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The influence of enzymes on nutrient deficient diets on growth performance, and bone mineralization of pigs

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Introduction

Phytase is an exogenous enzyme that catalyses the hydrolysis of phytic acid releasing P and other chelated minerals such as Zn, Mg, and Ca

Phytase increases P retention in pigs allowing a reduction of total P concentration in the diet so less inorganic P supply is needed, thereby reducing the cost of the diet, and P excretion into the environment.

Xylanases like other carbohydrases are hydrolytic enzymes which cleave bounds of the complex plant cell wall polysaccharides increasing its utilisation by the pig.

Objective

Validate the Matrix Nutrient Concept of phytase and xylanase for growing pigs fed diets limited in Ca, digP, AA and energy

Growth performance, feed efficacy, bone mineralisation and bone strength are used as response criteria.

Experimental design

Treatment	Basal diet	Mineral matrix	AA matrix	ME matrix kcal/kg	Phytase[1] FTU/kg	Xylanase[2] BXU/kg
1	Positive control (PC)	According to NRC (2012) for 25-50 and 50-75kg pigs				
2	Industry control (IC)	0.15% totP 0.12 % digP 0.165% Ca	-	-	500	-
3	Negative control (NC 1)	0.20% tot P 0.16% digP 0.22% Ca	Lys 0.05% Thr 0.05% M+C 0.05% Val 0.04% Trp 0.02% Ile 0.036%	-	-	-
4	NC1 + phytase + xylanase		-	-	2,000	9,600
5	Negative control (NC 2)	0.20% tot P 0.16% digP 0.22% Ca	Lys 0.05% Thr 0.05% M+C 0.05% Val 0.04% Trp 0.02% Ile 0.036%	120	-	-
6	NC2 + phytase + xylanase		-	-	2,000	9,600

[1] phytase: Quantum Blue 5G; [2] xylanase: Econase XT25

Ingredient composition of diets

Feeding Phase	Grower 1 (25-50Kg; 0-4 weeks)						Grower 2 (50-75kg; 4-8 weeks)					
Ingredient, %	PC	IC	NC1	NC1+	NC2	NC2+						
Phytase	-	0.01	-	0.04	-	0.04						
Xylanase	-	-	-	0.006	-	0.006						
Barley	30.0	30.0	30.0		35.0							
Wheat	21.5	23.3	26.2		24.1							
Corn	20.0	20.0	20.0		20.0							
Soybean meal	20.4	20.0	17.6		17.0							
Fat	4.79	4.18	4.00		1.70							
Mono Phos	0.95	0.29	0.09		0.06							
Ca Carbonate	0.91	0.79	0.74		0.76							
Salt	0.41	0.30	0.30		0.30							
Lysine HCl	0.41	0.41	0.42		0.42							
Threonine	0.12	0.12	0.10		0.10							
Methionine	0.13	0.12	0.09		0.09							
Tryptophan	0.01	0.01	0		0							
Vit-Min premix	0.42	0.42	0.42		0.42							

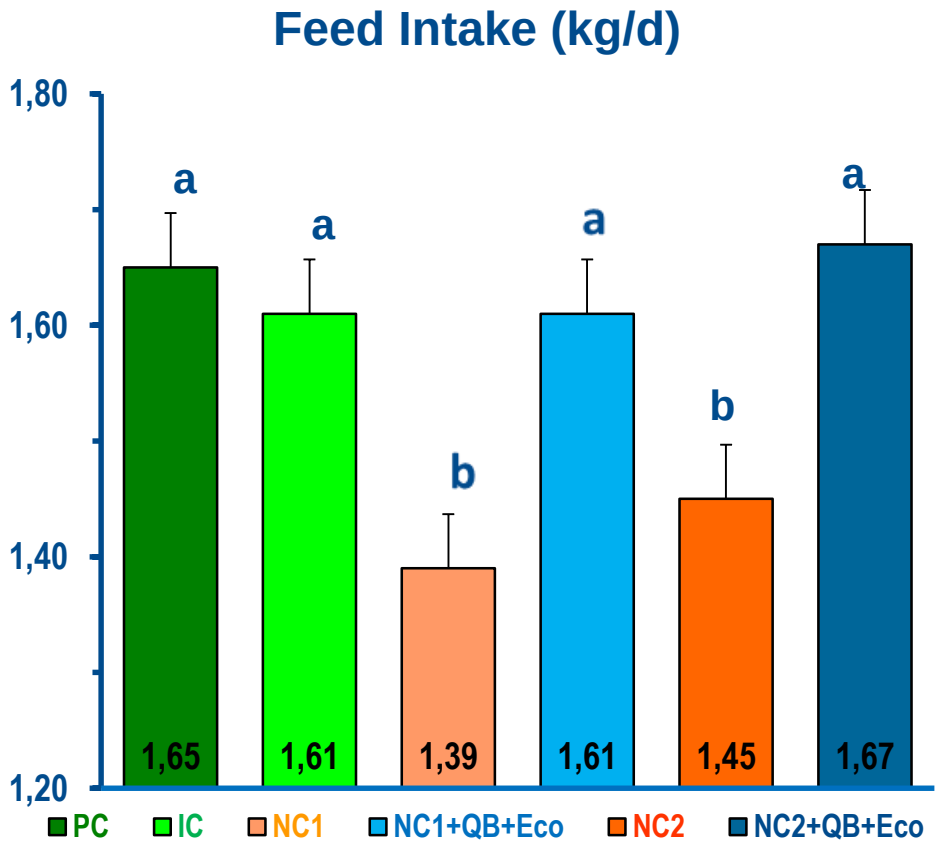
Nutrient content of diets

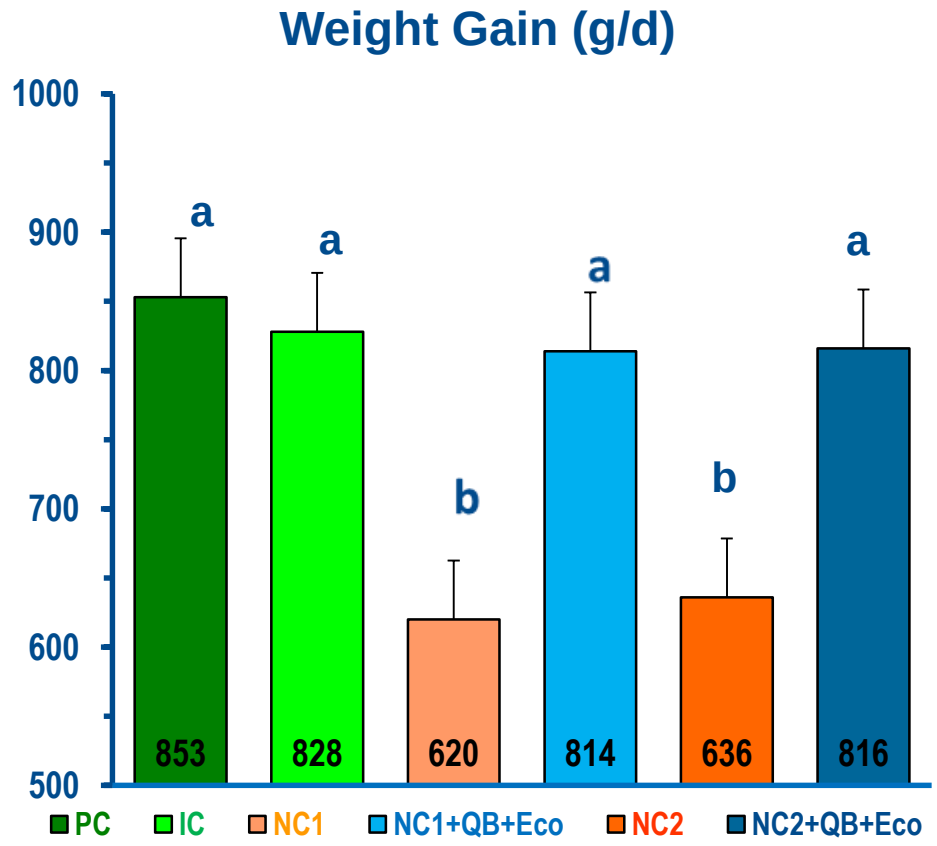
Feeding Phase	Grower 1 (25-50Kg; 0-4 weeks)						Grower 2 (50-75kg; 4-8 weeks)					
Nutrient	PC	IC	NC1	NC1+	NC2	NC2+						
Phytase, FTU/kg	17	599	98	2062	124	1963						
Xylanase, BXU/kg	-	-	-	8960	-	9120						
ME (Mcal/kg)	3.30	330	3.30		3.18							
NE (Mcal/kg)	2.51	250	2.52		2.41							
CP (%)	16.0	16.0	16.0		15.9							
sid Lys (%)	1.01	1.01	0.96		0.96							
sid Met (%)	0.35	0.35	0.31		0.30							
sid M+C (%)	0.61	0.61	0.56		0.56							
sid Thr (%)	0.61	0.61	0.56		0.56							
sid Trp (%)	0.18	0.18	0.16		0.16							
sid Ile (%)	0.58	0.58	0.55		0.55							
sid Val (%)	0.67	0.67	0.63		0.64							
Total P (%)	0.57	0.42	0.37		0.37							
Digestible P (%)	0.28	0.16	0.12		0.12							
Ca (%)	0.70	0.54	0.48		0.48							

Material & Methods

- 6 treatments (PC, IC, NC1, NC1+, NC2, NC2+)
- 192 male pigs (Pi * (LW * LR); 23.50 ± 3.50 kg)
- 48 pens (4 pigs/pen): 8 replicates / treatment
- 2-phase feeding program (25-50, 50-75kg)
- Pellet diets, offered ad libitum
- Wheat, barley pre-conditioned at >85ºC to destroy phytases
- Performance after 8 weeks trial (2 phases: 0-4, 4-8 wk)
- 1 pig/pen euthanized and metatarsal bones collected for analysis
- Bone ash, minerals (Ca, P) and bone strength measurements

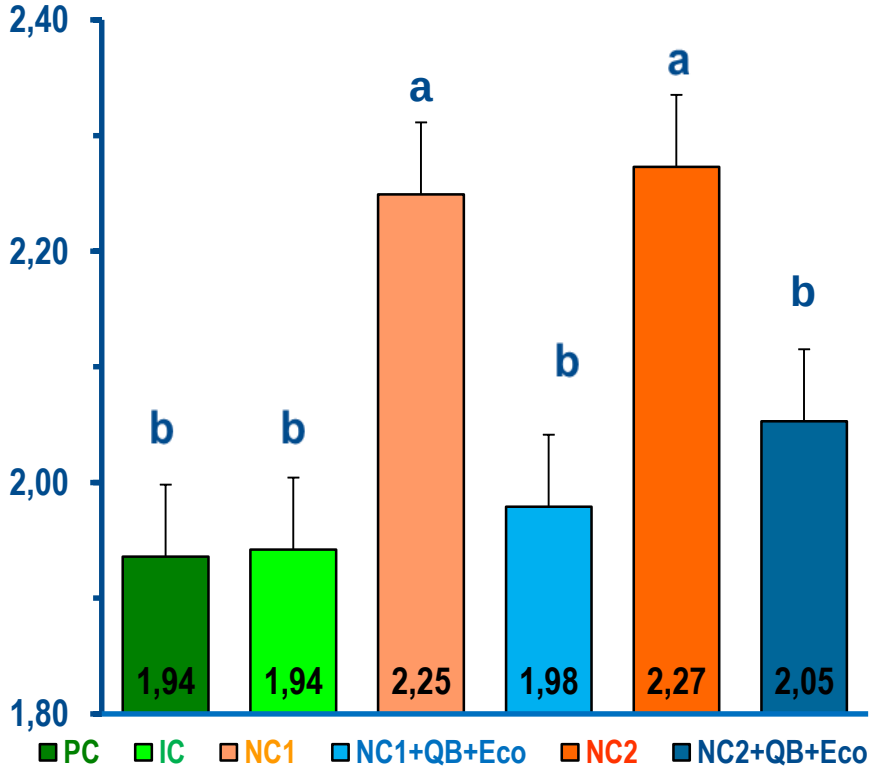
Intake and growth performance



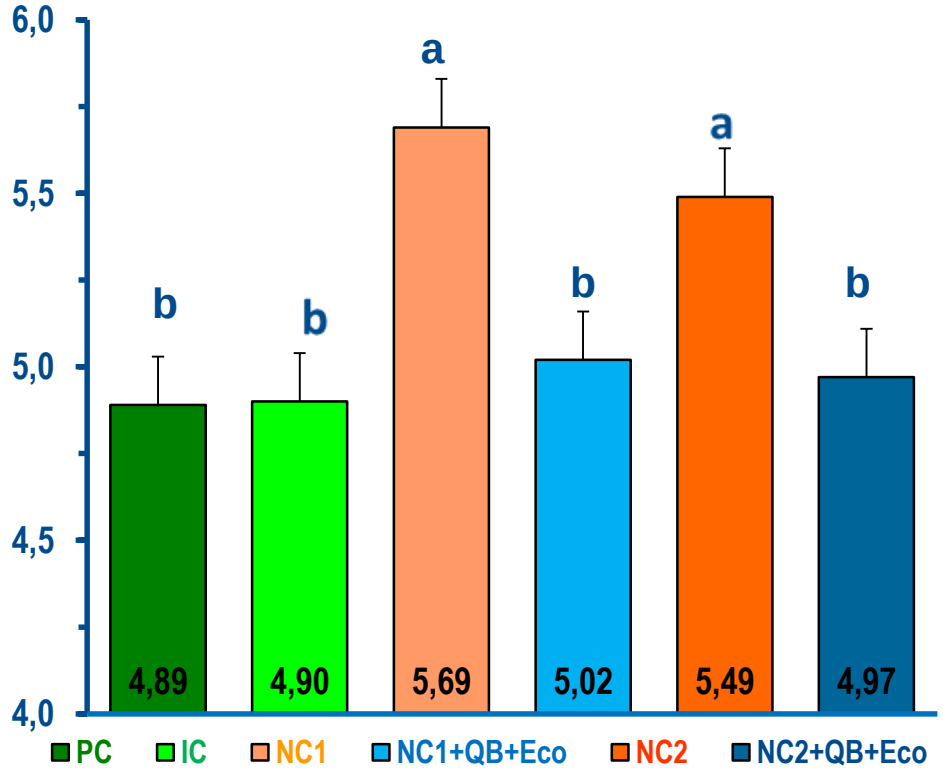


Feed efficacy

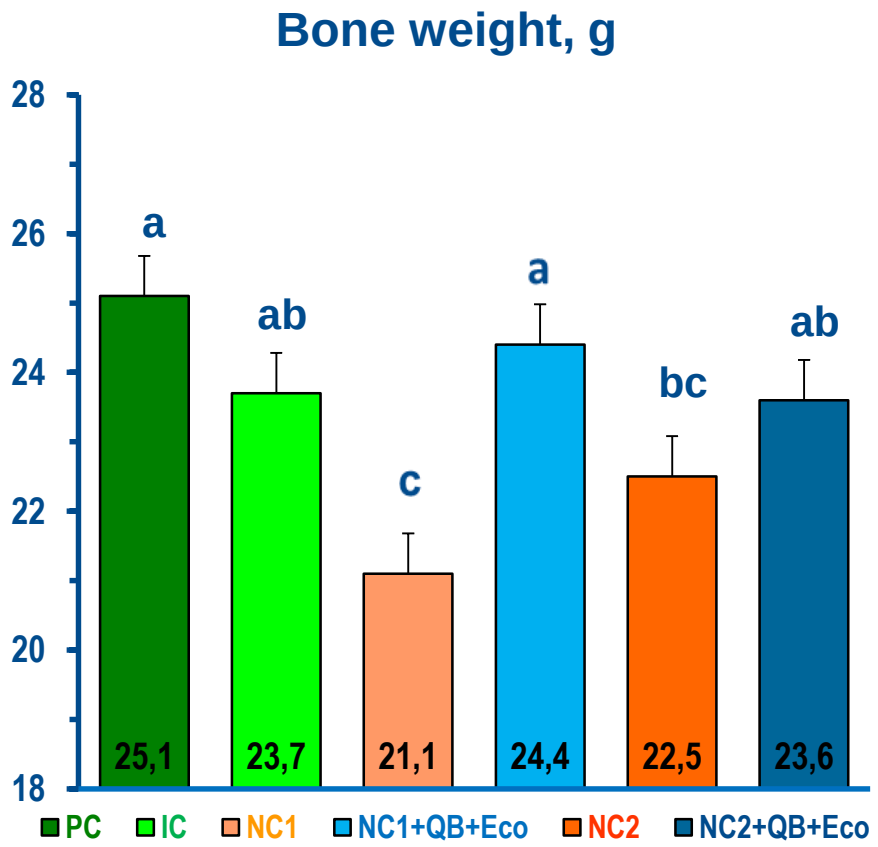
Feed Conversion Ratio

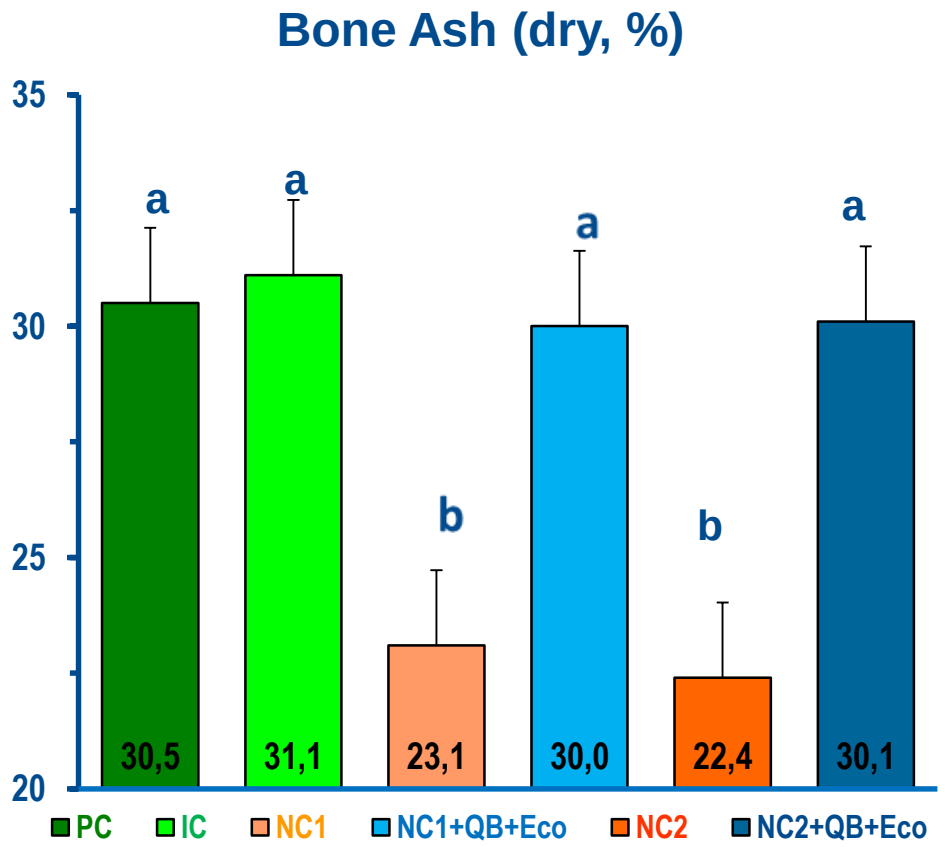


Energy Efficiency (Mcal/kg)

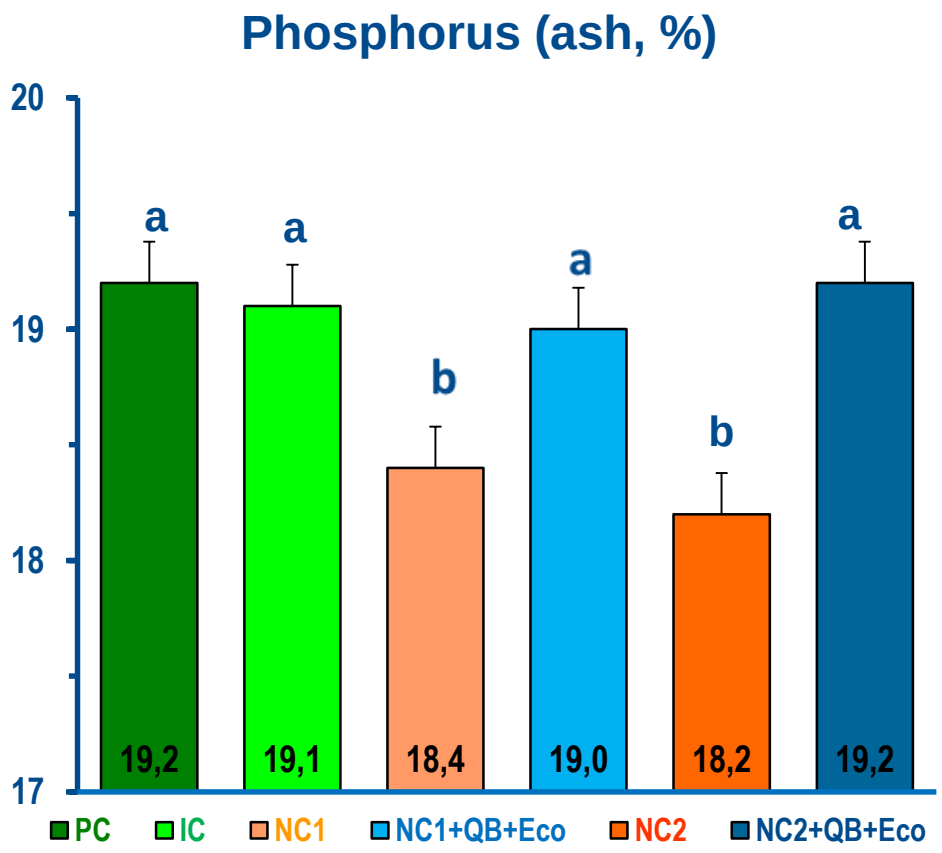


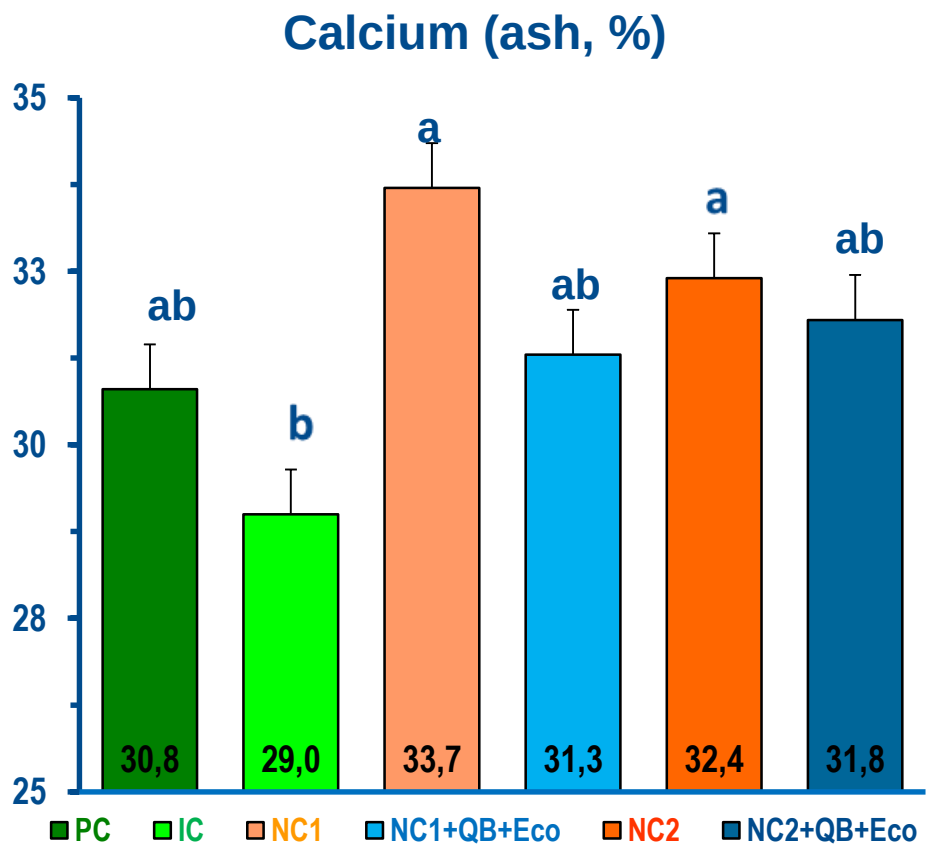
Bone mineralisation



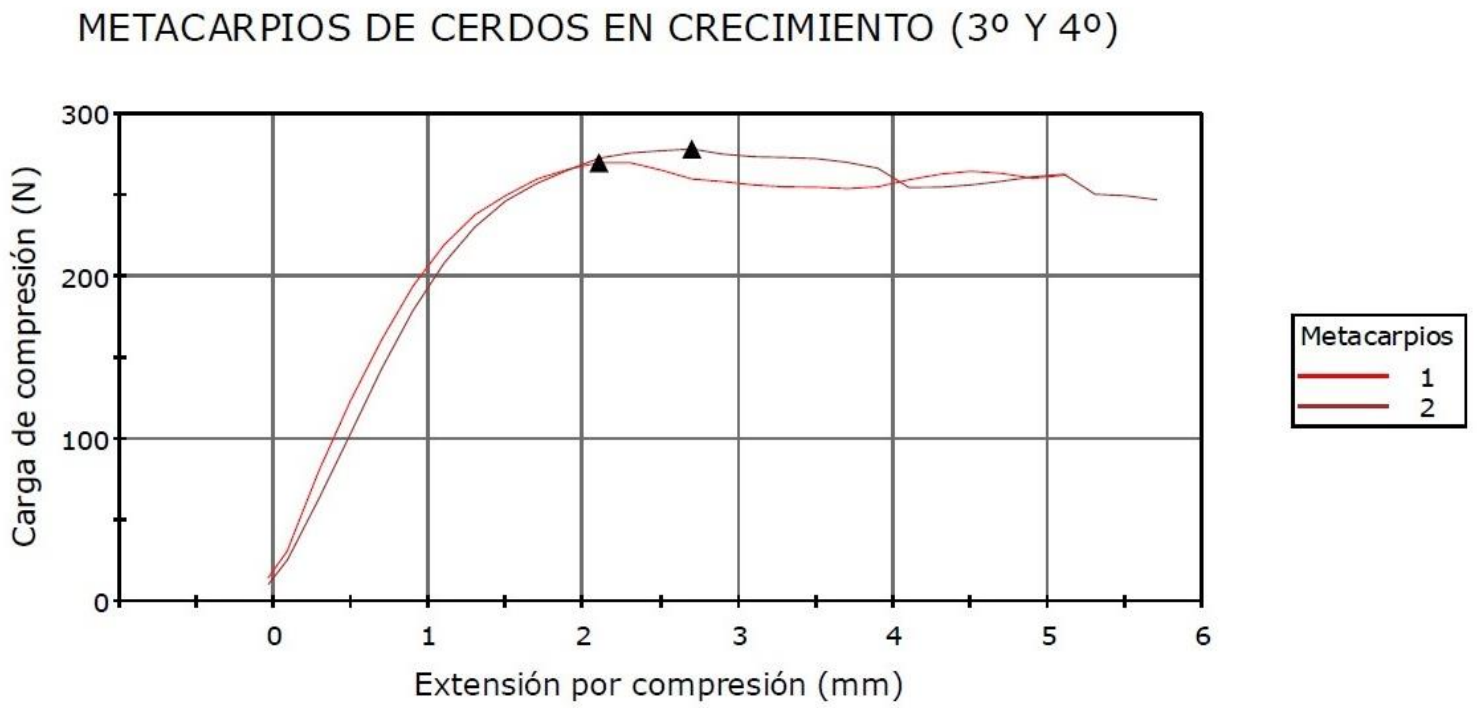


Bone mineralisation





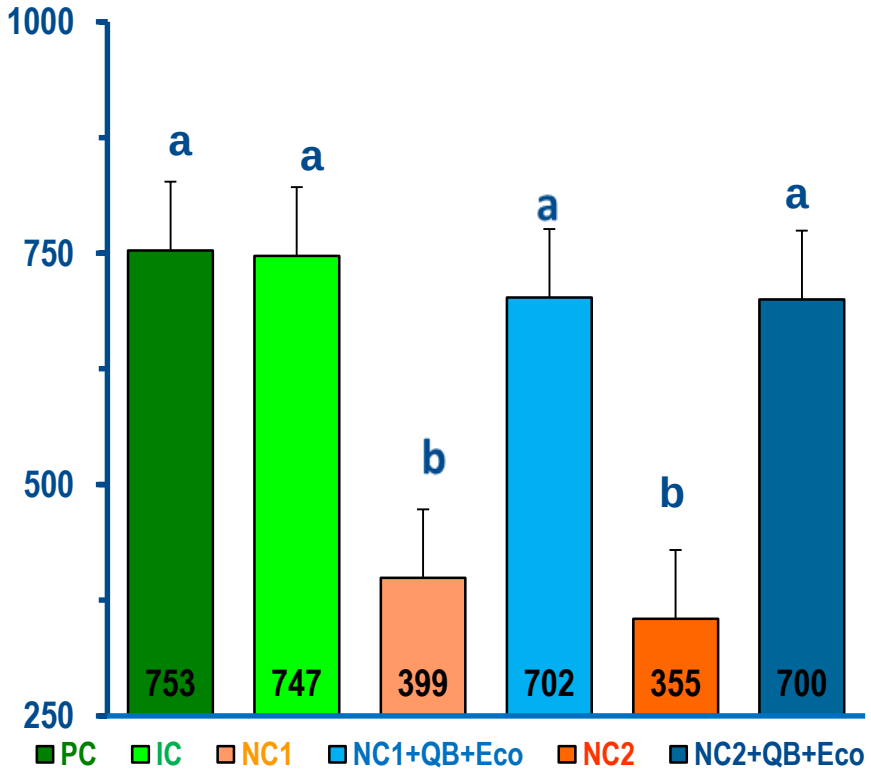
Bone strength



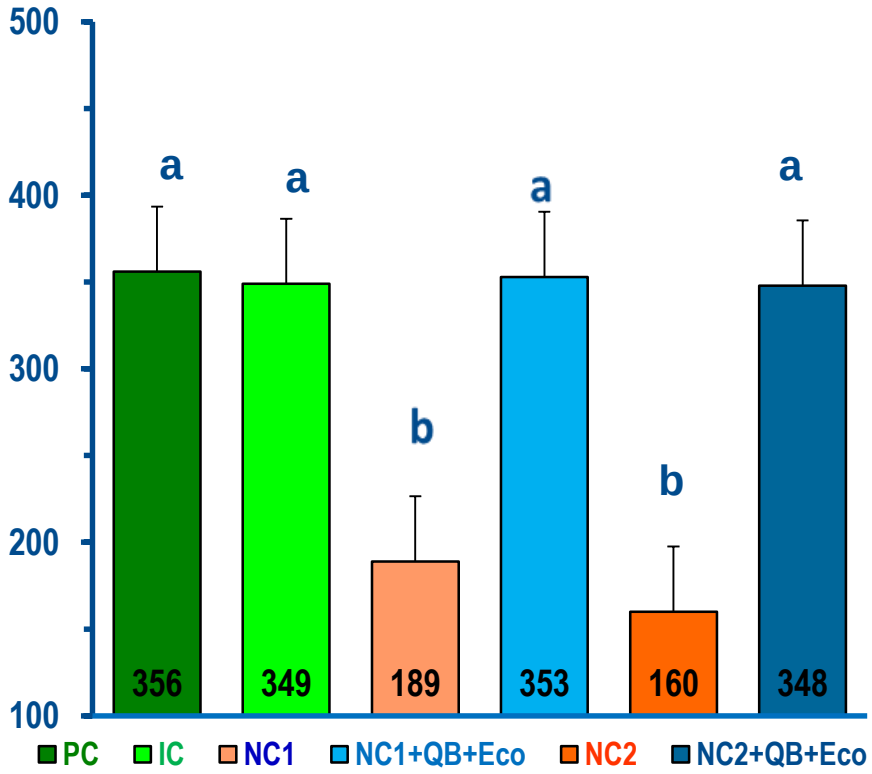
	Máximo Carga de compresión (N)	Extensión por compresión al Máximo Carga de compresión (mm)	Módulo (Automática) (MPa)	EnergíaalMáximo Carga de compresión (J)
1	269,68765	> 2,09791	232,45840	0,39293
2	278,16443	> 2,69812	212,01874	0,53840
Media	273,92604	2,39802	222,23857	0,46567

Bone strength

Ultimate force (N)



Stiffness (MPa)



Conclusions

- These results confirm that supplementation with high doses of phytase and xylanase in diets limited in Ca, digP, AA and Energy can result in performance, and bone characteristics equivalent to that of pigs fed more expensive nutrient adequate diets
- validating the Matrix Nutrient Concept, and
- helping to formulate cheaper diets while maintaining performance and reducing the environmental impact (through the nutrient sparing effect).


THANK YOU VERY
MUCH FOR YOUR
ATTENTION !!!!