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Influence of protein on odour characteristics of pig slurry

Slurry consists mainly of faeces and urine. A pig on balanced protein rations produces less urea and requires less water for its dilution and transport. The result is less produced urine. In that faeces production remains around the same in general the pig thus produces less slurry with higher dry matter content. With protein-adjusted feeding less undigested or non-reabsorbed feed-protein components are excreted. Thus not only the physical characteristics of slurry can be altered but also the chemical ones and with this the odour.

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Keywords

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In comparison with conventional rations for feeding pigs, a protein-adjusted feed with amino acid supplementation leads to reduced urine production. With rationed animals not only does the absolute amount of produced urine sink but also its Nr. concentration because the pigs then do not require to satisfy hunger feeling through abnormally high water intake [1]. According to the First Fick Law and the Henry Law this leads to substantially lower gas emissions in open systems.

In addition to ammonia slurry, especially the faeces, contains organic degradation products with osmophoric groups. According to [2] these tend to have a negative surface charge with a weak acid reaction, as does the degradation product hydrogen sulphide also to be found in slurry. A reduction in pH through lower ammonia-N concentration leads to a rise in the gas-type, at higher pH values dissociated weakly acidic reacting, volatile components of the slurry. In that pigs on a protein-adjusted diet produce less urine this is additionally missing as solutional product for these substances. On this basis a greater odour problem must be assumed for pig slurry from animals on protein adjusted rations.

On the other hand, odour active substances are in many cases degradation products of protein metabolism. In protein-adjusted feeding, however, the raw protein content is lowered and the amino acid spectrum is supplemented to such an extent through precise addition with the limiting amino acids that the feeding pigs get a nearly perfect feed. A lower protein content thus also leads to reduced proportions of undigested or non-reabsorbed N-compounds in the faeces. With this, the odour substance emissions potential, brought about through degradation products of the protein digestion are also reduced. This encourages the assumption that a protein supply adjusted to meet the needs of the pigs can cause reduced odour problems as well as lower ammonia emission.

It must be considered, however, that according to [3] livestock production odours feature odour substance complexes composed of several individual substances which, reacting with one another, can lead to compensatory as well as additive and synergistic and also over-additive odour effects. This has led to a DFG-supported project currently investigating the above hypotheses and their accuracy in systematically-organised trials.

Methods

In trial housing at the Futterkamp Training and Advisory centre (Schleswig-Holstein Chamber of Agriculture) feeding pigs in an all-in, all-out system were housed in groups according to sex in two compartments. Each compartment was split by a passage with a trial group on one side and a control on the other. Groups comprised 48 pigs in pens of 12. All pigs received the same starter ration with 19.5% crude protein (CP). At around 50 kg lw, the first trial group received a 15.5% CP diet and the second group a single feed with CP cut to 13.5%. The control groups continued with the same feed they had had from trial begin. Feeding for all animals was ad lib. via mash space feeders.

All three feeds used in the trial had an identical energy content of 13.3 MJ ME. Main constituents were wheat, rye, triticale, barley and soya extraction meal. The exact composition of the three individual feeds is given in *table 1*.

Cleaning-out of the individual compartments was via the damming-flushing system. Each trial group was cleaned out separately. In each case the slurry was held in the dung channel for 14 days and then flushed

Table 1: Composition of used feed

Feed components	Individual feed		
	I	II	III
Wheat	30,2	29,8	40,0
Rye	10,0	10,0	10,0
Triticale	15,0	15,0	15,0
Barley	10,0	20,0	17,4
Soya extraction meal	24,7	13,5	5,5
Other	10,1	11,7	12,1

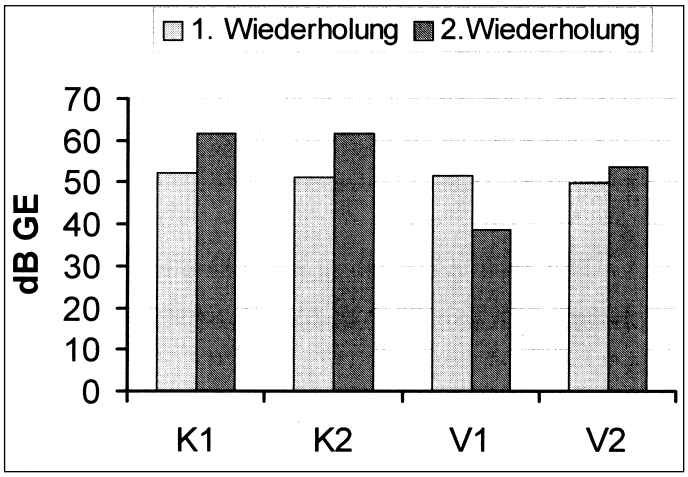

Fig. 1: Determination odour thresholds for two gas samples drawn in succession from one slurry

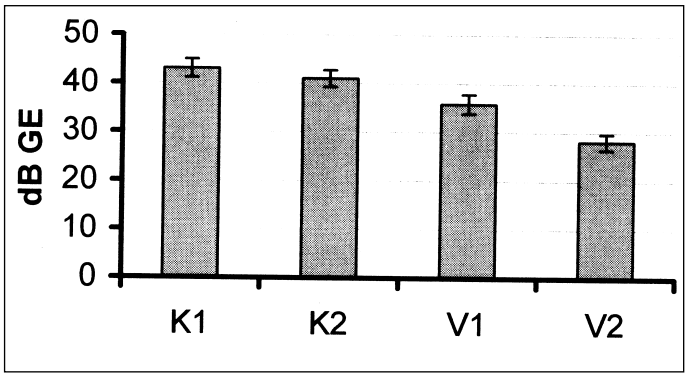

Fig. 2: Influence of feed protein content on odour emissions (K1 and K2 19,5 % CP, V1 15,5 % CP, V2 13,5 % CP in the feed)

into a pre-storage channel. The contents of which were mixed and then a 25 l sample taken.

The samples were then deep-frozen and seven days later warmed in a waterbath at exactly 20 °C. With this the temperature influence was reduced to a minimum. According to [4] this last has a substantial influence on the odour substance concentration, intensity and hedonic. The individual odour parameters were then determined with a Mannebeck TO 7 olfactometer.

Results

The slurry samples for all four groups taken from the pre-storage channel from the first feeding cycle were thawed out at the same time. Around an hour before starting the olfactometric investigations odour samples of the atmosphere in the slurry container above the slurry were taken. The subsequent determination of odour substance concentration, intensity and hedonic than often lead to contradictory results. If one sample collective confirmed an earlier hypothesis, e.g. a reduction in odour substance concentration with reducing CP content, then often the subsequent collective refuted the previously recorded measurement result, or was absolutely unable to determine any association between CP content in the ration and odour substance concentration (*fig. 1*). Investigations by [5] offer a possible explanation. These discovered that gas production from pig slurry can take place via different mechanisms triggered by differing situations. The trial methods were thus altered so that the slurry samples were homogenised around one hour before the collection of the gas samples and were left open up to sampling time. The odour samples themselves were taken out of the containers immediately before the investigation with the olfactometer. The odour substance concentration results are presented in *figure 2*.

Following the above changes a clear association could be determined between the odour substance emission rate and CP concentration. Stirring slurry samples before extracting the gas sample apparently led – as described by [5] – to odour-active slurry gas molecules of low water-solubility uniting to form sufficiently large gas bubbles allowing rising and eventual emission of the gases. Apparently, all that is required to start this reaction is a light shaking of the slurry container. Where gas sampling took place immediately before, during or after such a shaking then this led to the results indicated in figure 1.

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