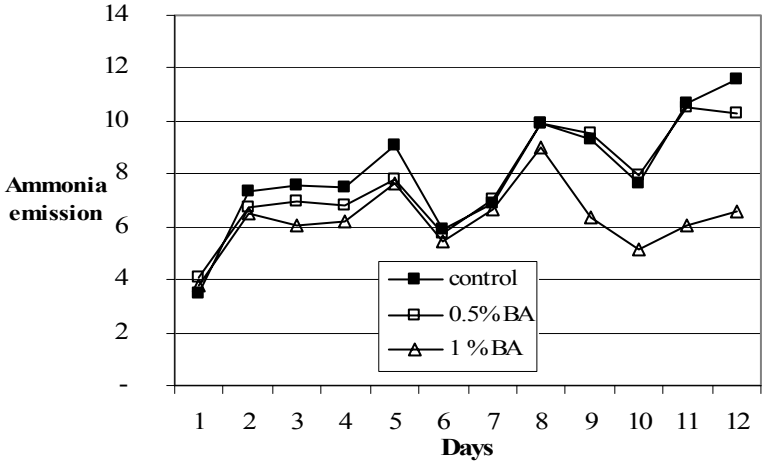
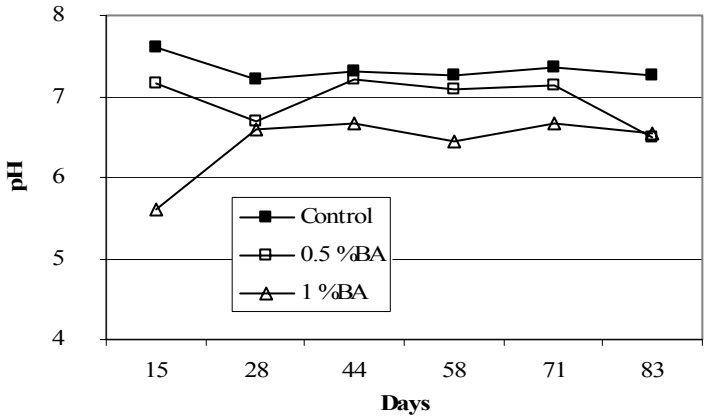


Figure 2: Urinary pH



Discussion

Improvement of ADG and FCR for pigs consuming diet with benzoic acid was already observed by Van der Peet-Schwering and al. (1999). Addition of benzoic acid to the feed increases the digestibility of amino acids by pigs leading in a better use of nutrients. The reduction of ammonia emission by adding benzoic acid to the feed can be explained by the decrease of urinary pH. In our studies, urinary pH of pigs consuming 1% benzoic acid feed is reduced by 1 point in comparison with urinary pH of pigs consuming the control diet. Effect on urinary pH was already observed by Den Brok and al. (1999). Ammonia is the result of the degradation of urea by urease. Ammonia emission is influenced by ammonium concentration, pH and temperature (Muck and Steenhuis, 1981). In the equilibrium between ammonia and

ammonium, the reduction of pH leads to maintain ammonium in the slurry, reducing the volatilisation of ammonia in the ambience.

Conclusion

Adding benzoic acid to the feed of growing-finishing pigs led to improved pig performance and reduced ammonia emission. In our studies, the significant effect of benzoic acid on ammonia emission was only reached with an incorporation of 1%. Considering that 60% of ammonia is emitted by building, a reduction of 25% by adding benzoic acid could permit pig breeders to apply an abatement factor of 15% in the calculation of ammonia emission for the annual declaration. In comparison with others techniques of ammonia reduction, addition of benzoic acid appears to be easier and less expensive.

References

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