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Effect of Protein Supply in Feed for Fattening Pigs on Selected Slurry Properties

To a large degree the composition and properties of slurry from fattening pigs are effected by the amount of protein in the feed. Non-used protein undergoes deamination and is excreted. Experiments proved that this effects the pH-value of the slurry, odour development and ammonia release.

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Keywords

Protein adapted feeding, slurry properties, fattening pigs

Literature

[1] *Andree, H., T. Hügle und E. Roth*: Einfluss der Eiweißversorgung auf die Geruchsemission bei Mastschweinen. Landtechnik 58 (2003), H. 1, S. 38-39

The composition and characteristics of pig slurry are strongly affected by the pig feed. A surplus of feed protein that is not utilised by the pig in terms of body protein accretion (muscle tissue), runs through a process of deamination. In the liver the released amino-groups are converted into urea and excreted via the kidneys by the urine. Since the nitrogen content in the faeces is relatively constant, different levels of protein supply affect mainly the level of nitrogen excretion by the urine. In the slurry, faeces and urine are united, so that the protein level in the pig feed not only affects the amount of total nitrogen in the slurry but also the amount of ammonia nitrogen that results from the break down of the urea excreted with the urine. Pig faeces always contain the enzyme urease (bacteria of the large intestine and undigested plant residues of the feed), which is known to break down the carbon-nitrogen bond of amides to form carbon dioxide, ammonia, and water. This process starts immediately after the excretion, as soon as faeces and urine get into contact with each other. In addition it can be observed, that varying levels in the protein supply of fattening pigs not only cause changes in the ammonia nitrogen content but also affect the pH-value of the slurry.

Experimental design

The effects of protein reduced diets for fattening pigs on selected properties and the emission behaviour of the slurry have been investigated in a fattening trial. Details on experimental design and important results on odour emissions have been reported in a previous article [1]. Two fattening periods with eight trial groups of each 48 animals have been fed from 30 to 110 kg live mass. Two compartments were available per fattening trial. Each compartment contained one trial group and one control group. Feeding was performed with an automatic mash dispenser. Feed and water consumption was recorded per trial group on a daily basis. The slurry was collected separately for each group every two weeks; after homogenisation, samples for analyses were taken. All diets were designed on basis of grain and soy bean meal. Up to a live mass of about 65 kg all animals received a diet (control diet R) with 13.4 MJ ME and 19.5 % crude protein (CP). In the finishing phase above 65 kg live mass all control groups (A, C, F and H) still received the control diet until the end of each fattening period. The trial groups in each compartment received either a diet (V1) with 13.4 MJ ME and 15.5 % CP (B and E) or a diet (V2) with 13.4 MJ ME and 13.5 % CP (D and G).

Results

Between 30 and 110 kg live mass average daily feed intake was observed around 2.13 kg/animal/day with a feed conversion rate of 2.7 kg feed/kg growth, an average water intake of 5.7 l/animal/day and an average daily growth of 800 g, respectively. The compared trial and control groups of each compartment and fattening period showed no statistic significant differences in these features. Dry matter content of the slurries was similar as well.

Due to different crude protein contents in the applied diets, especially in the finishing period, crude protein intake in the trial groups was significant lower compared to the control groups. The amount of feed intake and crude protein content of the diet allows calculation of the nitrogen intake. For the control group an average of 6.4 kg N/animal and for the trial groups an average of 5.5 kg N/animal and 5.3 kg/animal for the diets V1 with 15.5 % CP and V2 with 13.5 % CP was calculated. A closer view on the growing and finishing period shows the nitrogen intake as follows. In the growing phase up to about 65 kg live mass all animals had an average nitrogen intake of 2.2 kg N/animal. In the finishing phase beginning with >65 kg live mass, the control groups had an average intake of 4.0 kg N/animal and the trial groups of 3.3 and 3.0 kg N/animal for V1 and V2, respectively.

Different levels of nitrogen intake are mainly reflected in the slurry, since the fat-

tening performance was unaffected. Content of total nitrogen and ammonia nitrogen are presented in *table 1*. Mean nitrogen content of all groups and the entire fattening period was about 0.76 %, with a slight increase from growing to finishing phase. Within the individual trial and control groups the course of total nitrogen content differs. Whereas in the control groups the nitrogen content of the slurry increases around 12 %, from 0.73 % (grower) to 0.82 % (finisher), it decreased in V1 around 2 % from 0.76 % (grower) to 0.74 % (finisher) and in V2 even around 7 % from 0.75 % (grower) to 0.68 % (finisher).

Related to the ammonia nitrogen content of the slurry, the values show a similar course. Across the entire fattening period and all groups, the average ammonia-nitrogen content of the slurry was observed to be around 0.45 %, with a tendency to increase from the beginning to the end of the fattening period. The increase of the ammonia nitrogen content of the slurry from growing to finishing was mostly pronounced in the control groups with 22 %, compared to the trial groups with 5 % (V1) and -3 % (V2), respectively.

The results shown above lead to the following conclusion. Related to the protein requirement and to the utilised protein, the surplus of applied feed protein can be found in the slurry, but not according to the dimensions expected by the surplus of protein in the ration R compared to the protein adapted rations V1 and V2. The difference to expectation can be explained with different amounts of ammonia emission in the protein enriched control groups.

Besides the different levels of nitrogen compounds in the investigated slurries, feeding also showed an effect on the pH value of the slurries. The values of the pH are depicted in *figure 1*. At the beginning of the fattening period all values averaged around pH 7.5. The further course seems not only to be affected by the feeding strategy, but also by the age of the animals. There is a tendency of the pH-value to increase in the course of the fattening period. This increase is more pronounced, when the crude protein surplus in the feed is higher. As can be seen in the control groups (figure 1, picture a), the pH increases until the end of the fattening period about 1 unit up to the value of 8.5. In the trial groups (figure 1, picture b) V1 the increase is less with 0.5 units, and V2 the pH remains almost constant.

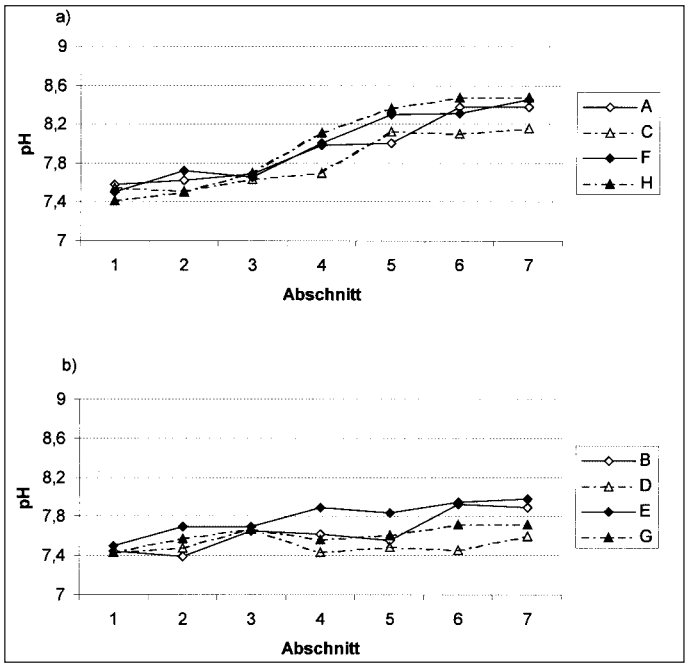

Fig. 1: Course of the pH-values over the entire fattening period (section 1-7) for a) reference groups with 19.5% CP and b) trial groups with 15.5% CP (B, E) and 13.5% CP (D, G)

Discussion

Essentially, these results reflect general experiences with protein adapted feeding. Multi-phase-feeding with protein reduction in the diet is an effective method to reduce ammonia emissions from pig keeping. The question that is still not resolved sufficiently is how to establish the right level of protein supply for different situations. The utilisation of feed protein by the pig is affected by numerous complex interacting factors. Besides the genetic background of the animals, the keeping environment interacts with the utilisation of the applied nutrients by the fattening pig, for example influences of the environmental temperature. It could be interesting for future developments of automatic feeding control systems in an emission reduced pig keeping to use more system parameters than is usually done so far. Especially the pig slurry seems to be an interesting medium that should deserve more attention by the pig keeper, as it allows immediate conclusion to the metabolism of the animals. Such a slurry related parameter should be easy to measure in short intervals. As it could be shown in this trial, the pH value of the slurry could be an interesting feature for feeding control. Further investigation in this area is still necessary.

Group R	V1	V2	N [%] total	N [%] growing	N [%] finishing	NH_4^+-N [%] total	NH_4^+-N [%] growing	NH_4^+-N [%] finishing
A			0,85	0,80	0,89	0,51	0,48	0,53
	B		0,73	0,73	0,74	0,42	0,39	0,44
C			0,79	0,75	0,82	0,44	0,40	0,47
		D	0,71	0,78	0,66	0,39	0,42	0,36
	E		0,77	0,79	0,75	0,49	0,49	0,49
F			0,71	0,65	0,75	0,43	0,37	0,48
		G	0,71	0,71	0,71	0,43	0,41	0,44
H			0,80	0,74	0,84	0,48	0,40	0,54

Table 1: Mean values for nitrogen (N) and ammonia-N (NH_4^+-N) over total fattening period and for grower (before feed change) and finisher (after feed change)