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Effect of supplemented phytase at different Zn- and Cu- feed contents in pig nutrition

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Introduction

Zinc (Zn) and copper (Cu) are essential trace elements in plants and animals. In livestock production a deficiency of these elements can decrease animal performances or/and influence the health of animals (Mc Dowell 2003, Pallauf, 2003). That's why these elements are supplemented to all compound feeds. In areas with a high livestock density the excreted amounts of Zn and Cu let the discussion of environmental problems (KTBL, 2002). This is the reason for the development of new upper limits of some trace elements in the EU valid from January 2004.

The German recommendations for the supply of Zn and Cu of pig diets are from 1987 (GfE, 1987) and the correctness concerning the changes in animals performance and feed processing are also under discussion.

In case of a possible limited supply of trace elements the absorption rate (bioavailability) is more and more interesting. These bioavailability may be influenced by the phytate content of feed or/and the binding form of supplemented trace elements.

These reasons let us create an experiment with growing – finishing pigs to investigate the following questions:

1. Can the supplementation of phytase, especially in extremely limited Zn- and Cu supplemented feeds, increase the absorption rate of these elements?
2. Which height of supplementation of Zn and Cu to the native feed content of a cereals – soy bean meal – ration can influence performance data of pigs?
3. Has a trace element – amino acid – complex a better bioavailability compared to the sulfat bounded trace elements?

Material and methods

A three factorial experiment with 100 pigs from 25 kg to 115 kg live weight (LW) was designed according Table 1. The sex ratio was 1:1, means in every group were 5 females and 5 castrated males. To influence the enrichment of the Zn- and Cu stores equal, 130 piglets after weaning (3 weeks of age) were reared in the institutes stable.

The high quality feed of piglets was supplemented with 60 mg Zn and 5 mg Cu per kg feed, half from inorganic and half from organic source of these trace elements, described later.

The supplementation of phytase of microbial origin should reach at least 750 FTU/kg feed. The stages of trace elements supplementation were:

- Native content of feed without an additionally supplementation.
- According the GfE (1987) recommendations a supplementation of 35 mg Zn and 2 mg Cu per kg feed.
- According the new EU limits (while planning this experiment these limits were yet under discussion) a supplementation of 95 mg Zn and 9 mg Cu per kg feed.

The source of these supplementation stages was on the one hand Zn- or $CuSO_4$ or rather a trace element – amino acid – complex of both elements.

Table 1: Experimental design

Group	1	2	3	4	5	6	7	8	9	10
n	10	10	10	10	10	10	10	10	10	10
Phytase	yes	yes	yes	yes	yes	no	no	no	no	no
Supplem.	Native	GfE	GfE	EU	EU	Native	GfE	GfE	EU	EU
Source	Native	Inorg.	Org.	Inorg.	Org.	Native	Inorg.	Org.	Inorg.	Org.

The animals came from a common breed (BHZP). The aim was to achieve about 900 g daily live weight gain (DLG). While growing – finishing three feeding phases (prestater, starter and finisher) were used to adapt the nutrients supply to the requirement of the animals. The feed composition is shown in Table 2.

Table 2: Composition of the feeds (%)

	Prestarter	Starter	Finisher
Cereals [1)]	71.0	75.1	81.7
Soy bean meal	21.5	17.5	12.0
Oil	3.5	3.6	3.5
AA/Min./Vit.	4.0	3.8	2.8

[1)] Wheat, barley and corn

All animals were fed individually according the LW and the calculated DLG twice daily. The LW was determined once a week by individual weighing of animals.

Results and discussion

The experiment took a normal course. But two animals must be removed because of fundamental problems before reaching slaughter weight (groups 1 und 6) and were slaughtered in the slaughter house of the institute. One further animal was selected even so because of refuse feed (group 3).

The realised feeding phases on average were 24.9 – 61.2 – 88.5 – 115.3 kg LW. In this time the realised mean DLG was 887 g (900 g when reaching 110 kg LW) and the realised mean feed conversion ratio was 2.54 kg/kg gain. The results of the feed analyses are shown in Table 3.

Table 3: Energy, protein- and lysine content of the feeds

	Prestarter	Starter	Finisher
ME (MJ/kg)	13.8	13.8	13.8
Protein (g/kg)	174	160	141
Lysine (g/kg)	11.6	10.0	8.5

The phytase contents were analysed shown in Table 4.

Table 4: Phytase content of the groups (FTU/kg feed)

Group 1	Group 2	Group 3	Group 4	Group 5	Groups 6 - 10
1310	1650	1890	1860	1180	290

The content of 290 FTU/kg of the unsupplemented feed is normal corresponding to a wheat, barley and corn based diet (Table 2). The partly extreme high contents of the supplemented diets are inexplicable but without any influence of the experimental questions. Table 5 showed the analysed Zn- and Cu contents in the diets.

Table 5: Zn- and Cu contents (mg/kg feed)

Stage:	Native	GfE		EU	
Source: Groups:	Native 1 and 6	Inorganic 2 and 7	Organic 3 and 8	Inorganic 4 and 9	Organic 5 and 10
Zn	35.8	61.4	65.7	119.9	122.4
Cu	8.0	9.6	9.0	15.3	14.2

The native Zn- and Cu contents of the diets could be expected under consideration of the contents of feeds. The supplemented levels could be measured in the mixtures (Table 5).

The results of performance are shown for the whole period (24.9 kg – 115.3 kg LW) or divided in the periods 25 kg up to 60 kg LW and 60 kg up to 105 kg LW (Table 6). The dividing in the two periods can better illustrate if there is a possible influence of age on the performance data and upper LW of 105 kg LW is more correct then 115 kg LW because the lightest animal was slaughtered reaching 105 kg LW.

In the whole period there are nearly no differences in the DLG between the groups (Table 6, Figure 1).

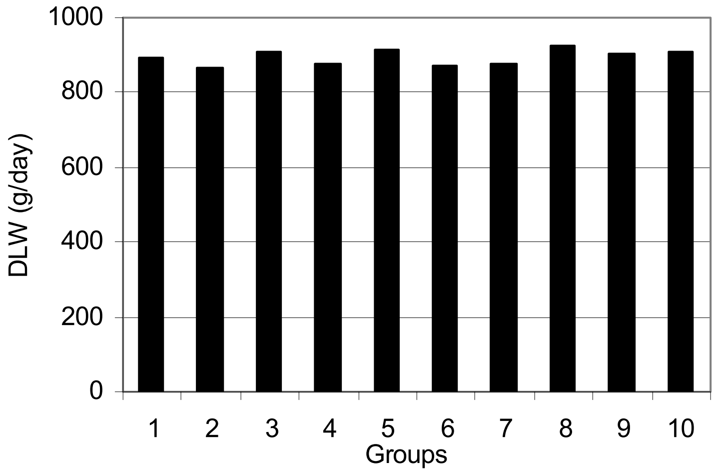

Figure 1: Daily Live Weight Gain (whole period)

Table 6: DLG Daily live weight gain (g) of pigs in various periods

Groups	1	2	3	4	5	6	7	8	9	10
25-60 kg	874 ± 53	871 ± 72	892 ± 81	878 ± 55	892 ± 51	860 ± 36	868 ± 52	899 ± 45	866 ± 40	886 ± 52
60-105 kg	944 ± 74	885 ± 97	953 ± 67	941 ± 85	955 ± 49	907 ± 84	909 ± 54	982 ± 89	961 ± 90	961 ± 81
25- 115 kg	893 ± 56	866 ± 76	911 ± 63	879 ± 69	916 ± 48	871 ± 58	878 ± 37	923 ± 53	903 ± 67	907 ± 59

DLG increased from the first to the second period. Comparing groups 1 and 6 there seems to be a small influence of phytase supplementation. But the pigs of the unsupplemented group 1 (phytase added and without trace elements supplementation) shows in both periods higher DLG than groups 2, 6 and 7 ($p > 0.05$). Looking on energy conversion ratio (ECR) all data were more equal than DLG data ($p > 0.05$; Table 7).

Table 7: Energy efficacy (MJ ME/kg live weight gain) of pigs in various periods

Groups	1	2	3	4	5	6	7	8	9	10
25-60 kg	29.1 ±2.2	28.8 ±2.8	27.9 ±2.6	28.7 ±1.9	28.1 ±1.6	28.9 ±1.4	28.6 ±1.8	27.9 ±1.8	28.9 ±1.8	28.5 ±2.4
60-105 kg	41.5 ±3.5	42.8 ±4.2	40.6 ±3.1	41.2 ±3.5	40.6 ±1.9	41.7 ±2.9	42.3 ±2.7	40.0 ±3.3	40.5 ±3.5	41.1 ±3.7
25- 115 kg	36.7 ±2.5	37.4 ±3.1	35.7 ±2.6	37.6 ±3.2	35.6 ±1.3	36.6 ±2.8	37.2 ±2.0	35.6 ±1.8	36.8 ±3.15	36.5 ±2.8

The analyses of variance showed no significant influence of phytase supplementation. Only in the whole period there is a significant influence of the trace element source for both parameters (DLG, FCR) and in the second period for the DLG. No interaction showed any influence of the results. That's why we pooled the phytase supplemented groups (1 to 5) and the phytase unsupplemented groups (6 to 10, Table 8).

Table 8: Influence of phytase supplementation on DLG (g) and ECR (MJ/kg)

	+ Phytase (n = 48)		– Phytase (n = 49)	
	DLG	ECR	DLG	ECR
25 – 60 kg LW	881 ± 61	28.5 ± 2.2	876 ± 46	28.6 ± 1.8
60 – 105 kg LW	935 ± 78	41.3 ± 3.3	945 ± 83	41.1 ± 3.2
25 – 115 kg LW	893 ± 63	36.6 ± 2.6	897 ± 57	36.5 ± 2.5

t-Test, $p < 0.05$

There is no significant difference in ECR data by phytase supplementation.

Summery and conclusions

The supplementation of phytase to cereals – soy bean meal – based diets did not significantly influence pig performance of growing – finishing pigs from 25 to 115 kg LW ($p > 0.05$). Also the height of supplementation of Zn and Cu showed no significant effect on performance data of the animals. Animals with only the native Zn- and Cu- content in feed tends to smaller performances only. But the supplementation of Zn and Cu in form of a trace element – amino acid – complex in contrast of the sulphate form showed significant differences at least in the whole period. The German recommendations of (GfE, 1987) concerning Zn and Cu are safe enough to achieve a high pig performance.

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