THE EFFECT OF MICROBIAL PHYTASE ON IMPROVING DIGESTIBILITY OF NUTRIENTS AND PERFORMANCE PARAMETERS OF GROWING PIGS

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Abstract

During the last decades various experiments have been conducted all over the world with commercially available microbial phytases. Supplementation of these enzymes into the diets of growing pigs results in improving of performance parameters and digestibility of nutrients. The aim of this study was to test the effects of the microbial phytase (NATUPHOS) on the performance parameters and digestibility of nutrients of growing pigs. The microbial phytase preparation (Aspergillus niger, NATUPHOS) was supplemented to a basal ration 750 FTU/kg feed and the effects on growth performance of growing pigs were studied for six weeks experimental period. The supplementation of microbial phytase improved slightly daily weight gain, feed conversion ratio, increases the digestibility of nutrients 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.

Key words: Growing pigs, Microbial phytase, Performance parameters, Digestibility of nutrients

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 [2]. Phytate P in plants is a mixed calcium-magnesium-potassium salt of phytic acid that is present as chelate and solubility is very low [3]. Phosphorus in this form is poorly digestible/available for simple-stomached animals [7].

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 [6]. 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 [8]. 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 [4,5]. 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 the

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enzyme within the digestive tract of the host animal [1]. The aim of this study was to test the effects of the microbial phytase (NATUPHOS) on the performance parameters and faecal excretion phosphorus of piglets.

MATERIAL AND METHOD

Forty piglets (Large White x Landras) of four litters were transferred to flat-decks and allocated to 2 groups (A and B) with 20 animals (10 male and 10 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 nine replications per control group and nine 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 24^{0}C for three first weeks and lowered by 1^{0}C for each week thereafter. 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. The diets were offered ad-libitum and animals had free access to water.

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.

Determination of digestibility of nutrients was measured with "*The indicator method*". The last week of the experiment, the whole food was labeled with titanium oxide TiO_2. Titan (IV) -Oxide, Art 808, Merck, which was used at a dose of 0.2% in the diet.

The Coefficient of Digestibility was calculated as follows:

$$\text{Coefficient of Digestibility} = 100 - \left(\frac{\text{\% of the food indicator x \% of the nutrient in the faeces}}{\text{\% of the indicator on faeces x \% of nutrient in food}} \text{ x } 100\right)$$

Table 1 The calculated nutrient concentration of diet

Nutrient concentration (g/kg feed)	Control group (A)	Experimental group (B)
ME (MJ/kg)	18.22	17.76
Dry matter	89.25	89.26
Mineral matter	4.62	6.39
Crude protein	20.02	18.34
Crude gross	2.95	2.77
Calcium	7.33	10.43
Phosphorus	4.15	5.27
NDF	18.00	16.96

RESULTS AND DISCUSSIONS

The experimental group supplemented with phytase enzyme had a tendency to increase the "live weight", but there were no statistically significant differences. The difference between the averages live weight in the experiment group was 0.59% higher compared to the control group. The phytase-enzyme-supplemented group had a significant increase of the "*Daily Weight Gain*" indicators, which was statistically verified. The average value of the weight gain for the entire experimental period was + 3.21% higher to the experiment group.

Feed Conversion Ratio (FCR) was reduced (-1.83%) to compare with control group. This indicator had the highest percentage difference in the last period of the experiment; 6 weeks after the experiment began.

Table 2 The effect of phytase on production parameters

Parameters	Control group	Experimental group
Production n[1]	X ± SD	X ± SD
Initial BW, kg 20	40.10 ± 2.34	40.12 ± 2.13
BW 6th week [2]	60.34 ± 2.34	61.00 ± 2.36
DWG, g [3]	481.6 ± 11.3	497.1 ± 11.7
FCR [4]	2.72± 0.03	2.67± 0.02

[1] Number of animals, (20 piglets/ every group, at the beginning of the experiment)
[2] BW at the end of the trial
[3] DWG for whole experimental period
[4] FCR for whole experimental period

Table 3 Nutrient digestibility (%)

Nutrient concentration (g/kg feed)	Control group	Experimental group
Energy (MJ/kg)	76.71	70.14
Dry matter	78.92	71.63
Mineral matter	12.16	38.93
Crude protein	74.48	61.68
Crude gross	42.81	27.25
NDF	41.74	23.51
Phosphorus	17.76	24.66
Calcium	-	40.78

From the data on nutrient's digestibility, it results that in the experimental group there was a higher digestibility for the indicators: minerals, as well as calcium and phosphorus. The coefficient of digestibility of minerals was + 26.77% higher than in the control group. It was worth mentioning that phosphorus digestibility has increased by + 6.9% more in the experiment group than in the control group. Calcium digestibility in the experiment group was also estimated at 40.78%.

There was no improvement of digestibility for other dry matter indicators. If we start from the nutrient content in the nutritive ratio, the experiment group had the same content of dry matter, but the lower content of metabolisable energy, crude protein, crude fat and NDF.

CONCLUSIONS

The supplementation of microbial phytase preparation (*Aspergillus niger*, NATUPHOS) 750 FTU/kg feed induced slightly the growth parameters. However there were no statistically significant differences.

Our study resulted at the use of microbial phytase as replacement of inorganic phosphorus in growing pigs diet. 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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