Effect of dietary Guanidinoacetic acid supplementation on growth performance in nursery pigs

Joaquín Morales*[1], Meike Rademacher[2], Ulrike Braun[3], María Rodríguez[1], Alberto Manso[1]

[1]PigCHAMP Pro Europa, SL; Spain
[2]Evonik Nutrition & Care GmbH; Germany
[3]AlzChem Trostberg GmbH; Germany

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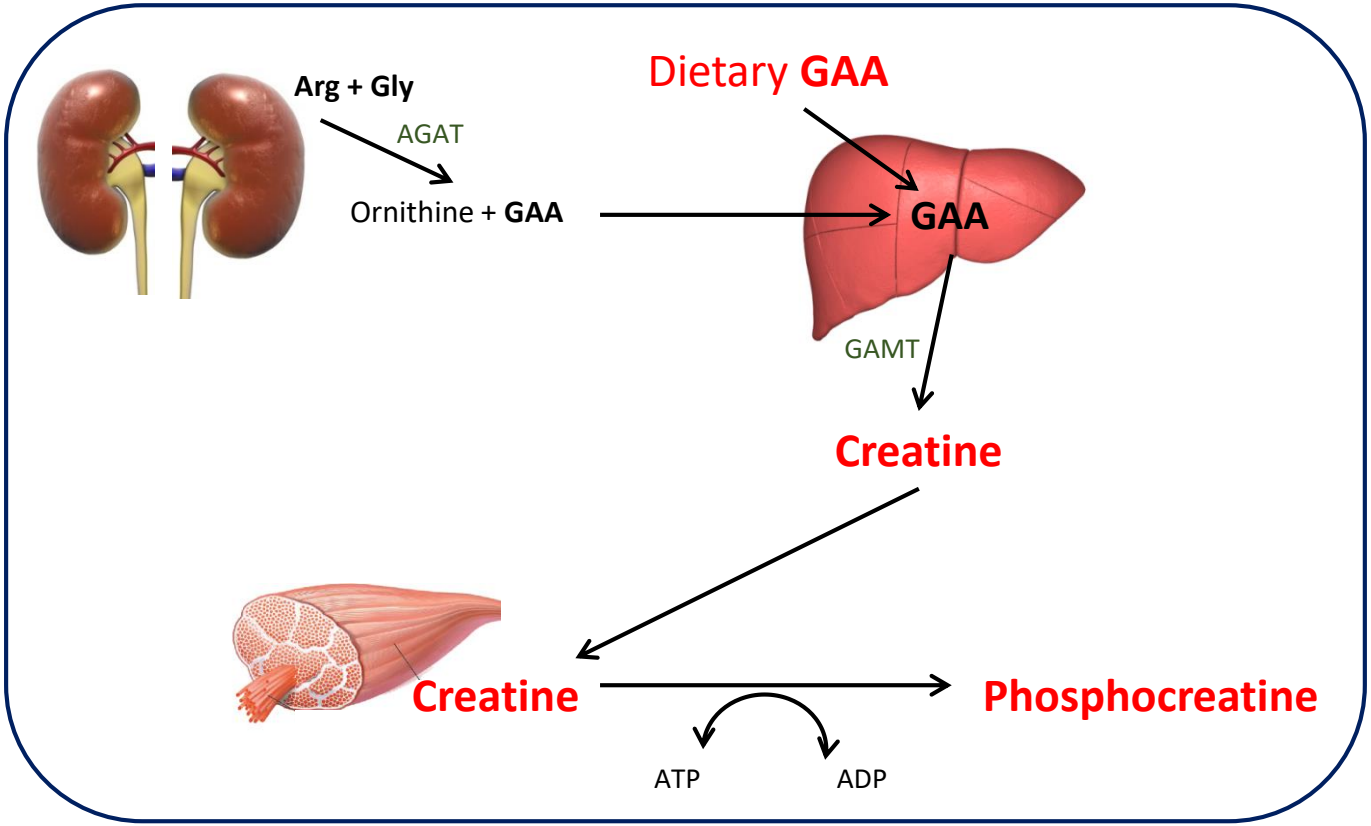
Background

Guanidinoacetate (GAA):



Background

GAA is

- an endogenous amino acid derivative formed from Arg and Gly
- the immediate metabolic precursor for **creatine** in the body

Creatine is

- essential for rapid energy supply (to restore ATP from ADP)
- stored in skeletal muscle for proper muscle function and growth
- not fully loaded in muscle during early life
- used in humans to improve lean body mass and strength
- scarce in commercial feed (not available from plant ingredients)

Background

CREATINE is

- not stable during feed processing (high temperature)

GAA is

- stable during heat treatment
- approved as a nutritional feed additive to supply creatine
- proven to increase growth performance and feed conversion in broilers
- reported to improve lean body mass and performance of finishing pigs

Objective

Limited information is available on the role of GAA/creatine in nursery piglets

- ❑ *Will GAA act as a source of **creatine** in piglets?*
  - *Absorption: GAA in blood*
  - *Metabolization to creatine: Creatine in blood, muscle & liver*
- ❑ *Will piglet **growth performance** benefit from creatine?*
- ❑ *At which **dose levels** will GAA benefit piglets?*

Materials and Methods

Study location & Animals

Commercial farm CEP (Centro Experimental Porcino, Segovia, Spain)

A total of **336 piglets** (50% entire males; ACMC x Pietrain) were distributed in **56 pens** of 6 piglets / pen (0.30 m2/piglet).

Adaptation period: 5 days (from weaning at 28 days age to day 33)

Study duration: 42 days (14 days prestarter + 28 days starter).

Experimental design

Groups	Dose GAA, %	Nº pens	Nº animals/treat
T1	0	14	84
T2	0.06	14	84
T3	0.09	14	84
T4	0.12	14	84

Diets formulations & nutrient values

Diets Ingredients	Pre-starter	Starter
Corn	29.1	12.0
Wheat	25.0	30.0
Soybean meal, 48 %	24.0	25.0
Barley	9.0	24.6
Skim milk powder	4.0	-
Soybean oil	4.0	3.7
Dicalcium phosphate 22	1.51	1.47
Corn starch*	0.68	0.70
Premix[2]	0.30	0.30
CaCO3	0.80	0.89
L-Lys-HCl	0.56	0.43
DL-Met, 99 %	0.25	0.17
L-Threonine	0.23	0.15
Salt	0.25	0.34
Choline Chloride (60 %)	0.10	0.08
L-Valine	0.11	0.02
L-Tryptophan	0.09	0.05
L-Isoleucine	0.04	-
Nutrient content		
NE (MJ/kg)	10.30	10.10
CP, %	19.7	20.0
Total Lys, %	1.42	1.30
SID Lys, %	1.30	1.17
SID Met, %	0.51	0.42
SID Met + Cys, %	0.78	0.71
SID Thr, %	0.82	0.74
SID Trp, %	0.29	0.26

*Corn starch partially replaced in T2-T4 by GAA

Analysed Arg content = 1.2% in all experimental feeds

Materials and Methods

Controls

- **Growth performance**: days 0, 14 (end prestarter), 28 and 42 (end nursery)
- **Blood sampling** at day 42 (12 pigs / treatment, 6m/6f), first thing in the morning, from the jugular vein by venipuncture in EDTA tubes.
- **Tissue sampling** at day 42 (6 pigs / treatment, 3m/3f) were sacrificed for muscle (*longissimus dorsi*) and liver sampling.

Statistics

Normal distribution was checked (proc UNIVARIATE of SAS) in all variables and outliers detected (Cook's distance measure) prior to analysis.

Growth performance data: Pen of 6 piglets was the experimental unit. Data were analysed using the proc GLM of SAS. Initial BW was included as covariate.

Blood & tissue data: The piglet was the experimental unit. Data were analysed using the proc GLM of SAS.

MAIN RESULTS

1. DIET ANALYSIS
2. GROWTH PERFORMANCE
3. CREATINE SERUM, MUSCLE & LIVER CONTENT

Results

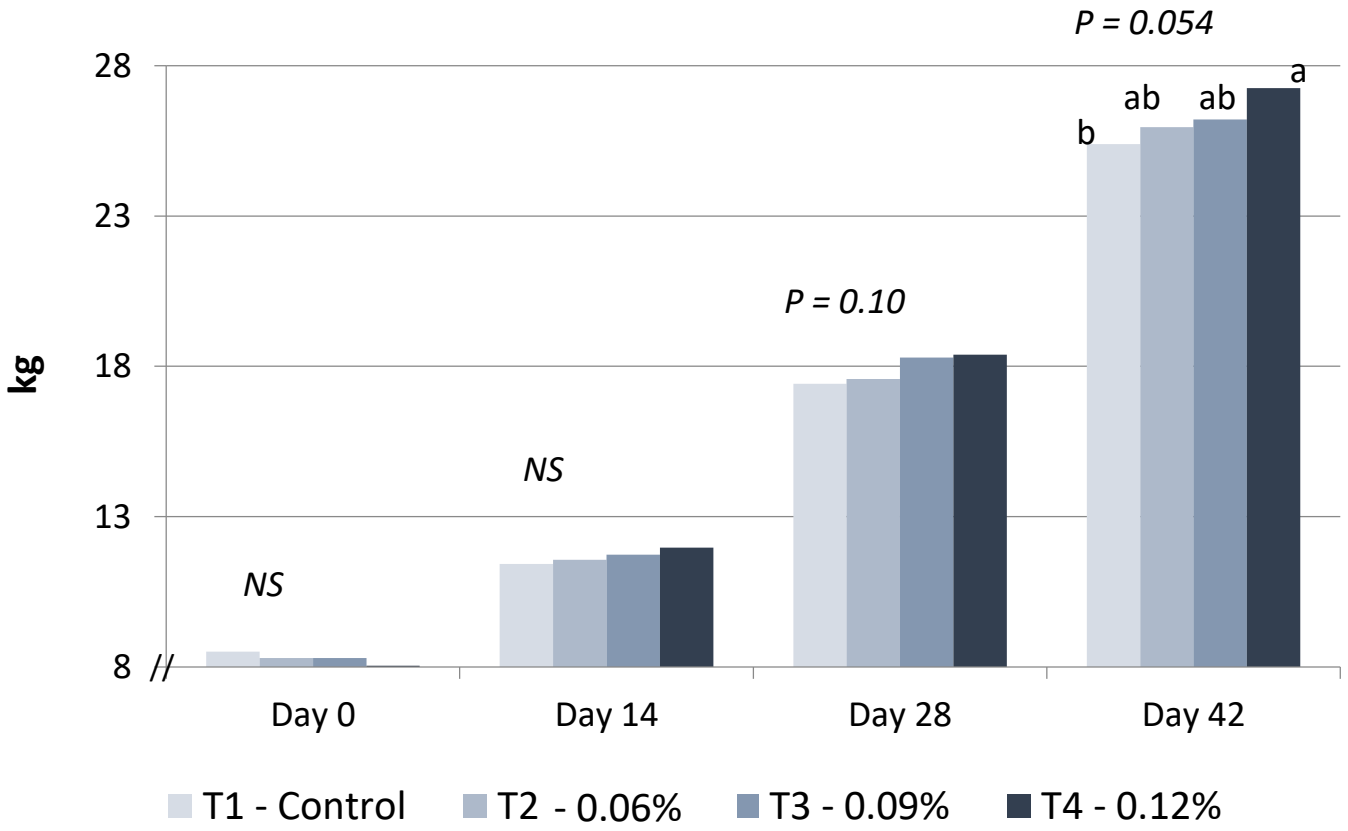
Feed analysis

Content (mg/kg)	Pre-starter feeds				Starter feeds			
	T1 Control	**T2** 0.06%	**T3** 0.09%	**T4** 0.12%	**T1** Control	**T2** 0.06%	**T3** 0.09%	**T4** 0.12%
Intended value:								
GAA*	<1	586	879	1172	<1	586	879	1172
Analysed values:								
GAA	<1	727	996	1230	<1	571	779	1150
Creatine	26	<25	<25	<25	-	-	-	-

*Calculated from GAA assay in test article CreAMINO®: 97.7%

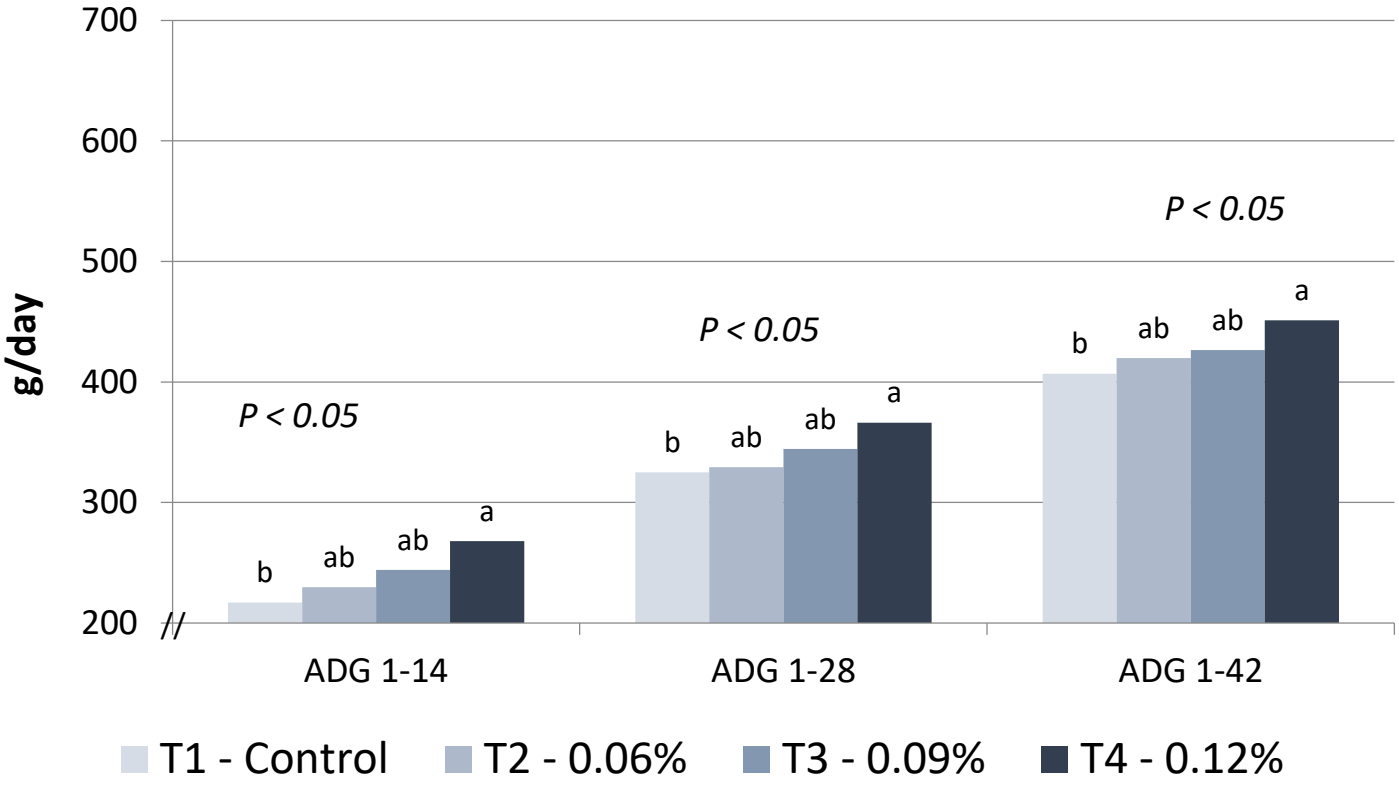
Results

Body weight (kg)



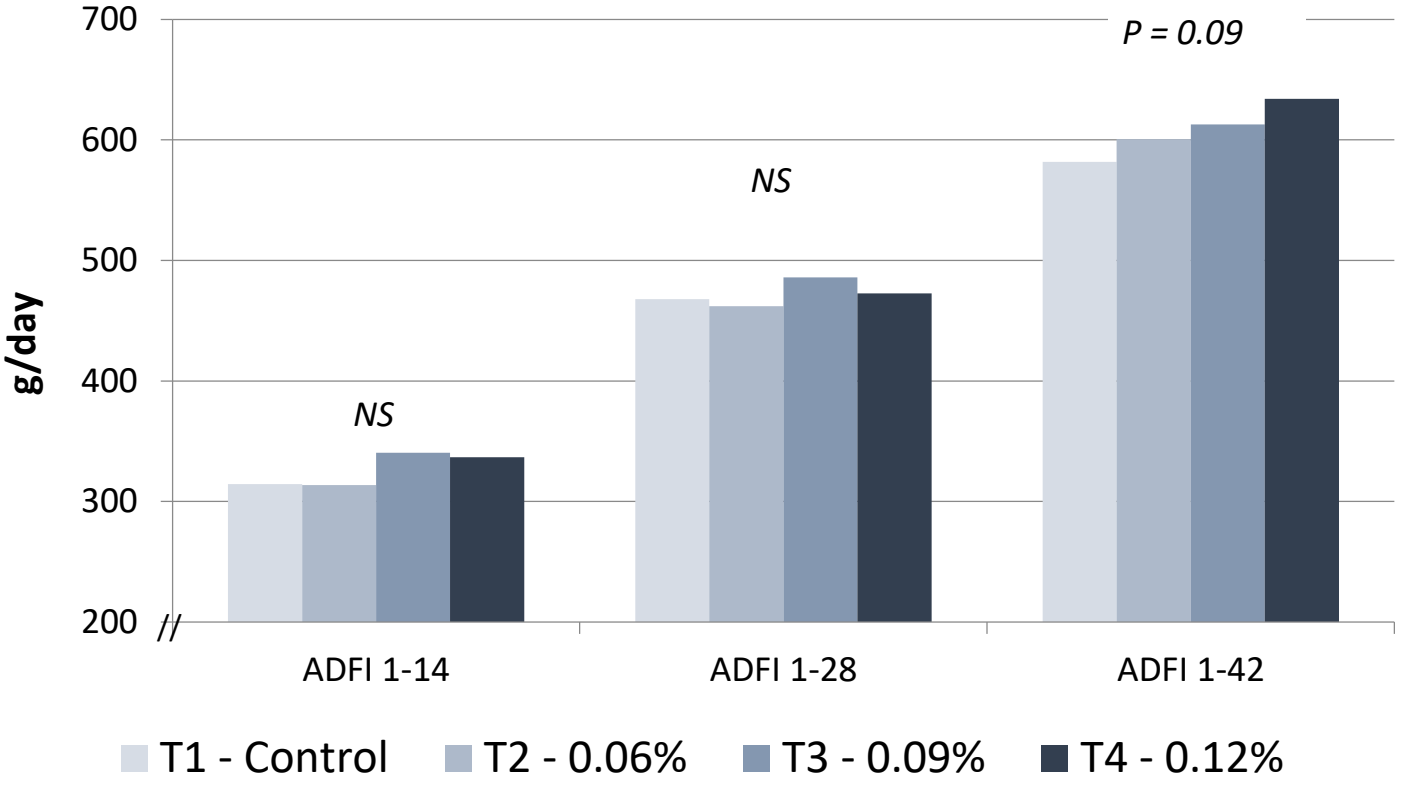
Results

Average daily gain (g/day)



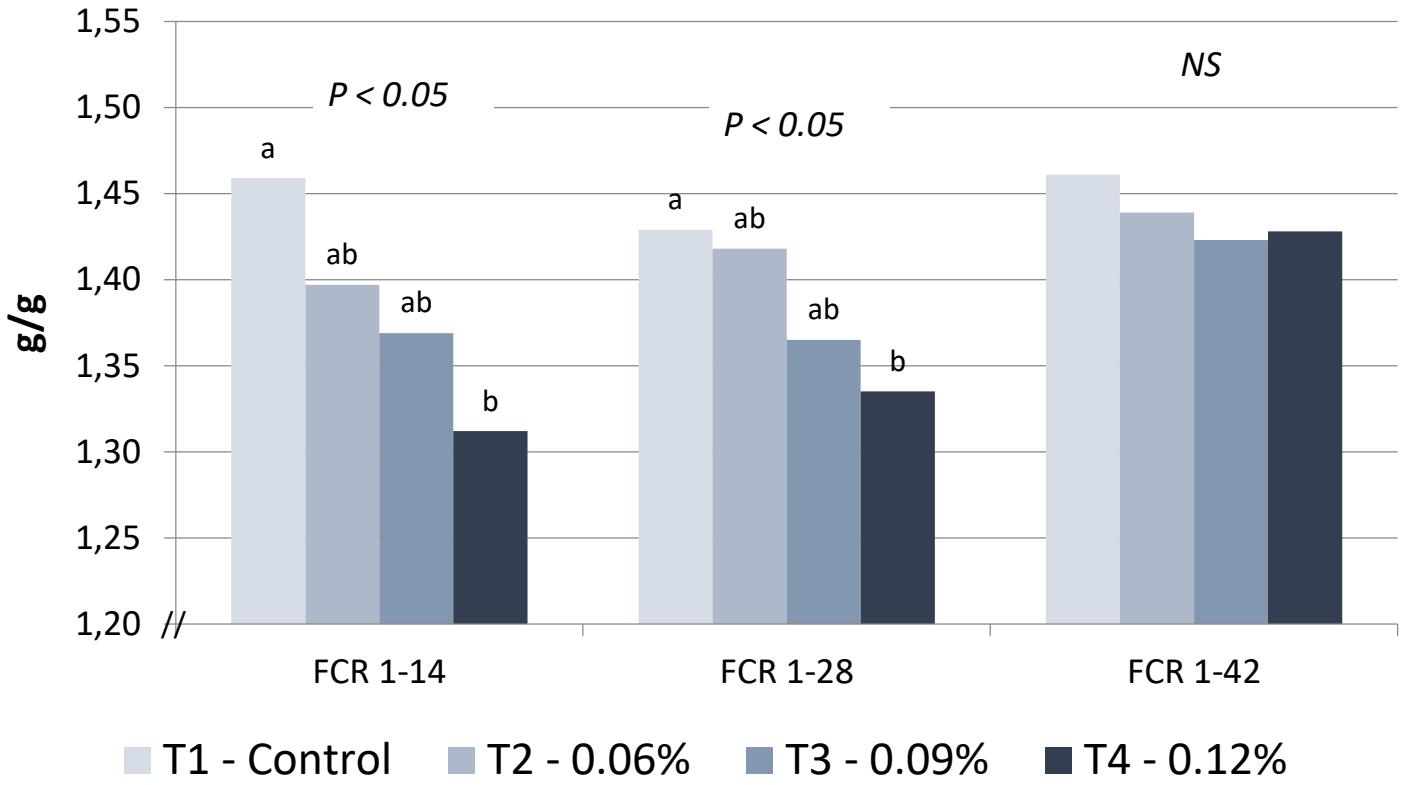
Results

Average daily feed intake (g/day)



Results

Feed conversion ratio (g/g)



Results

Blood & muscle analysis (Day 42)

Parameter	T1 Control	T2 0.06% GAA	T3 0.09% GAA	T4 0.12% GAA	*SEM*[1]	*P*-values
Blood content						
GAA (µmol/L)	7.93	9.15	9.33	9.66	*0.625*	*0.22*
Creatine (mg/dL)	1.81	2.50	2.49	2.16	*0.253*	*0.18*
Creatine content (mg/kg) in muscle & liver						
Muscle	5759.3	5704.0	5555.2	5830.0	*84.91*	*0.16*
Liver	130.3[b]	276.0[ab]	394.8[a]	339.2[ab]	*65.64*	*0.05*

[1]Standard error of mean, n=12 in blood analysis and n=6 in muscle&liver analysis

Conclusions

From the present experiment, we can draw the following conclusions:

1. Feed supplementation with 0.12% GAA improved ADG in prestarter and whole nursery periods. In consequence, final BW of pigs was increased by 7.4% compared with the negative control group.
2. 0.12% GAA improved FCR in prestarter and after 28d.
3. Efficient absorption (numerically higher GAA in blood) and metabolization (elevated liver creatine) of supplemented GAA.
4. GAA is an efficient source of creatine in nursery piglets.
5. The recommended dose range is between 0.09 and 0.12 % GAA in feed.

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joaquin.morales@pigchamp-pro.com