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Session 47:

Feed additives to improve diet utilisation

Efficacy of a probiotic (*Bacillus subtilis C-3102**) in weaned piglets

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Introduction

- Probiotics have been used in the last 20 years as feed additives, both in animal and human nutrition
- The mechanisms of action are still unclear, and probably consist of several pathways working together (exclusive competition, immunity, lactic acid production, etc)

Introduction

- However, trial results are not homogeneous for these additives, and differences due to probiotic addition are not always significant
- Several reasons may cause these differences: nature, dose and stability of the probiotic, sanitary status of animals, type of diet, age of animals…

Introduction

- For the evaluation of this kind of additives, probably the meta-analysis of several studies (different studies analysed together, with the diet and study as main effects) shows more representative results, and probably gives an average of the result of use of the additive on a farm level

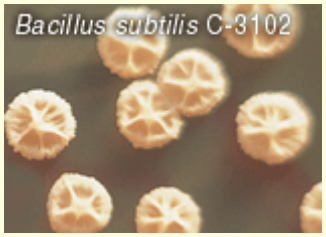
Objective

To evaluate the efficacy of a probiotic feed additive[1] in weaned piglets by means of a meta-analysis of results obtained in four different EU experiments conducted from weaning at approximately 23-28 days of age during 6 weeks (42 days).

[1] *Bacillus subtilis*, Calsporin®, Calpis Co. Ltd.

Materials and Methods

- Four studies
  - Three countries
    - Spain (2), Italy and Greece
  - Four experimental facilities
    - IRTA
    - IMASDE AGROALIMENTARIA
    - UNIVERSITY OF MILAN
    - UNIVERSITY OF THESSALONIKI



Experimental Design

Applied in both the Prestarter (14 days long) and the Starter (28 days long) periods

Treatment	Dose[1] of *B. subtilis* C-3102 (CFU/g feed)
T1	-
T2	3×10^5 (30 ppm)

Number of treatments:	2	Piglets per replicate:	8-9
Replicates per treatment:	66	Piglets per treatment:	537
Total number of replicates:	132	Total number of piglets:	1,074
Number of studies:	4		

Materials and Methods: diet form

Trial	Design	Dose of *B. subtilis* C-3102
Study 1 (IRTA 2007, Spain)	Control vs PROBIOTIC Pelleted feeds	3 x 10^5 CFU/g feed
Study 2 (Imasde 2007, Spain)	Control vs PROBIOTIC Pelleted feeds	3 x 10^5 CFU/g feed
Study 3 (University of Milan 2008, Italy)	Control vs PROBIOTIC Pelleted feeds	3 x 10^5 CFU/g feed
Study 4 (University of Thessaloniki 2008, Greece)	Control vs PROBIOTIC Mash feeds	3 x 10^5 CFU/g feed

Materials and Methods: genetic line

Trial	Genetics	Sex
Study 1 (IRTA 2007, Spain)	Duroc x LR	Males
Study 2 (Imasde 2007, Spain)	LWx (LDxLW)	Males & Females
Study 3 (University of Milan 2008, Italy)	LWx (LDxLW)	Males & Females
Study 4 (University of Thessaloniki 2008, Greece)	LDxLW	Males & Females

Materials and Methods: diets

	IRTA		IMASDE		U. MILAN		U. THES.
	P	S	P	S	P	S	S
CEREALS[1]	56	62	12	65	-	28	66
COOKED CEREALS[1]	-	-	42	-	55	37	-
SOYBEAN MEAL	17	22	-	24	-	-	15
FULL FAT SOYBEAN	-	-	19	-	-	8	-
MILK PRODUCTS	11	7	16	-	25	10	3
PROTEIN CONC.[2]	10	4	8	-	13	13	5
OIL/LARD	3.0	2.7	0.4	5.5	3.6	2.0	2.0
OTHERS[3]	≈100	≈100	≈100	≈100	≈100	≈100	≈100
ME, kcal/kg	3,375	3,300	3,382	3,327	3,963*	3,717*	-
CRUDE PROTEIN, %	22.0	20.0	19.5	19.0	20.5	21.0	22.3
TOTAL LYSINE, %	1.50	1.23	1.38	1.28	1.50	1.40	1.57

[1]Wheat+barley+corn; [2]Soy/Potato concentrates, fish meal;[3]Wheat bran, carbonate, phosphate, salt, vit+min, AA's; *DE

Materials and Methods

Analysed viable spore counts, CFU/g feed (expected $3x10^5$)

	IRTA		IMASDE		U. MILAN		U. THES.
	P	S	P	S	P	S	S
Control	$<10^4$	$<10^4$	$<10^4$	$<10^4$	$<10^4$	$<10^4$	$<10^4$
30ppm	$1.7x10^5$	$2.5x10^5$	$2.1x10^5$	$2.1x10^5$	$1.8x10^5$	$1.8x10^5$	$2.2x10^5$

Materials and Methods: Data analysed

- Body weight (g) at 14 and 42 days of trial,
- Mortality (%) from 1-14 and 1-42 days of trial,
- Mean daily gain (g) from 1-14, 15-42, and 1-42 days of trial,
- Feed intake (g/day) from 1-14, 15-42, and 1-42 days of trial,
- Feed conversion ratio (g feed / g gain) from 1-14, 15-42, and 1-42 days of trial
- ONLY FOR THE WHOLE PERIOD IN TRIAL 4

Materials and Methods

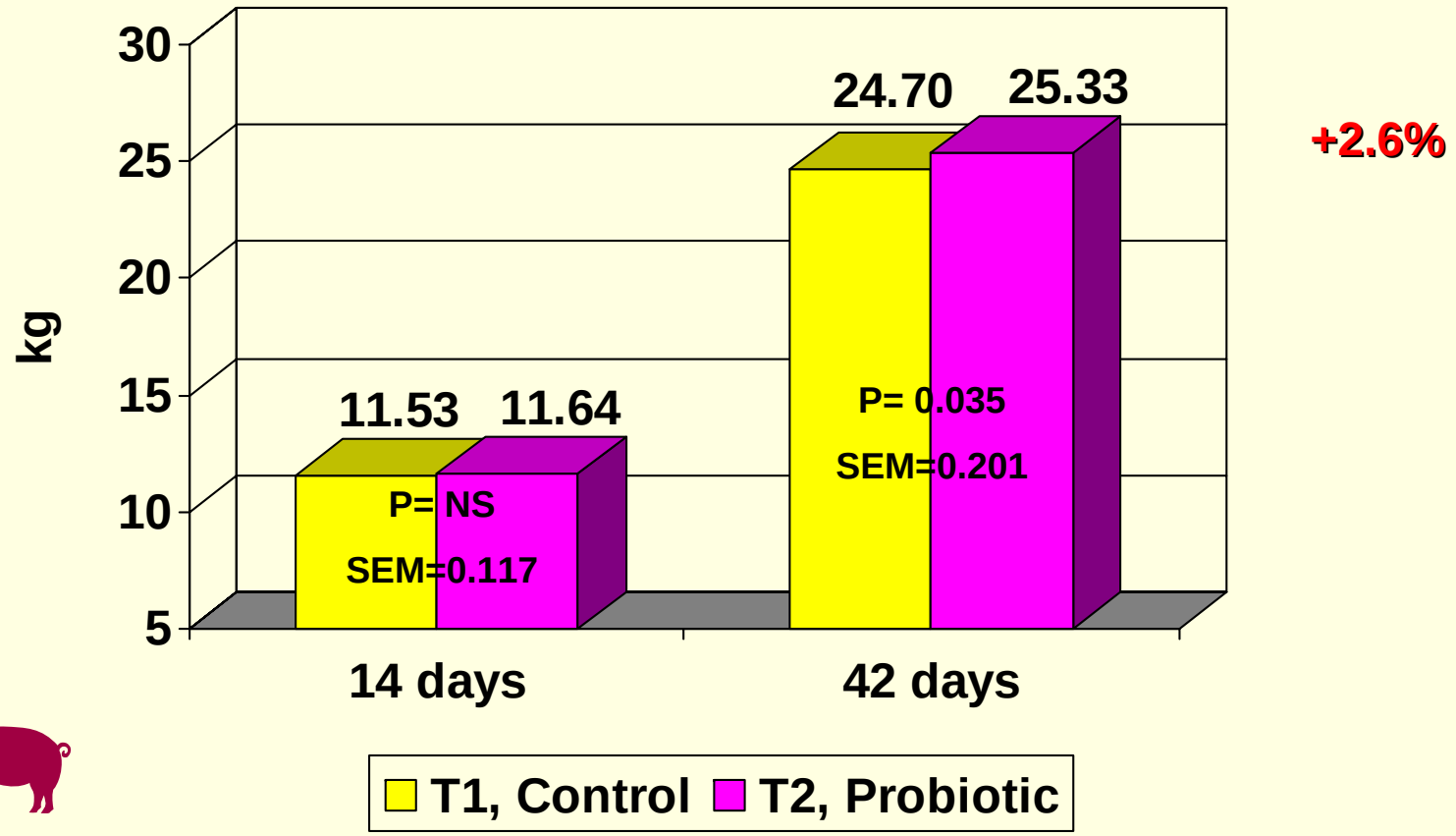
- Meta-analysis
  - Definition: statistical analysis of results obtained from individual studies
  - Purpose: combination of the data and integration of results
  - Application: to obtain of a more precise estimate, more reliable information about treatment effects

Materials and Methods

- Statistical analysis
  - Original data used for the analysis
    - Mean body weight, average daily gain, average daily feed intake and feed conversion rate for each replicate
  - Data analyzed by GLM procedure of SAS
    - Main effects: *Probiotic supplementation, experiment* and its interaction

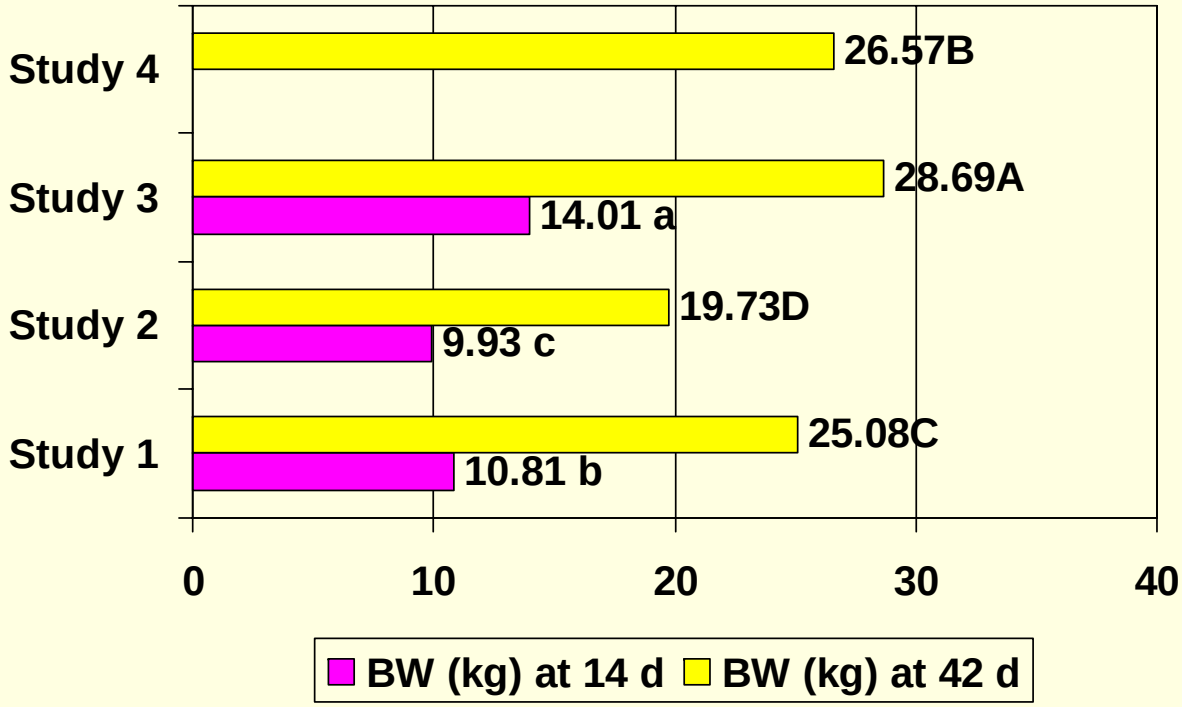
Results: Performance parameters

- Body Weight
  - Main effect: Probiotic supplementation



Results: Performance parameters

- Body Weight.
  - Main effect: Study[1]



[1] Different capital letters shows statistical differences (P<0.050) between studies for BW at 42 days
Different lower case letters shows statistical differences (P<0.050) between studies for BW at 14 days

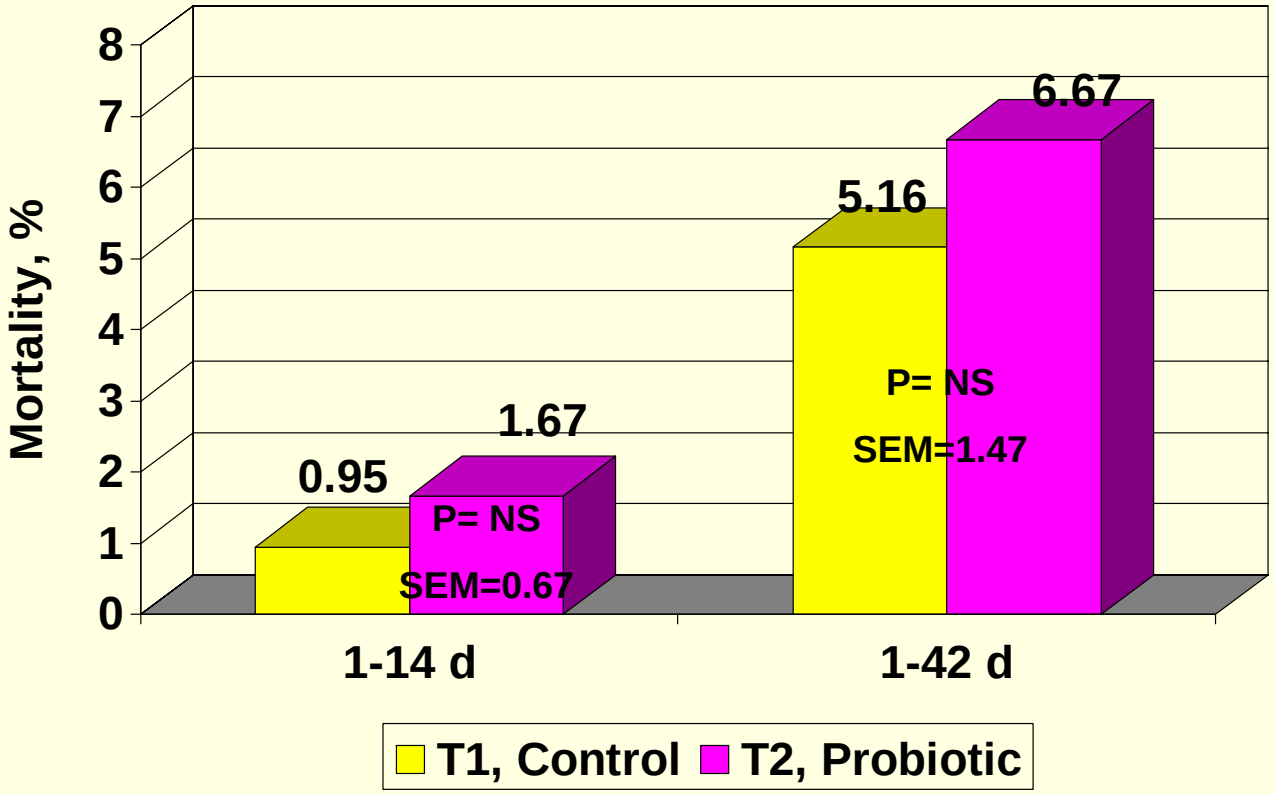
Results: Performance parameters

- Interaction Study x Treatment
  - More effect of the probiotic supplementation in studies 3 and 4

Treatment x Study[1]		**Body weight (g)**	
		14 d	**42 d**
T1 Control	1 Study 1 (IRTA P-328)	10.85^{c}	25.1^{c}
	2 Study 2 (Imasde PLI+D1151106)	10.14^{de}	20.0^{d}
	3 Study 3 (Milan Cal.Pig.8.4.08)	13.60^{b}	28.1^{b}
	4 Study 4 (Thessaloniki GP3.2008)	--	25.6^{c}
T2 Calsporin®	1 Study 1 (IRTA P-328)	10.77^{cd}	25.0^{c}
	2 Study 2 (Imasde PLI+D1151106)	9.71^{e}	19.5^{d}
	3 Study 3 (Milan Cal.Pig.8.4.08)	14.43^{a}	29.3^{a}
	4 Study 4 (Thessaloniki GP3.2008)	--	27.6^{b}
SEM[2] (n=14, 16)		0.203	0.408
Probability		0.0067	0.0043

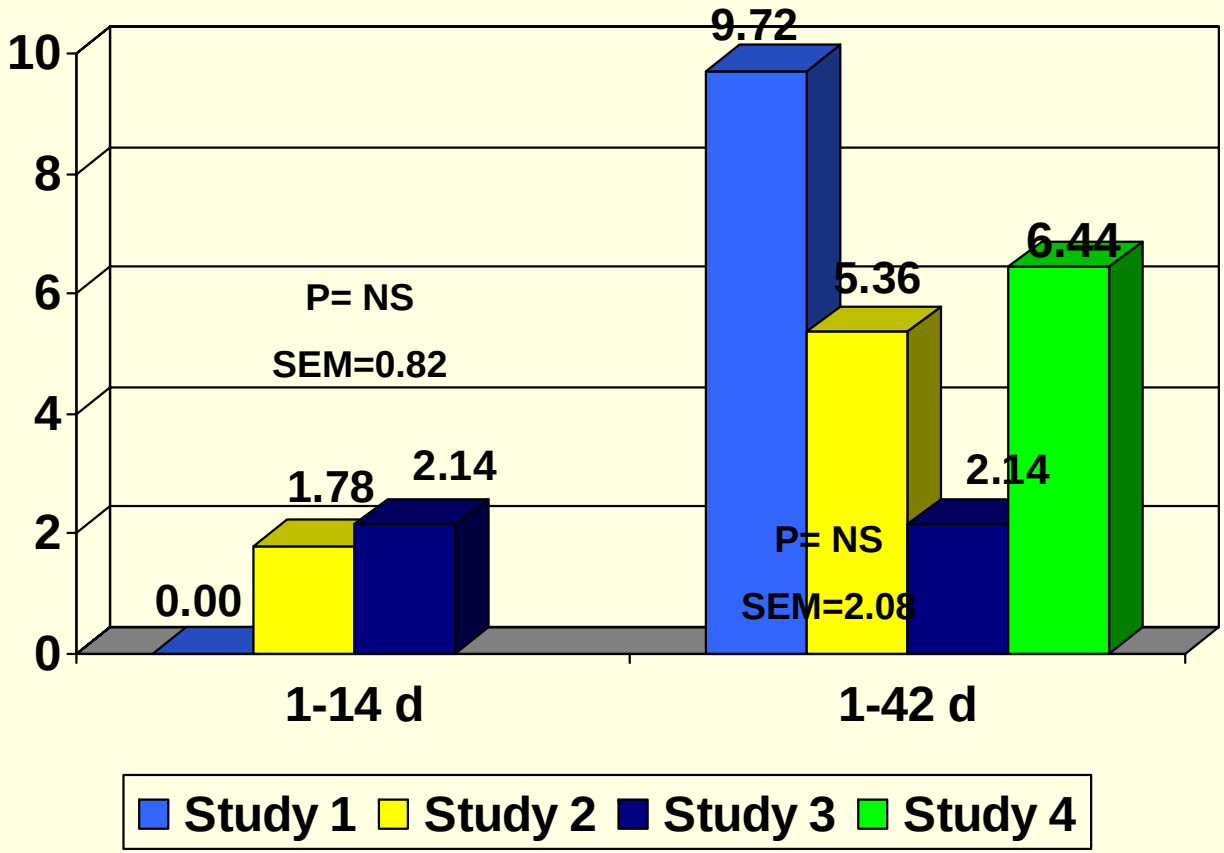
Results: Performance parameters

- Mortality, %
  - Main effect: Probiotic supplementation



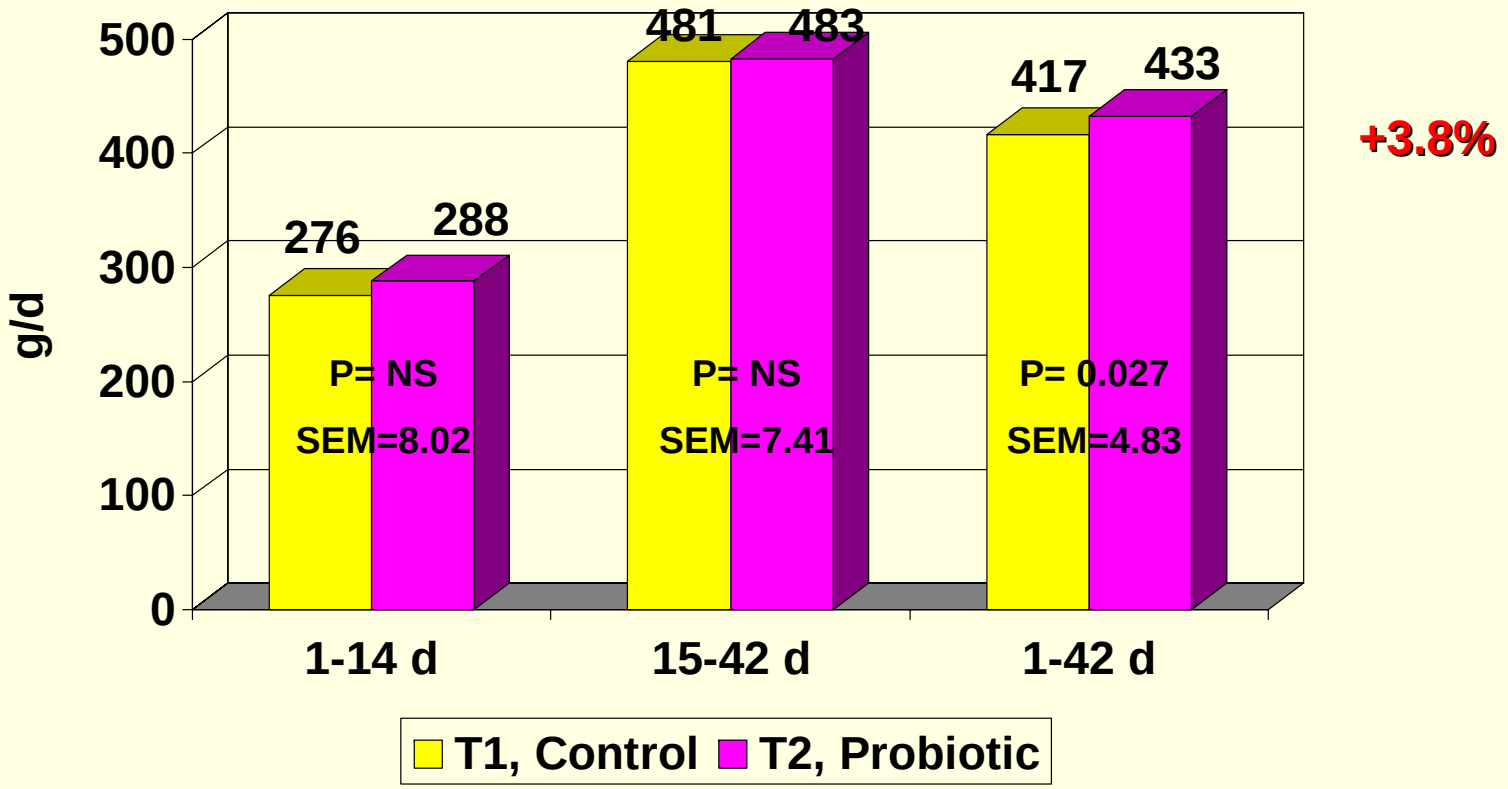
Results: Performance parameters

- Mortality.
  - Study. No effect. No interaction study x treatment



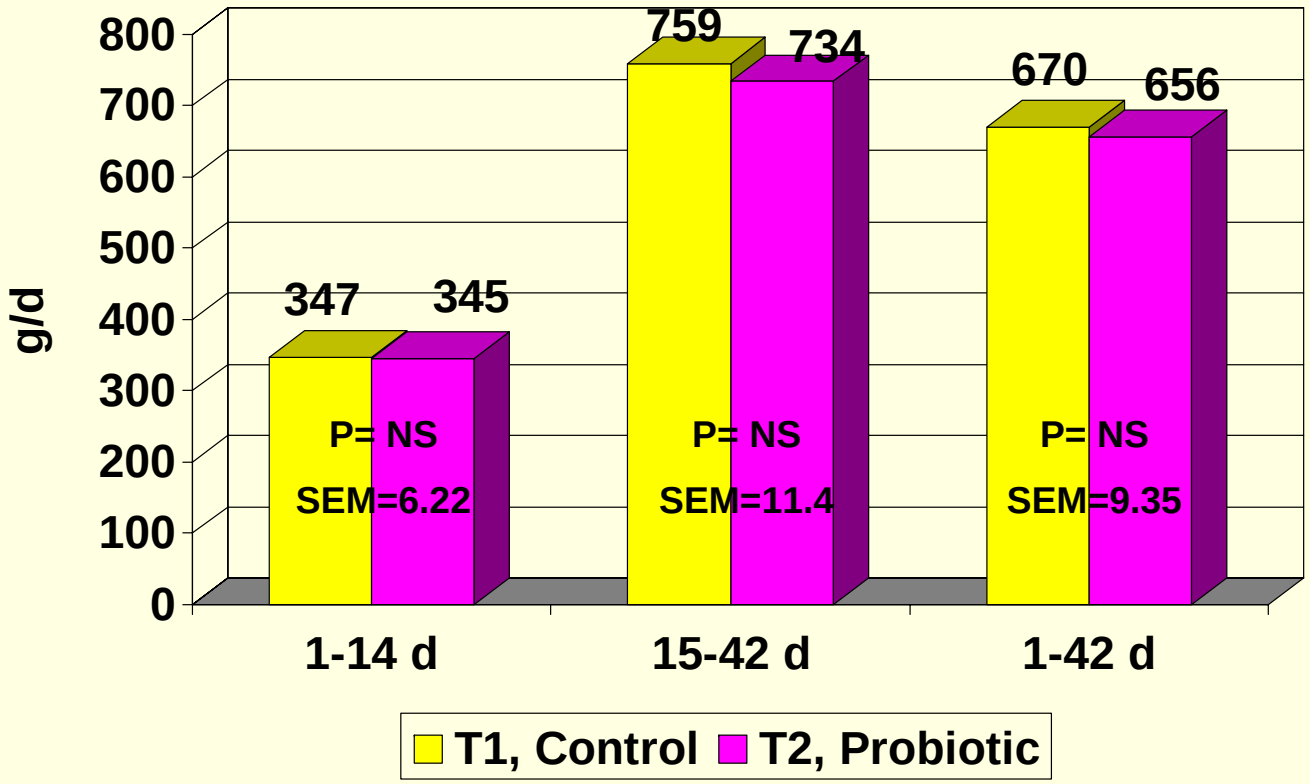
Results: Performance parameters

- Average Daily Gain
  - Main effect: Probiotic supplementation



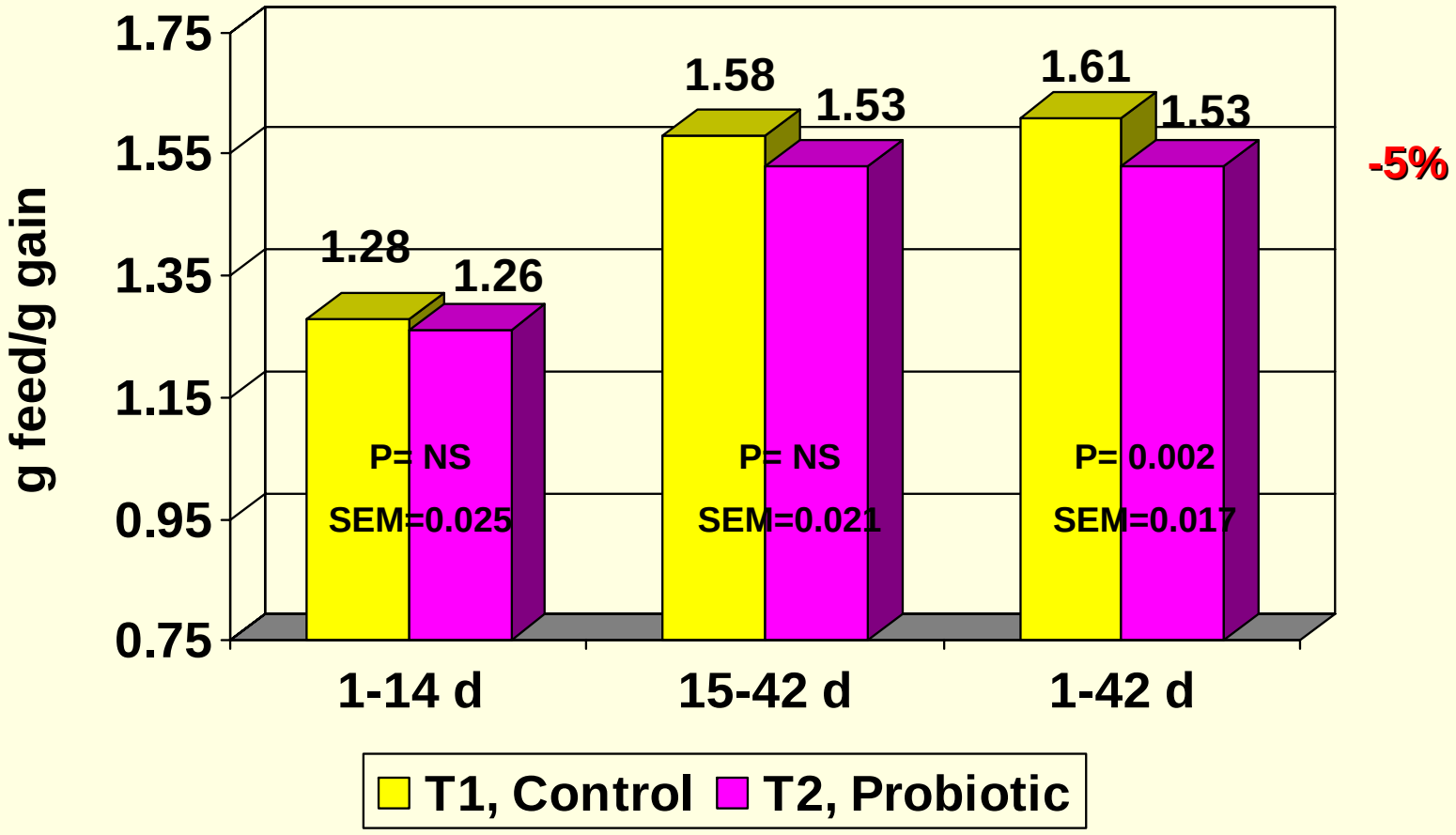
Results: Performance parameters

- Feed consumption
  - Main effect: Probiotic supplementation



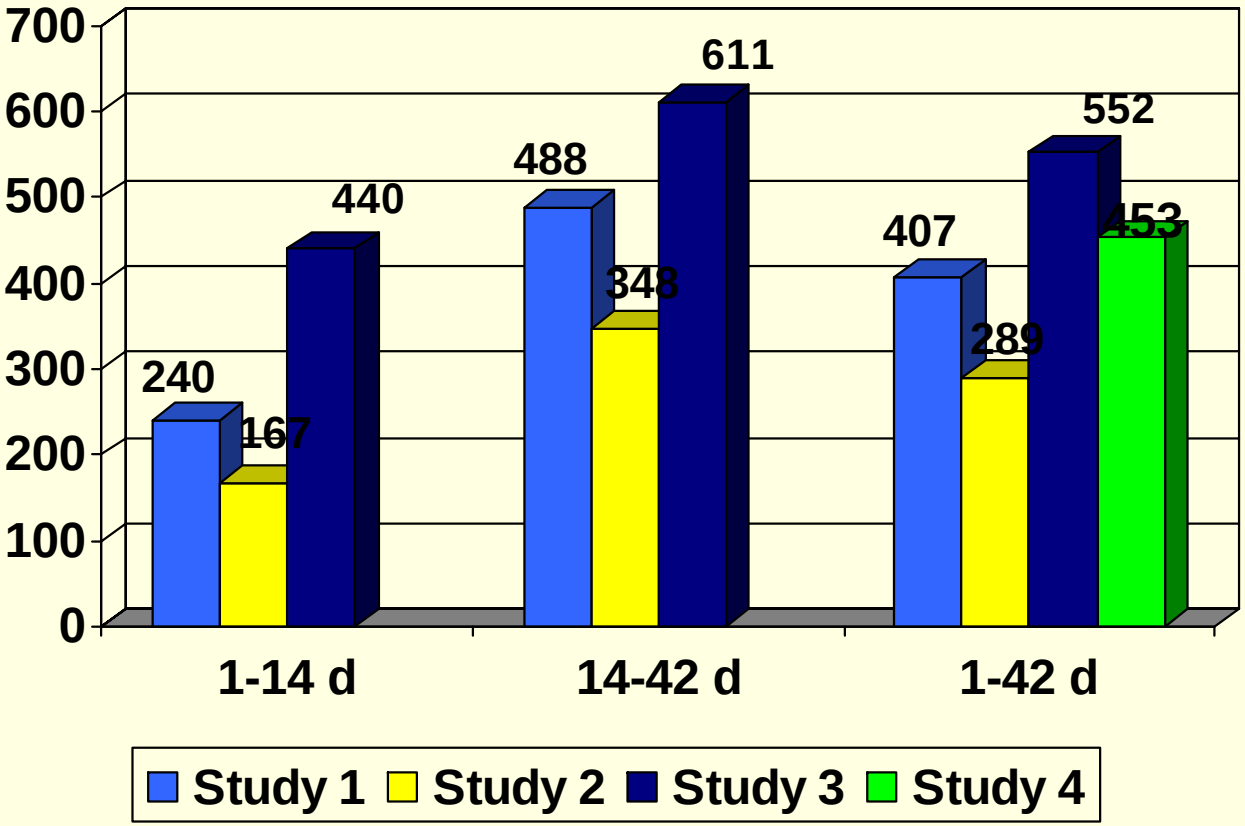
Results: Performance parameters

- Feed Conversion Rate
  - Main effect: Probiotic supplementation



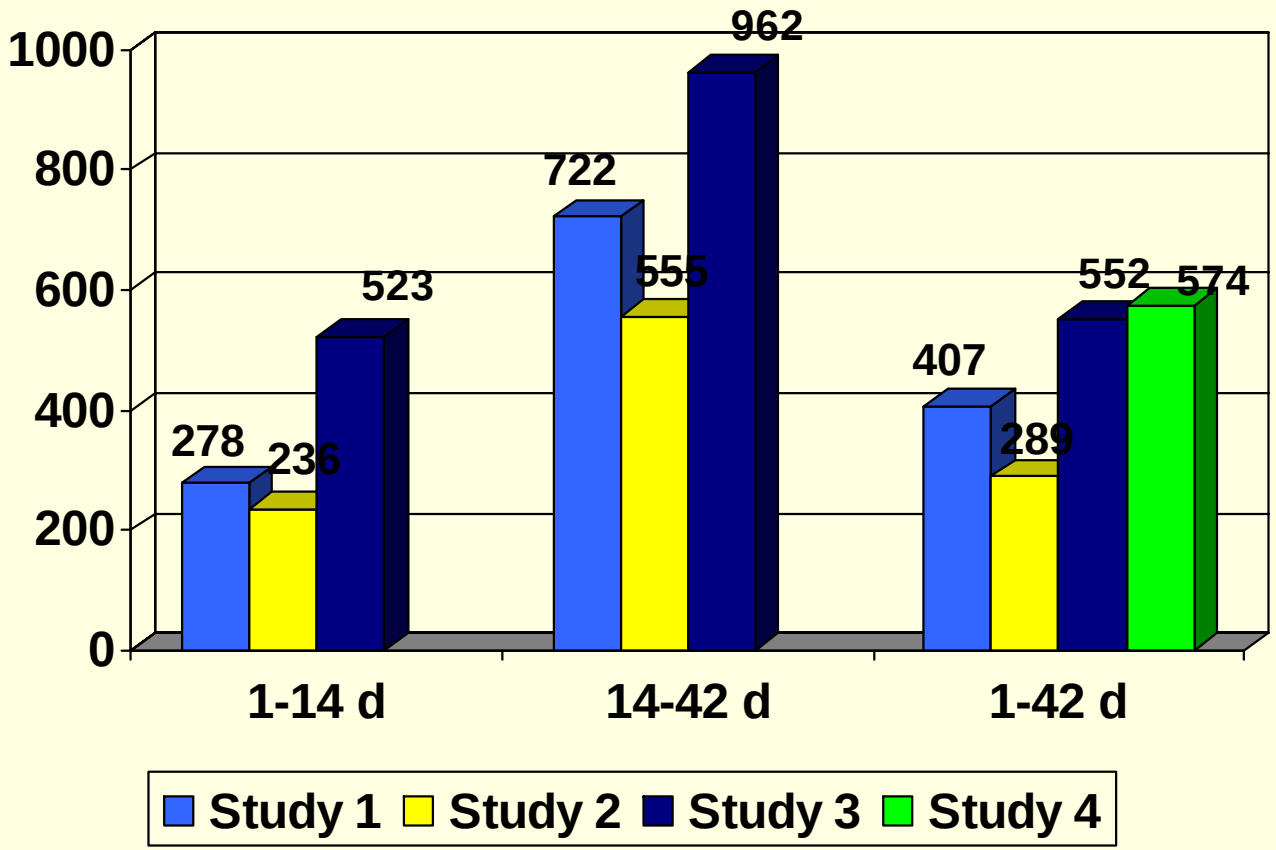
Results: Performance parameters

- Average Daily Gain.
  - Study. All differences were significant P<0.05



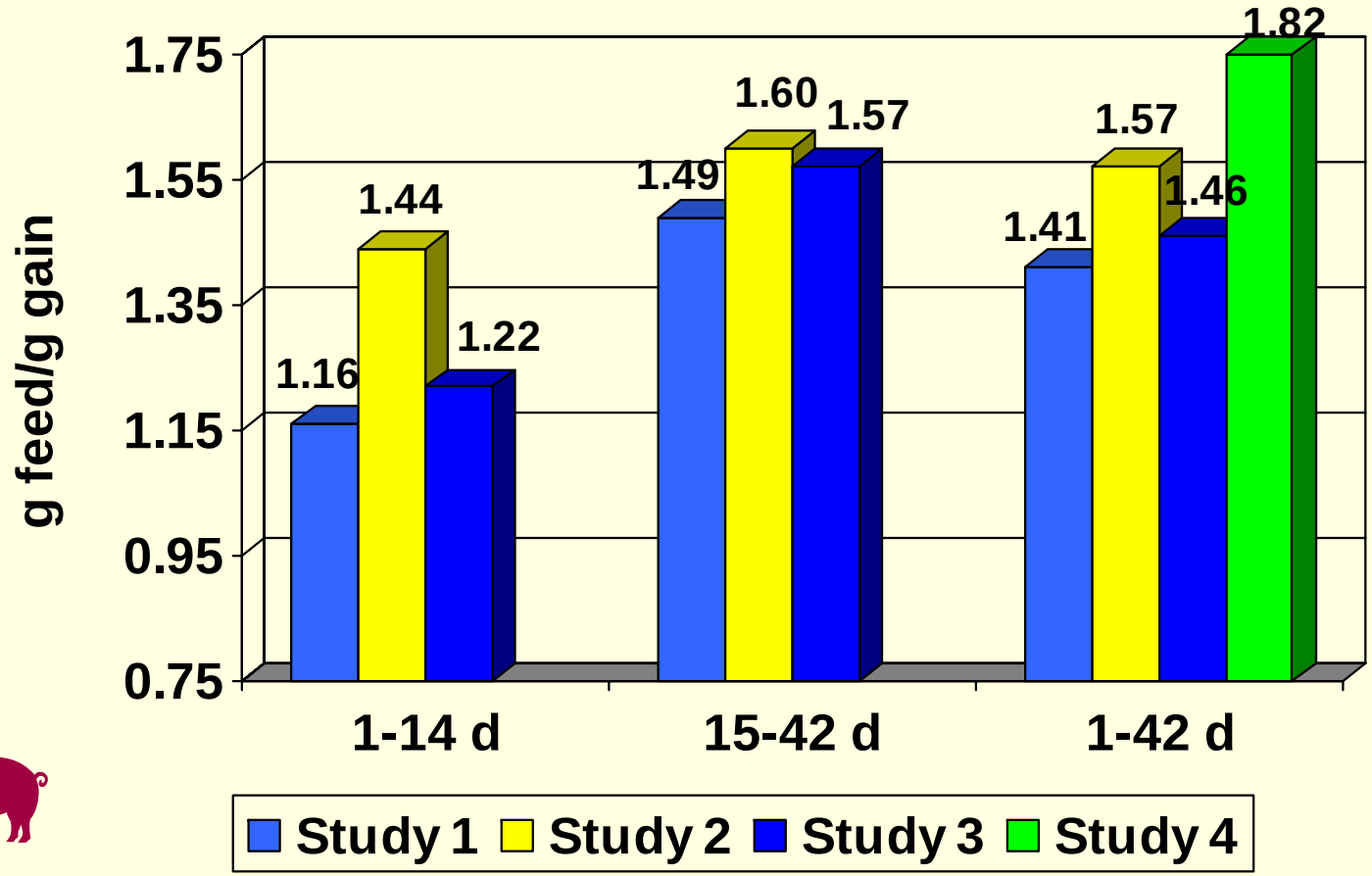
Results: Performance parameters

- Feed consumption.
  - Study. All differences were significant P<0.05



Results: Performance parameters

- Feed Conversion Rate.
  - Main effect: Study. All differences were significant P<0.05



Results: Performance parameters

- Interaction Study x Treatment
  - More effect of the probiotic supplementation in studies 3 and 4

Treatment x Study[1]		1-42 d		
		ADG	FI	FCR
T1 Control	1 Study 1 (IRTA P-328)	409.3^{d}	580.5	1.42^{ab}
	2 Study 2 (Imasde PLI+D1151106)	295.1^{e}	458.8	1.56^{c}
	3 Study 3 (Milan Cal.Pig.8.4.08)	534.3^{b}	813.8	1.52^{bc}
	4 Study 4 (Thessaloniki GP3.2008)	429.4^{d}	827.2	1.93^{e}
T2 Pro-biotic	1 Study 1 (IRTA P-328)	403.9^{d}	567.1	1.40^{a}
	2 Study 2 (Imasde PLI+D1151106)	282.3^{e}	442.1	1.58^{c}
	3 Study 3 (Milan Cal.Pig.8.4.08)	569.4^{a}	796.0	1.40^{a}
	4 Study 4 (Thessaloniki GP3.2008)	476.3^{c}	816.8	1.72^{d}
SEM		9.81	18.99	0.035
Probability		0.0030	0.9966	0.0013

Conclusions

1. The probiotic supplementation of diets at 3 x 10^5 CFU/g feed improved body weight of piglets at the end of the trial by 2.6% (P = 0.0351).
2. For the whole study period (from 1 to 42 days of age, encompassing both prestarter and starter feeds) piglets fed the probiotic diets grew 3.8% more (P = 0.027) and converted 5% better (P = 0.002) than control pigs.

Conclusions

3. Study x diet interactions were detected for the whole period in ADG and FCR, but they could not be related with any controlled parameter (type of diet, mortality…)
4. These results probably show the real effect of the additive in practical conditions better than analysing the trials one by one.
5. More research is needed to understand the variable response of the animals to probiotic inclusion.

THANKS