



# Effect of Particle Size and Enzyme Supplementation on Nutrient Excretion of Growing Pigs



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## Introduction

In parts of the world where intensive livestock operations exist, there is growing public concern over the impact that these operations have on the local ecology. Of primary concern is the output of nutrients, in particular nitrogen (N) and phosphorus (P), which have been linked to water quality problems. For the past decade, research into methods by which N and P excretion from pigs can be reduced has been quite active, particularly in Europe where nutrient application rates onto farmland are restricted by legislation. Also, lowering nutrient excretion means that more is retained by the animal, which could result in a significant economic benefit for the producer.

## Objectives

- to observe any particle size x enzyme supplementation interaction for N or P excretion variables
- to observe any alterations in excretion patterns of N or P as a result of either enzyme supplementation or particle size treatments

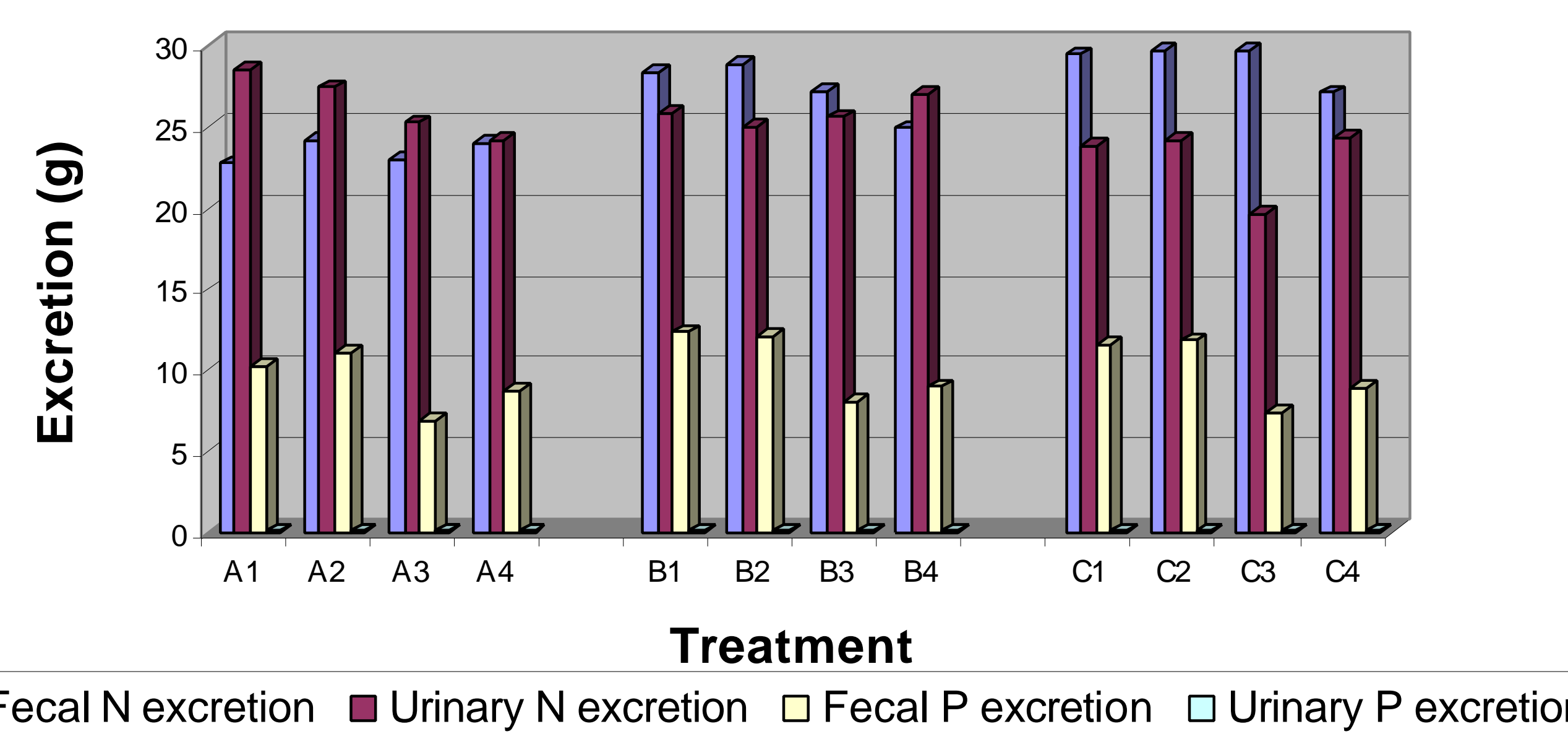
## Methods and Materials

Three different particle sizes (400, 700, and 850 $\mu$ m) were compared with four enzyme treatments (control,  $\beta$ -glucanase/xylanase (444 and 1385 U/kg diet) (i.e. carbohydrase), phytase (374 U/kg diet), and carbohydrase/phytase), in a 3 x 4 factorial experiment. Diets were based on barley (70%) and field pea (25%), and were formulated to be limiting in DE (3250 kcal/kg), available P (0.12%), and digestible lysine (1.6 g/Mcal DE). These nutrients were restricted in order to facilitate observation of any improvements in retention, excretion, or digestibility resulting from dietary treatments.

Sixty barrows (25.3  $\pm$  1.4 kg) were housed in individual metabolism pens. Each pig received an acclimation diet for 5 days, followed by a 7-day pre-collection period and a 5-day collection period, when they received the experimental diets. All diets were fed in wet-mash form. Feces and urine were collected to determine N and P excretion.

## Results

### Total nitrogen and phosphorus excretion



**Note:** particle size treatments (A=fine, B=medium, C=coarse), enzyme treatments(1=control, 2=carbohydrase, 3=phytase, 4=carbohydrase/phytase).

### Influence of particle size on nutrient digestibility

	Particle size			SEM	P value
	fine (400 $\mu$ m)	medium (700 $\mu$ m)	coarse (850 $\mu$ m)		
DE (kcal/kg)	3682 <sup>a</sup>	3579 <sup>b</sup>	3538 <sup>b</sup>	18.37	P<.05
DM digestibility (%)	83.78 <sup>a</sup>	81.47 <sup>b</sup>	80.71 <sup>b</sup>	0.27	P<.05
CP digestibility (%)	79.40 <sup>a</sup>	74.52 <sup>b</sup>	73.84 <sup>b</sup>	0.54	P<.01
N retention (%)	56.22	53.43	55.80	0.79	P>.10
P digestibility (%)	46.42 <sup>a</sup>	35.40 <sup>b</sup>	37.50 <sup>b</sup>	1.82	P<.06
P retention (%)	49.44 <sup>a</sup>	38.03 <sup>b</sup>	41.40 <sup>b</sup>	1.88	P<.10

**notes:** different superscripts in rows indicate significant differences. Above data generated exclusively from control enzyme treatments

There was an enzyme x particle size interaction for dry matter digestibility and crude protein digestibility. Total N excretion was reduced by 6.8% with the fine particle size compared to the medium particle size (9.97 vs. 10.64 g/d; P<.05).

Digestible energy was increased by 2% and 2.7% with the fine particle size (3655 kcal/kg; P<.05) compared to the coarse (3581 kcal/kg) and medium particle size (3558 kcal/kg) diets, respectively. The addition of phytase reduced total N excretion by 5.5% compared to the control (10.02 vs. 10.58 g/d, P<.05).

Fecal and total P excretion were reduced by 35% and 22% by phytase (1.48 and 1.48 g/d) and carbohydrase+phytase supplementation (1.76 and 1.77 g/d) respectively, compared to the control (2.27 and 2.28 g/d; P<.05). Addition of the carbohydrase enzymes had no detectable effect on either N or P excretion. ADG was not significantly affected by treatment.

## Conclusions

Based on the results of this experiment:

- particle size has a greater effect on N excretion than enzyme supplementation, while phytase supplementation significantly altered P excretion
- a particle size x enzyme supplementation interaction was not detected for total N or P excretion
- energy was most likely not a limiting factor to protein deposition under the conditions of this study

## Implications

Reducing particle size below 700 $\mu$ m proved effective in increasing the digestibility of several nutrients in the diet, and in altering N excretion patterns. Phytase proved very effective in improving the retention of P from the diet, while the addition of carbohydrase showed little benefit in reducing N or P excretion.

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