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CATCHMENT SENSITIVE FARMING

Nutritional Approaches to Reducing Ammonia Emissions in Pig Diets

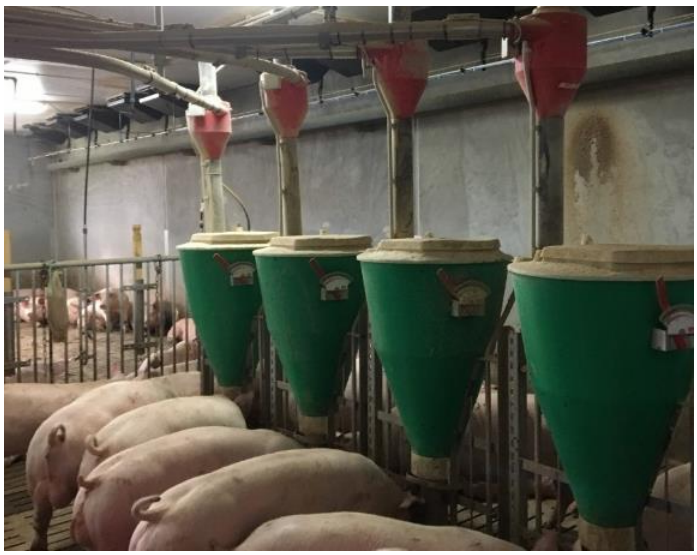
Background

Ammonia is released from livestock manures as a result of chemical reactions between urine and faeces. Agriculture is responsible for about 87 per cent of UK ammonia emissions. Ammonia gas in the atmosphere reacts with other pollutants, mainly released by combustion sources such as boilers and engines, to create fine particulate matter. These particulates contribute to poor air quality and are damaging to human health. Ammonia is also transported in the air where it can damage sensitive plant species and falls to ground causing enrichment and acidification of soils. Many protected habitat areas and sites are showing signs of ammonia damage. Reducing ammonia from agriculture is a key part of Defra's Clean Air Strategy which is seeking to improve air quality creating a healthier environment for both humans and wildlife.

The formulation of pig feed plays a key role in the rate of nutrient uptake by the animal and the nitrogen content of any urine and excreta and consequent release of ammonia to the atmosphere. Feed ingredients containing protein account for a significant proportion of the cost of pig feed. Feed is typically responsible for 60 per cent of the cost of production for pig farmers.

Feed is either purchased as compounds from feed mills or mixed on the farm, often using a mix of home grown and purchased ingredients. Diet formulation is complex, the majority of commercial farmers and feed millers use professional nutritionists to design diets bespoke to their farm, their pigs and type of production.

The techniques described apply to the whole country and are commonly applied by those formulating rations.



The approach taken to optimise protein in pig diets

Nutritionists seek to optimise the uptake of protein, which contains nitrogen compounds, fed to pigs.

Commercial pig farmers seek to optimise their costs of production by feeding diets formulated to balance the efficient utilisation of feed protein and cost.

Nutritionists aim to include ingredients with proteins that are digested well and avoid those, which whilst they may cost less, are also less digestible. They enhance digestibility through the use of pure synthetic amino acids.

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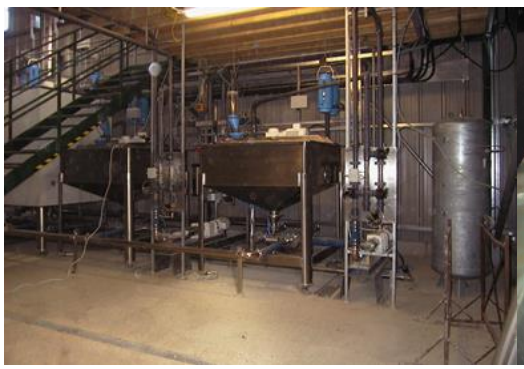
The chemistry

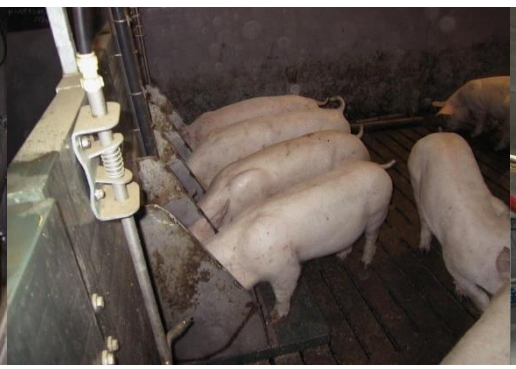
Ammonia is predominantly derived from waste nitrogen in the form of urea excreted in the urine. This urea is broken down by bacterial urease in the presence of water and, depending on pH and temperature, ammonia or ammonium compounds are formed. Ammonia is favoured in typical farm conditions, i.e. with slurry pH just below neutral (pH 7) and, being volatile in nature, it is emitted from the slurry into the atmosphere as a gas.

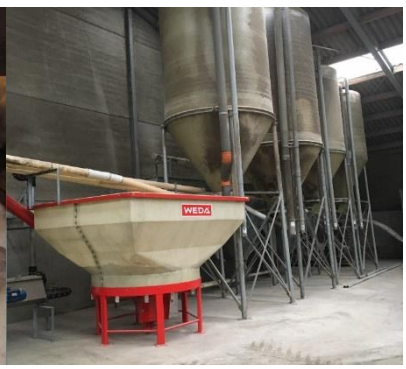
Limitations of past nutritional management

In order to "steer" economical diet formulation, the nutritionist's target should be to ensure that animals are fed sufficient nutrients, especially nitrogen and phosphorus, to achieve the targeted level of production whilst minimising excretion of surpluses (i.e. without leading to adverse environmental impacts). However, from the perspective of nitrogen, the historical approaches to ration construction have tended to use what would be regarded as safety margins in the level of dietary protein, i.e. a cautionary excess, to cover for issues such as the following:

1. Uncertainties about nutrient requirements caused by different ages or weights of pig in the building being fed by the feeding system in question (i.e. a lack of precision feeding approaches).
2. Uncertainties about the nutrient demands of different genotypes.
3. Uncertainties about the actual contents or digestibility of amino acids within the raw material mixes being used.
4. Uncertainties about levels of daily feed intake across a pen group, especially where variation in health status is apparent.
5. Uncertainty about, or lack of control of, disease demands on dietary nutrients.
6. Occasional necessity of controlling carcase fatness using energy-costly deamination processes.







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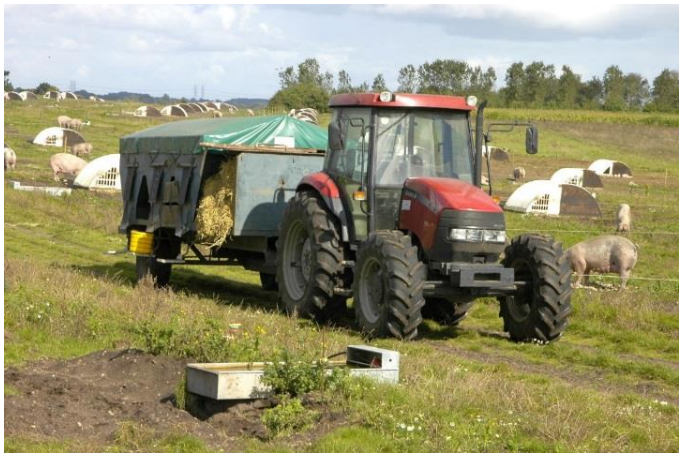


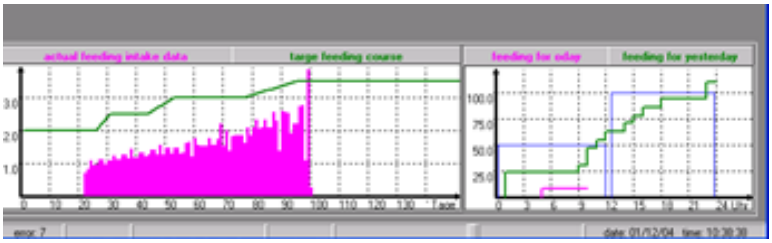
Actions to improve feed efficiency and reduce ammonia losses

1. Avoid using ingredients which contain proteins that are less easily digested compared to, for example, soya and fishmeal (where appropriate), and maximise the inclusion of pure amino acids; 7 out of the 18 essential amino acids (EEAs) are available in feed grades.
2. Ensure that as far as possible diets contain additives that are known to improve nitrogen retention either by enzyme processes or by maintaining the microflora balance in the gut.
3. The pig is not efficient at removing useful nutrients from crude fibre. Where the benefits of fibre are desired for gut benefit, accentuate this using milling techniques to texture the grist of cereal inclusions, especially for wheat.
4. Some raw materials contain significant levels of anti-nutrient factors. Avoid those which negatively influence protein digestion.
5. Consider using those authorised feed additives that block activity of the enzyme urease that is involved in the conversion of urea into ammonia.
6. Use feed or water acidification processes that reduce urine pH and to ensure that the initiation of diet protein occurs optimally within the stomach.

What can these achieve?

Emissions of ammonia to the atmosphere can be reduced by 8 – 13 per cent for each percentage point reduction in dietary protein, up to a certain point depending on the stage of production.

In addition, productivity gains arising from good health and husbandry may achieve a further 10 per cent reduction.



Daily feed intake increasing with days housed

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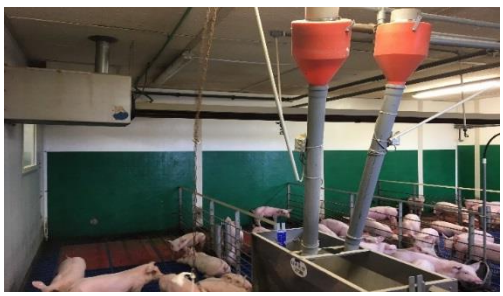
What are the wider benefits of nutritional approach?

Providing diets optimised for the type and age of pig production can result in lower feed use and cost of production. In addition, litter weights, milk yield of sows and finisher pig carcase conformation, can all be optimised. Nutrition can also influence and offer improvements in gut health. The AHDB report, "Pig Cost of Production in Selected Countries", gives the UK Feed Conversion Ratio (FCR) for finisher pigs as 2.86:1. For Spain the figure is 2.46:1, a difference of 14 per cent (same dead weight). This highlights a difference in approach between the two countries and the potential for improvements which can help lower ammonia emissions in parts of the UK herd.

Demonstration of low ammonia emissions through implementing a nutritional approach can improve the possibility of obtaining permissions for development of new pig housing where obtaining planning permission is dependent on air quality impacts.



'Take-away' messages

1. Reducing the excretion of surplus nutrients, particularly nitrogen, into manure can reduce ammonia emissions and reduce the area of land needed for manure spreading based on crop nutrient need.
2. Efficient use of feed through taking an optimised approach to diet formulation closely linked to type and stage of production can improve pig litters, gut and physical health, conformation, performance and financial returns.
3. Attention to detail – measuring and recording current performance is critical to determining the cost-benefit returns of an approach to nutritional management.
4. Lower ammonia emissions can allow development of farm buildings and provide a better environment for pigs and pig keepers as well as delivering higher animal welfare and productivity.

Key contacts and information

Catchment Sensitive Farming (CSF) is able to provide events, tailored advice, individual visits and grant support to farmers on air quality measures and reducing water pollution on farm.

Agriculture and Horticulture Development Board (AHDB) has been working to build knowledge and information for pig producers across the UK. AHDB has a range of resources available to better understand pig nutrition. We are grateful for the assistance of Dr Kevin Stickney and Harbro Feeds in preparing this case study.

Department for Environment, Food and Rural Affairs (Defra) published a Code of Good Agricultural Practice for Reducing Ammonia Emissions in 2018.

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