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Microbial Phytase as a Way to Improve Growth Performance of Weaned Piglets and to Reduce Phosphorus Excretion

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Abstract

The microbial phytase preparation (*Aspergillus niger*, NATUPHOS) was supplemented to a basal ration 750 FTU/kg feed and the effects on growth performance of weaned piglets were studied.
The supplementation of microbial phytase improved slightly Daily Weight Gain (DWG), Feed Conversion Ratio (FCR) and increases the digestibility and bioavailability of phosphorus from phytate, reduces the amount of inorganic phosphorus needed to maximize growth and bone mineralization and markedly reduces fecal excretion of phosphorus. At the end of experimental period, Daily Weight Gain (DWG) was increased 6.15% more and Feed Conversion Ratio (FCR) was decreased 4.7%, compared to the control group. Overall a positive effect of the microbial phytase on performance parameters was observed. The P-excretion in the faeces was reduced by 25-30%.

Keywords: Faeces, microbial phytase, P-reduction, weaned piglets.

Abbreviations: Growth Performance, (GP), Body Weight (BW), Daily Weight Gain (DWG), Feed Conversion Ratio (FCR).

1. Introduction

Pigs and poultry diets are primarily on cereals, legumes and oilseed products. About two-thirds of phosphorus (P) in these feedstuffs occur as phytates (mio-inositol hekxakisphosphate, InsP6), the salts of phytic acid [4]. Phytate P in plants is a mixed calcium-magnesium-potassium salt of phytic acid that is present as chelate and solubility is very low [6]. Phosphorus in this form is poorly digestible/available for simple-stomached animals [11].

For the utilization of phytate phosphorus, minerals and trace elements bound in phytic acid complexes, hydrolysis of the ester-type bonded phosphate groups of phytic acid by phytase is necessary [10]. Phytases (mio-inositol hekxakisphosphate - phosphohydrolase) belong to a special group of phosphatases which are capable of hydrolyzing phytate to a series of lower phosphate esters of myo-inositol and phosphate. Two types of phosphates are known: 3-phytase (EC 3.1.3.8) and 6-phytase (EC 3.1.3.26), indicating the initial attack of the susceptible phosphate ester bond. Monogastric animals' intrinsic phytase which is necessary for hydrolysis of phytate present in the plant feedstuffs [12]. However many fungi, bacteria and yeast can produce this enzyme.

With the industrial production of phytase, application of this enzyme to pig's diet to increase P availability and improve animal performance, as well as reducing environmental pollution has gained widespread attention. The beneficial effects of supplementary phytases on P digestibility and animal performance have been well documented [8], [9].

The efficacy of any enzyme preparation depends not only on the type, inclusion rate and level of activity present, but also on the ability of the enzyme to maintain its activity in the different conditions encountered through the gastrointestinal tract and the conditions used for the pre-treatment of a feedstuff or diet. To evaluate an enzyme preparation, it's important to characterize the enzymes in terms of pH stability, behavior during technological processing of feeds resistance to proteolytic attack and stability of

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the enzyme within the digestive tract of the host animal [3]. The aim of this study was to test the effects of the microbial phytase (NATUPHOS) on the performance parameters and faecal excretion phosphorus of weaned piglets.

2. Material and Methods

Thirty two piglets (Large White x Landras) of four litters were transferred after weaning (28 days old) to flat-decks and allocated to 2 groups (A and B) with 16 animals (8 male and 8 female), respectively. Two piglets from different litters (1 male and 1 female), with the same body weight were housed in every box (experimental unit). The litter origin was taken into account, avoiding that piglets from the same litter were allocated in the same treatment. There were eight replications per control group and eight also per treated group. The control group (A) was feed with a balanced diet, containing mono calcium phosphate. The experimental group (B) was feed with low level of phosphorus, without inorganic phosphorus. All the phosphorus in this group originates from soybean meal. This group was supplemented with NATUPHOS phytase 750 FTU/kg feed.

Ambient room temperature was maintained at 27^0C for three first weeks and lowered by 1^0C for each week thereafter. The photoperiod was controlled to provide 12 hour of light and 12 hour of dark in the stable. The ventilation also was provided to ensure good air quality. The basal diet mainly contained maize and soybean meal and the nutrient contents met or exceeded nutrient requirements recommended by NRC [5]. The diets were offered ad-libitum and animals had free access to water.

Table 1. *The calculated nutrient concentration of diet.*

Nutrient concentration (g/kg feed)		
	Control group (A)	**Experimental group (B)**
ME (MJ/kg)	12.75	12.80
Crude protein	201.2	201.1
Crude fibre	39.7	39.8
Calcium	7.0	6.5
Phosphorus	6.0	4.2
Lysine	2.1	1.9
Metionine+Cystine	6.4	6.5

During six weeks experimental period Body Weight (BW), Daily Weight Gain (DWG) and Feed Conversion Ratio (FCR, kg feed/kg Body Weight Gain were measured weekly. Data are presented as arithmetic means with standard deviation of the mean (Mean ± SD). One-way analysis of variance and Student's *t*-test ($P<0.05$) were performed to test the differences between two groups.

3. Results and Discussion

Feeding phytase NATUPHOS was slightly improved the production parameters respectively: Final Body Weight (FBW) by 5.33% and Body Weight Gain (BWG) by 6.15% (statistically significant).

Table 3. Efficacy of supplemented phytase in low phosphorus diet for weaned piglets

Parameters		**Control group**	**Experimental group**
Production	n^1	**X±SD**	**X±SD**
Initial BW,kg	16	6.20 ± 0.24	6.45 ± 0.31
Final BW,kg		16.12±1.02*	16.98 ± 0.67*
DWG,g		236.1 ± 12.0	250.6 ±13.2
FCR		2.20 ± 0.12	2.10 ± 0.10
Bone strength, kg		31	29

n^1 number of animals, in a trial.

*Significantly different ($p<0.05$).

Feed Conversion Ratio (FCR) was reduced (-4.7%) to compare with control group, but the differences were not significant. This is in agreement with results obtained by [2]. Bone strength was reduced by feeding the low P-diets, 6.5%, compare with control. The P-excretion was reduced by 25-30%, provided that pig's diets can be supplemented with an economical and efficacious level of phytase that will allow all of the supplemental inorganic P to be removed from the diet [1].

In some region in Albania like Durres region and on the suburb of the capital Tirana, pigs and poultry manure production per unit of arable land greatly exceeds the requirements for reasonable crop production [7].

Sometimes the farmers have distributed the animal manure in everywhere, because there is no law, which not allows this kind of distribution. In such situation, it's difficult to have control on the quantity of the phosphorus and nitrogen in the arable soil and ground water. Actually, in Albania the problem of soil and water pollution are very important yet. The preventive measures at institutional and organizational level are necessary in order to limit the consequence on the future. In such situation the utilization of microbial phytase in nutritive ration of pigs is an original way for reduction of soil and water pollution.

4. Conclusions

The supplementation of microbial phytase preparation (*Aspergillus niger*, NATUPHOS) 750 FTU/kg feed induced slightly the growth parameters. Our study resulted at the use of microbial phytase as replacement of inorganic phosphorus in piglet's diet. The inorganic phosphates in faeces, harmful for the environment, were reduced by 25-30%. This new technology offer substantial benefits to swine production by reducing the potential for environmental problems associated with excess P excretion. Supported by these conclusions, some of the best known companies of swine production in our country have actually included this technology in the everyday practice of the pig's diet.

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