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Dry and wet diets with and without phytase for growing and finishing pigs

Luiz Alberto Garcia de Oliveira[1], Romão da Cunha Nunes[1], Luciana Moura Rufino[1], Márcia Nunes Bandeira Roner[2*], José Henrique Stringhini[1] and Izabela Cruvinel Di Castro[1]

*[1]Departamento de Produção Animal da Escola de Veterinária, Universidade Federal de Goiás, Goiânia, Goiás, Brazil. [2]Departamento de Zootecnia, Universidade Federal de Sergipe, Aracaju, Sergipe, Brazil. *Author for Correspondence. E-mail: marciaroner@yahoo.com.br*

ABSTRACT. The present study assessed the effect of adding water and phytase to middling diets on digestibility, metabolism, performance, carcass characteristics, and the bone mineralization of growing and finishing pigs. For the digestibility trial, 16 pigs were distributed in randomized blocks, placed in digestibility cages following a 2 x 2 factorial design (dry and wet diets, with and without phytase). For the performance trial, 48 piglets were distributed into a complete randomized design. During the growing period, wet diets presented higher values for digestibility and energy metabolism. In the finishing stage, the addition of water to the feed caused a greater weight gain and interfered with the carcass length. The balance of the mineral matter and the availability of calcium and phosphorus were influenced by the diets with phytase. The addition of water to the diets in the growing phase improved the digestibility and energy metabolism, and increased the weight gain, carcass length and calcium content in bones during the finishing period. The supplementation of phytase improved energy metabolism and the digestibility of calcium and phosphorus, and the balance of mineral matter.

Keywords: carcass length, feed conversion, digestibility, metabolism.

Dietas secas e úmidas com e sem fitase para suínos em crescimento e terminação

RESUMO. O estudo avaliou os efeitos da adição de água e fitase em rações fareladas sobre a digestibilidade, metabolismo, desempenho, características da carcaça e mineralização óssea de suínos em fase de crescimento e terminação. Para o ensaio de digestibilidade, utilizaram-se 16 animais distribuídos em blocos ao acaso, alojados em gaiolas de digestibilidade, em arranjo fatorial 2 x 2 (dieta seca e úmida, com e sem o uso da fitase). Para o ensaio de desempenho, foram utilizados 48 leitões distribuídos em delineamento inteiramente casualizado. As dietas úmidas durante o crescimento apresentaram valores maiores para a digestibilidade e metabolização de energia. Na terminação, a adição de água na ração proporcionou maior ganho de peso e interferiu no comprimento de carcaça. O balanço da matéria mineral e a disponibilidade de cálcio e fósforo foram influenciados pelas dietas com fitase. A adição de água nas dietas na fase de crescimento melhorou a digestibilidade e metabolização de energia e aumentou o ganho de peso, comprimento de carcaça e teores de cálcio nos ossos na fase de terminação. A suplementação de fitase melhorou a metabolização de energia e a digestibilidade de cálcio, fósforo e balanço da matéria mineral.

Palavras-chave: comprimento de carcaça, conversão alimentar, digestibilidade, metabolismo.

Introduction

A problem in swine feeding is related to the digestibility of calcium and phosphorus, once in the main dietary ingredients, these minerals are complexed with the phytic acid (SELLE et al., 2006) and thus diets for pigs commonly contain inorganic sources of minerals.

To reduce the inclusion of inorganic minerals in the diet, some nutritional strategies have been investigated as the use of exogenous phytase. The results of studies using this ingredient are positive, leading the nutritionists to decrease the inorganic sources of calcium and phosphorus in pig diets.

The use of phytase changes the biological flow of nutrients in the animal body, particularly, minerals, because it interferes with the absorption of phosphorus, calcium, zinc and copper, reducing by 20% the excretion of these elements in feces. This decline contributes to preserving the environment, by improving nutrient availability and optimizing the utilization of feed by swine (MOREIRA et al., 2004).

In the context of swine nutrition, the liquid feeding system is emerging as an alternative to minimize the cost of animal feed. Its use gained interest given the possibility of adding cheap liquid ingredients, besides the reduction of waste from the food and pharmaceutical industries, and biofuel that can be used in this type of feeding (CANIBE; JENSEN 2012).

Considering the above, two trials were conducted to evaluate the effects of adding water and phytase to middling diets on digestibility, metabolism, performance, carcass characteristics, and bone mineralization of growing and finishing pigs.

Material and methods

The study was developed at the Sector of Pig Farming of the Department of Animal Production of the School of Veterinary and Animal Science, Federal University of Goiás, from June to August 2010.

For nutrient digestibility evaluation, two experiments were carried out, one in the growing phase, and the other in the finishing phase, using 16 barrows, with an average of 39.41 ± 2.5 kg body weight for the growing phase, and 64 ± 4.8 kg for the finishing phase. Animals were distributed in randomized blocks in a factorial arrangement (dry and wet diets, with and without phytase). Each animal corresponded to one experimental unit. Pigs were individually housed in metabolism cages as described by Pekas (1968), in masonry shed, covered with clay tiles, concrete floors and curtains of plastic canvas.

The enzyme used was Phyzyme XP® 5000G, provided by Nutron Company, trademark of the phytase obtained through fermentation with *Aspergillus niger*. The dosage used was 500 units of phytase (UFA), 10 g 100 kg^{-1} of feed, equivalent to 1.15 g of available phosphorus from dicalcium phosphate. The calcium concentration was reduced, always presenting a 1.2:1 ratio (calcium: phosphorus) in diets based on corn and soybean meal.

Diets were formulated (Table 1) to meet the requirements of the animals, according to Rostagno et al. (2005). Each digestibility trial lasted 10 days, with five days to adapt to the cages, environment and experimental diets, and five days for total collection of feces and urine. Throughout the experimental period, feeding was done twice daily, at 7:00 am and 5:00 pm.

The daily amount of feed for each animal was calculated based on the metabolic consumption, considering the individual metabolic body weight of each animal ($BW^{0.75}$). For wet diets, water was added to the feed at each meal, always in the proportion 1:1. Immediately after consumption of diets fresh water was supplied ad libitum.

It was adopted the methodology of total collection of feces with marker. To set the start and end of the collection period, 2% ferric oxide (Fe_2O_3) was added to the diets as an indigestible marker to indicate the beginning and end of each sampling period.

Table 1. Proximate and nutrient composition of experimental diets with and without phytase for growing and finishing pigs.

Ingredient	Growing		Finishing	
	Basal diet (%)	Basal diet + Enzyme (%)	Basal diet (%)	Basal diet + Enzyme (%)
Corn grain	70.24	71.18	78.69	79.09
Soybean meal 45%	25.96	25.78	18.7	18.71
Dicalcium phosphate	1.22	0.68	0.81	0.27
Limestone	0.73	0.67	0.52	0.87
Soybean oil	0.58	0.41	0.40	0.00
Mineral and vitamin supplement[1]	0.40	0.40	0.40	0.40
Common salt	0.40	0.40	0.26	0.31
L-lysine HCl	0.32	0.33	0.06	0.26
L-threonine	0.10	0.10	0.06	0.06
Dl-methionine	0.04	0.04	0.02	0.02
Enzyme	0.00	0.01	0.00	0.01
Inert	0.01	0.00	0.01	0.00
Calculated composition				
Calcium (%)	0.63	0.53	0.48	0.48
Metabolizable Energy for pigs (Mcal kg^{-1})	3.23	3.23	3.23	3.23
Available phosphorus (%)	0.33	0.23	0.25	0.15
Total phosphorus (%)	0.55	0.45	0.45	0.35
Digestible lysine (%)	1.03	1.03	0.82	0.82
Total lysine (%)	1.15	1.15	0.92	0.92
Digestible Methionine (%)	0.31	0.31	0.26	0.26
Total Methionine (%)	0.33	0.33	0.28	0.28
Digestible Protein (%)	15.43	15.43	12.12	12.12
Crude Protein (%)	18.25	18.25	15.60	15.60
Sodium (%)	0.40	0.40	0.36	0.36
Digestible threonine (%)	0.67	0.67	0.54	0.54
Total threonine (%)	0.80	0.80	0.65	0.65

[1]Composition of mineral and vitamin supplement: mineral supplement 702 (Micromin for Pigs Nutron) – Assurance levels: Iron: 100,000.00 mg kg^{-1}, Copper: 15,000.00 mg kg^{-1}, Manganese: 40,000.00 mg kg^{-1}, Zinc: 120,000.00 mg kg^{-1}, Cobalt: 300.00 mg kg^{-1}, Iodine: 1,000.00 mg kg^{-1}, Selenium: 340.00 mg kg^{-1}, vitamin supplement composition of (Vit S-CT Nutron). Assurance levels: Vit. A: 16,000.00 UI g^{-1}, Vit. D 36,000.00 UI g^{-1}, Vit. E: 80,000.00 UI kg^{-1}, Vit. K3: 6,000.00 mg kg^{-1}, B1 (Thiamine): 3,200.00 mg kg^{-1}, B2 (Riboflavin):8,000.00 mg kg^{-1}, B6 (Pyridoxine): 6,000.00 mg kg^{-1}, Vit. B12: 44,000.00 mg kg^{-1}, Niacin: 44,000.00 mg kg^{-1}, Pantothenic Acid: 24,000.00 mg kg^{-1}, Folic Acid: 1,600.00 mg kg^{-1}, Biotin: 240.00 mg kg^{-1}, Antioxidant: 20,000.00 mg kg^{-1}.

Collection of feces was performed daily, which were weighed, placed in labeled plastic bags and stored for analysis. Urine was also collected daily in plastic containers with 20 mL HCl (1:1) to prevent nitrogen loss and bacterial proliferation. From each animal, 200 mL of urine were stored totaling one liter after five days.

The quantities of feed supplied, feces and urine excreted, besides the values of laboratory tests were used in the calculations of digestibility and metabolizability as described by Sakomura and Rostagno (2007). Thus, we evaluated the digestibility of energy (CDE), calcium availability (CaD), phosphorus availability (DP) and balance of mineral matter (BMM).

For testing the performance in growing and finishing periods, we used forty-eight commercial crossbred pigs, 24 barrows and 24 females, with an initial weight of 39.41 ± 2.5 kg for the growing phase and 64 ± 4.8 kg in the finishing phase, respectively.

The experimental design was completely randomized in a 2 x 2 factorial design (dry and wet diets, with and without phytase), with four treatments and six replications. Experimental units consisted of one male and one female, housed in pens with compact floor equipped with masonry feeders and nipple drinkers.

The treatments were similar to those of nutrient digestibility trials (Table 1). The phytase tested was the same used in the digestibility trial, being 10 g 100 kg^{-1} feed, which releases 500 units of phytase (UFA). Animals were fed twice daily, at 7:00 am and 5:00 pm, in sufficient amounts, taking as a basis the leftovers in the feeders.

The performance variables evaluated were feed intake, weight gain and feed conversion. The carcass evaluation was performed according to recommendations of the ABCS (1973) and Bridi and Silva (2006).

In the finishing period, pigs were fasted for solids for 12 hours, weighed, slaughtered and eviscerated for the evaluation of carcasses. After evisceration, carcasses were sawn in half and weighed. The left half of the carcass was cooled to 7°C for 24 hours for further evaluation.

Measurements of backfat thickness were taken in relation to the spine in the point 1: on the first rib; point 2: after the last rib; point 3: located between the last and penultimate lumbar vertebra. All measurements were made according to the Brazilian Method for Carcass Evaluation (ABCS, 1973). The determination of carcass yield followed the formula described by Guidoni (2000).

For bone assessment, the metacarpal bones of the hind limbs were placed in aluminum pan, wrapped in aluminum foil and boiled to loosen the soft tissues. After cleaning, the bones were washed in cold water, and with a brush, residual meat and proximal cartilage were removed. Subsequently they were defatted in Soxhlet extractor, oven dried at 55ºC for 72 hours, and ground in a ball mill for the final drying at 105ºC for 24 hours.

Ash content was determined in muffle furnace at 600ºC. The concentrations of calcium and magnesium in the bones were determined by atomic absorption spectrophotometry and concentrations of phosphorus by colorimetry, according to Silva and Queiroz (2002).

The results of digestibility, metabolism, performance and carcass characteristics were subjected to analysis of variance. Means were compared by Tukey's test at 10% probability. All statistical analyses were run using SAS statistical software (SAS, 2002).

For analysis of parameters related to bone composition, as the variables present responses in percentage, whose results have a limited universe (0 - 100%), data were arcsin transformed, $y = \text{arcsen}\sqrt{X}$, where y is the transformed variable and X is the variable value in percentage (SAMPAIO, 1998) and their means were compared by Tukey's test ($p < 0.10$).

Results and discussion

In the growing phase, there were no interactions between type of diet and phytase levels ($p > 0.10$). The addition of water to the diet resulted in higher values of digestibility of energy ($p < 0.10$). However, treatments with and without phytase were not different ($p > 0.10$) for calcium and phosphorus availability and balance of mineral matter (Table 2).

In the finishing phase, there was an interaction ($p < 0.10$) between factors evaluated for availability of calcium and phosphorus and balance of mineral matter (Table 2). Higher values of these parameters were observed with the dry diet ($p < 0.10$), with phytase ($p > 0.10$). The availability of calcium and phosphorus in the diets with and without phytase, and the balance of mineral matter in the diets without phytase, showed similar values ($p > 0.10$).

Table 2. Mean values of digestibility of energy (CDE), calcium availability (CaD), phosphorus availability (DP) and balance of mineral matter (BMM) for growing and finishing phases of pigs fed dry and wet diets, with and without phytase.

Characteristic	Diet	Phytase: Without	Phytase: With	Mean*	P-value: Diet (R)	P-value: Phytase (F)	P-value: RxF	CV (%)
Growing phase								
CDE (%)	Dry	91.58	90.46	91.02^{B}	0.067	0.444	0.644	1.95
	Wet	92.96	92.69	92.83^{A}				
	Mean	92.27	91.57					
DCa (%)	Dry	76.76	77.58	77.17	0.290	0.593	0.796	7.36
	Wet	79.21	81.54	80.37				
	Mean	77.98	79.56					
DP (%)	Dry	64.11	63.80	63.95	0.123	0.444	0.394	10.07
	Wet	66.76	72.30	69.53				
	Mean	65.43	68.05					
BMM (%)	Dry	72.55	68.73	70.64	0.142	0.727	0.312	7.47
	Wet	73.96	75.86	74.91				
	Mean	73.25	72.29					

Characteristic	Diet	Phytase: With	Phytase: Without	Mean*	P-value: Diet (R)	P-value: Phytase (F)	P-value: RxF	CV (%)
Finishing phase								
CDE (%)	Dry	91.75	94.07	92.91	0.129	0.306	0.152	2.47
	Wet	91.63	90.49	91.06				
	Mean	91.69	92.28					
DCa (%)	Dry	75.25^{Ab}	87.38^{Aa}	81.32	0.492	0.042	0.035	6.50
	Wet	79.60^{Aa}	79.37^{Aa}	79.49				
	Mean	77.43	83.37					
DP (%)	Dry	60.56^{Ab}	83.15^{Aa}	71.86	0.747	0.005	0.099	12.25
	Wet	66.94^{Aa}	73.94^{Aa}	70.44				
	Mean	63.75	78.55					
BMM (%)	Dry	56.60^{Ab}	79.07^{Aa}	67.96	0.491	0.010	0.026	12.03
	Wet	64.18^{Aa}	66.13^{Ba}	65.15				
	Mean	60.52	72.60					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

The results partially confirms the findings of Ao et al. (2007) who reported that phytase make phosphorus available and interferes with the biological flow of this mineral from the gastrointestinal tract to the bones, as well as from bones and soft tissues to the intestinal tract of pigs. Thus, the present study demonstrated this effect only for the dry diets.

In the growing phase, there were no interactions between diets and phytase levels ($p > 0.10$) for metabolizable crude protein and metabolizable energy (Table 3). The coefficients of metabolizable crude protein and metabolizable energy were not affected by the levels of phytase ($p > 0.10$). Only the metabolizable energy was influenced by the type of diet, showing a higher value for the wet diet.

Table 3. Mean values of metabolizable crude protein (CMPB) and metabolizable energy (CME) for growing and finishing pigs fed dry and wet diets, with and without phytase.

Growing phase								
Characteristic		Phytase			P-value			CV (%)
	Diet	Without	With	Mean*	Diet (R)	Phytase (F)	RxF	
CMPB (%)	Dry	88.20	89.20	88.70				
	Wet	88.79	89.48	89.14	0.828	0.674	0.938	4.43
	Mean	88.50	89.34					
CME (%)	Dry	91.28	90.29	90.78^{B}				
	Wet	92.78	92.55	92.66^{A}	0.055	0.501	0.669	1.93
	Mean	92.03	91.42					
Finishing phase								
Characteristic		Phytase			P-value			CV (%)
	Diet	Without	With	Mean*	Diet (R)	Phytase (F)	RxF	
CMPB (%)	Dry	91.43	92.45	91.94				
	Wet	92.68	93.16	92.92	0.141	0.249	0.669	1.34
	Mean	92.06	92.81					
CME (%)	Dry	90.89^{Ab}	94.01^{Aa}	92.45				
	Wet	91.55^{Aa}	90.42^{Ba}	90.99	0.225	0.397	0.089	2.50
	Mean	91.22	92.22					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

In the finishing period, an interaction between factors ($p > 0.10$) was found for the coefficient of metabolizable energy. The coefficient of metabolizable protein was not affected by the types of diets and levels of phytase ($p > 0.10$).

The coefficient of metabolizable energy in the wet diet was similar to that of diets provided with and without phytase ($p > 0.10$), while in the dry diet the highest value was observed in the diets with phytase ($p > 0.10$).

The feeding soon after the addition of water to the middling feed may have negatively influenced the results during the finishing phase, without time sufficient for hydration of the ingredients of the diet. Nogueira et al. (2001) reported that the hydration of diets provides more suitable conditions for the digestion in pigs, especially when there is enough time for the process to develop effectively, considering that each ingredient has a specific hydration kinetics.

According to Canibe and Jensen (2012), fermented diets, whose ingredients have not been mixed with the liquid immediately before supply to the animal, have the potential to improve the nutritional value of the ingredients and promote the digestibility of various nutrients, such as amino acids and calcium. These authors argued that the fermentation conditions and ingredients used are crucial factors in improving digestion.

As for the metabolizable protein, different responses were registered by Farias et al. (2013), which observed that the addition of water to diets for finishing pigs caused a retention of up to 3.8g more nitrogen per day in the animal body. This occurred for digestible and metabolizable energy, with increase of up to 100 and 116 kcal kg^{-1} in wet diets, compared with dry diets.

No interaction was detected ($p > 0.10$) for the performance trial in growing and finishing periods. The feed conversion (Table 4) was the only performance variable influenced ($p < 0.10$) during the growing phase by the types of diet, with the dry diet achieving a better result.

Table 4. Daily mean values of feed intake (CDR), weight gain (GPD) and feed conversion (CA) of growing pigs fed dry and wet diets, with and without phytase.

Variables		Phytase			p-value			CV (%)
	Diet	Without	With	Mean*	Diet (R)	Phytase (F)	RxF	
CDR (kg)	Dry	1.92	2.01	1.97				
	Wet	2.04	1.98	2.01	0.590	0.868	0.367	9.99
	Mean	1.98	2.00					
GPD (kg)	Dry	1.13	1.07	1.10				
	Wet	1.03	0.98	1.01	0.118	0.371	1.000	13.43
	Mean	1.08	1.03					
CA	Dry	1.72	1.89	1.81^{B}				
	Wet	2.04	2.08	2.06^{A}	0.001	0.728	0.372	8.45
	Mean	1.88	1.99					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

The worst feed conversion verified for animals consuming wet diets was probably due to the low temperature in the experimental period (11 and 17°C). Probably the cold led to a higher cellular metabolism, which is partially explained by the results of feed intake and weight gain of animals fed this type of diet, although it has not shown statistical difference. Ferreira (2005) reported increased secretion of thyroxine and activation of epinephrine and norepinephrine during the cold, which causes an increased oxidation of the food and thereby increased cell metabolism.

Regardless of the performance variable, the addition of phytase did not cause significant differences between the means in the growing phase ($p > 0.10$). This result can be attributed to the short duration of this phase (22 days), suggesting that there was not sufficient time for the expression of beneficial effects of the use of the enzyme on the performance.

In the finishing phase (Table 5), animals fed wet diets showed greater weight gain, independent of phytase addition. This result suggests a better acceptance of this type of diet by animals given the absence of powder at the time of feeding and better palatability, which favored the ingestion. Opposite results were presented by Silva et al. (2011), who found that diets with different levels of water did not affect the performance of animals in the finishing phase.

Table 5. Daily means for feed intake (CDR), weight gain (GPD) and feed conversion (CA) of finishing pigs fed dry and wet diets, with and without phytase.

Variables		Phytase			p-value			
	Diet	Without	With	Mean*	Diet (R)	Phytase (F)	RxF	CV (%)
CDR (kg)	Dry	2.81	2.73	2.77	0.288	1.000	0.625	15.22
	Wet	2.92	3.01	2.96				
	Mean	2.87	2.87					
GPD (kg)	Dry	0.99	0.99	0.99 B	0.001	0.855	0.917	7.73
	Wet	1.15	1.14	1.15 A				
	Mean	1.07	1.06					
CA	Dry	2.84	8.77	2.80	0.334	0.230	0.612	8.02
	Wet	2.79	2.63	2.71				
	Mean	2.82	2.70					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

In relation to phytase, Lozano et al. (2011) found contradictory results when evaluated the effects of different levels of phytase inclusion in diets with high concentration of phytic acid for finishing pigs, and reported improvement in feed conversion for the treatments with 1000 and 1500 UFA of phytase.

For carcass characteristics (Table 6), no interaction was observed between factors evaluated ($p > 0.10$). Nevertheless, animals fed wet diets exhibited higher values of carcass length, independent of phytase. Contrarily, Farias et al. (2013) examined the effects of adding water to middling diets on carcass characteristics of finishing pigs and concluded that the addition of water had no effect on the yield and composition of carcass.

In a study with finishing pigs fed diets containing different levels of phytase (0, 500, 1000, and 1500 UFA), Lozano et al. (2011) found no effect on the slaughtering weight and carcass characteristics.

In this way, the supply of liquid diets may improve the carcass quality by reducing the heat stress with the intake of wet diets. Nogueira et al. (2001) showed that the heat as a stressor causes enhanced synthesis and secretion of steroids and corticosteroids, which affect the immune status, resulting in lower resistance to infections, increased catabolism, interfering with the synthesis and composition of tissues, thus affecting the carcass quality.

Table 6. Mean values of carcass lenght (CC), backfat thickness at point 1 (ETP1), point 2 (ETP2), point 3 (ETP3) of pigs fed dry and wet diets, with and without phytase.

Variables		Phytase			p-value			
	Diet	Without	With	Means*	Diets* (R)	Phytase (F)	RxF	CV (%)
CC (cm)	Dry	89.48	90.73	90.05B	0.085	0.708	0.422	2.80
	Wet	92.22	91.76	91.99A				
	Mean	90.85	91.25					
ETP1 (cm)	Dry	3.99	3.85	3.92	0.176	0.186	0.426	14.40
	Wet	4.52	4.00	4.26				
	Mean	4.25	3.92					
ETP2 (cm)	Dry	3.01	2.75	2.88	0.339	0.103	0.729	15.32
	Wet	3.25	2.87	3.06				
	Mean	3.13	2.81					
ETP3 (cm)	Dry	3.33	3.45	3.39	0.629	0.309	0.112	13.17
	Wet	3.73	3.23	3.48				
	Mean	3.53	3.34					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

For the chemical composition of metacarpal bones (Table 7), an interaction was found only for the percentage of calcium ($p < 0.10$). For wet and dry diets, there was no difference between diets with and without phytase ($p > 0.10$), but for diets without phytase, wet diets showed higher values ($p < 0.10$).

Table 7. Mean values of chemical composition of bones, for calcium (Ca), phosphorus (P), mineral matter (MM), moisture, total calcium in bones, total phosphorus, total mineral matter of pigs fed dry and wet diets, with and without phytase.

Variables		Phytase			p-value			
	Diet	Without	With	Means*	Diet (R)	Phytase (F)	RxF	CV (%)
Ca (%)	Dry	18.57Bb	19.35Ba	18.96	0.001	0.001	0.027	1.35
	Wet	19.49Aa	19.76Aa	19.62				
	Mean	19.03	19.55					
P (%)	Dry	9.58	9.89	9.73 B	0.001	0.001	0.675	1.75
	Wet	10.06	10.30	10.18A				
	Mean	9.82b	10.10a					
MM (%)	Dry	47.08	48.26	47.67B	0.001	0.001	0.606	1.05
	Wet	48.37	49.34	48.85A				
	Mean	47.72b	48.80a					

*Means followed by different letters (uppercase in the row and lowercase in the column) are significantly different by Tukey's test ($p > 0.10$). RxF: interaction between type of diet (R) and phytase (F).

For the content of phosphorus and mineral matter, the effects of factors occurred separately. Animals fed wet diets and animals fed diets supplemented with phytase showed higher content of phosphorus and mineral matter ($p < 0.10$), indicating the positive influence on the release of phytic phosphorus from the soybean meal and corn. This probably because the animals fed diet containing phytase had higher growth rate than pigs given diets without phytase. It is important to emphasize that the best acceptance of wet diets may have contributed positively to the emergence of high levels of these minerals.

Conclusion

The addition of water to the diet for pigs during the growing phase improves the digestibility and energy metabolism. In the finishing phase, it increases weight gain, carcass length and content of calcium in the bones. Phytase supplementation to the diets for finishing pigs improves the energy metabolism and digestibility of calcium, phosphorus and balance of mineral matter. The addition of water plus phytase to the diet increases the levels of phosphorus and mineral matter in the bones.

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