

Effect of feed form and delivery on the growth, feed efficiency and carcass quality of grow-finisher pigs

F. O' Meara, A. Torres-Pitarch, T. Ryan, D. Clarke, J. O' Doherty, G. Gardiner, P. Lawlor

Introduction: Feed delivery

- Up to 70% of pigs in Ireland are liquid-fed
- By-products + balancer = cheap balanced diet
- But now...
- Availability / quality?
- Labour saving?
- Liquid feeding vs dry feeding

↑ increased growth

↓ shorter time to slaughter

(Kim et al., 2001, Partridge et al., 1992, Hurst et al., 2008)

- Limited, good quality, information available comparing liquid, dry and wet/dry feed delivery systems, in controlled conditions



Introduction: Feed form

Advantages of pelleting over meal:

↑ Nutrient digestibility and nutrient density per unit volume

↓ Feed wastage during feeding, dustiness

↑ Growth, palatability & improved feed conversion ratio

↑ Improved flow-ability

(Ball et al., 2015, Nemecheck et al., 2015)

↓ Reduced pathogen load?

(Attar et al., 2017, Burns et al., 2015)

Objective

- Compare feed form and delivery methods using a common diet on the growth, feed efficiency and carcass quality of grow-finisher pigs
- Examined in a 2x3 factorial arrangement
- Feed form: Meal and pellets
- Feed delivery: Dry, wet/dry and liquid feeding



Materials and Methods

Meal

Pellets

Dry

Wet/Dry

Liquid

Dry

Wet/Dry

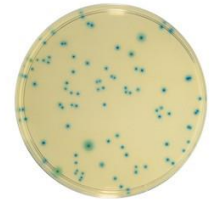
Liquid

Diet: 9.8MJ NE/kg, 9.97g SID lysine/kg – Start weight: ~ 33.6kg



Materials and Methods

- Microbial counts from feed
 - Lactic acid bacteria
 - *Enterobacteriaceae*
 - *E. coli*
 - Yeast
 - Mould
- Feed intake, growth and feed efficiency
- Carcass data



Materials and Methods

- 432 grow-finisher pigs (2 batches)
- 12 pens/treatment (6 pigs per pen)
- 2x 62 day batches
- All treatments were applied in the same house

 Dry meal

 Wet/dry meal

 Liquid meal

 Dry pellets

 Wet/dry pellets

 Liquid pellets



Results: Microbial Counts

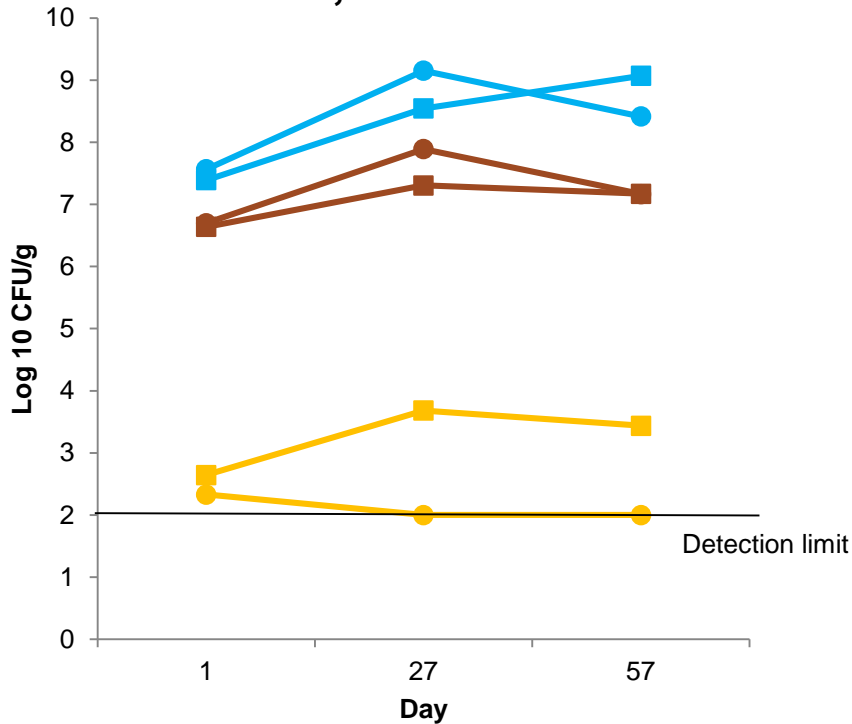


Liquid

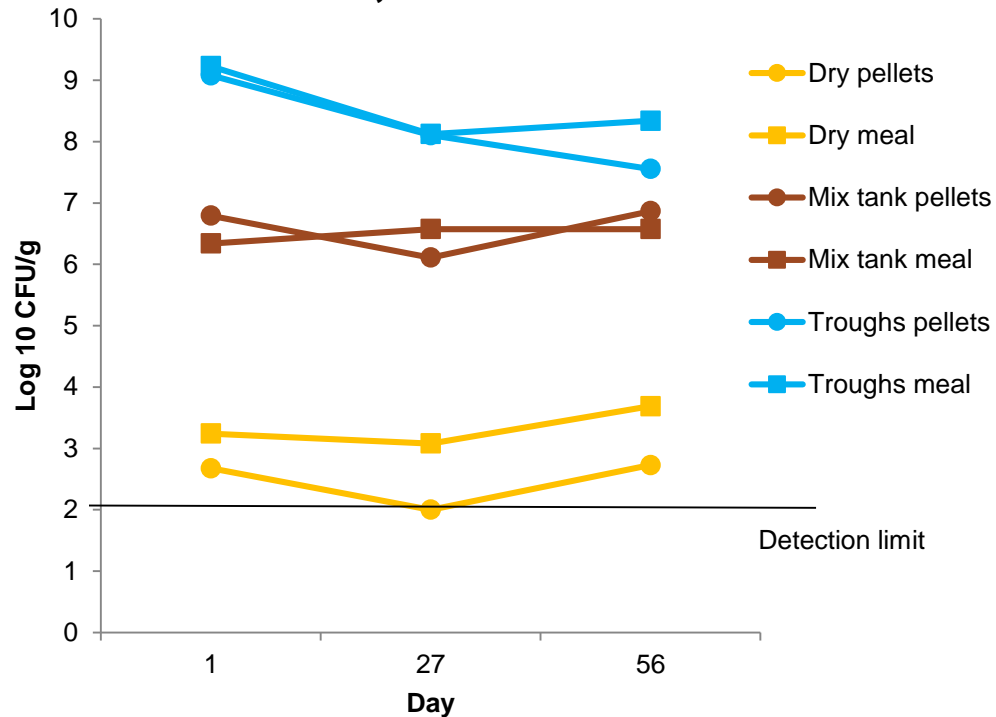
Dry, wet/dry & start of liquid feed mix

Microbial Counts

Batch 1, Lactic acid bacteria



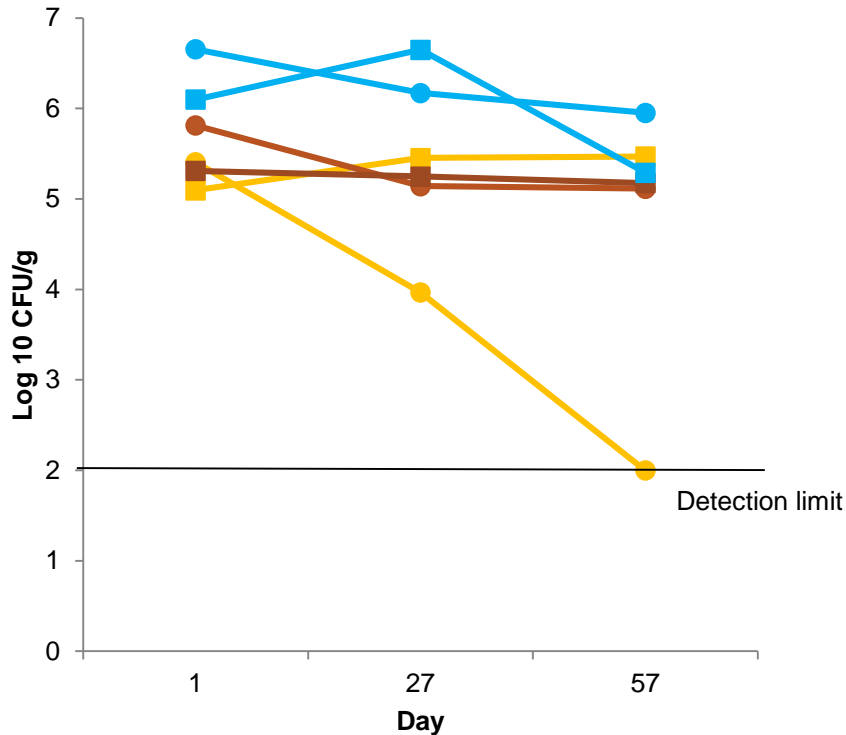
Batch 2, Lactic acid bacteria



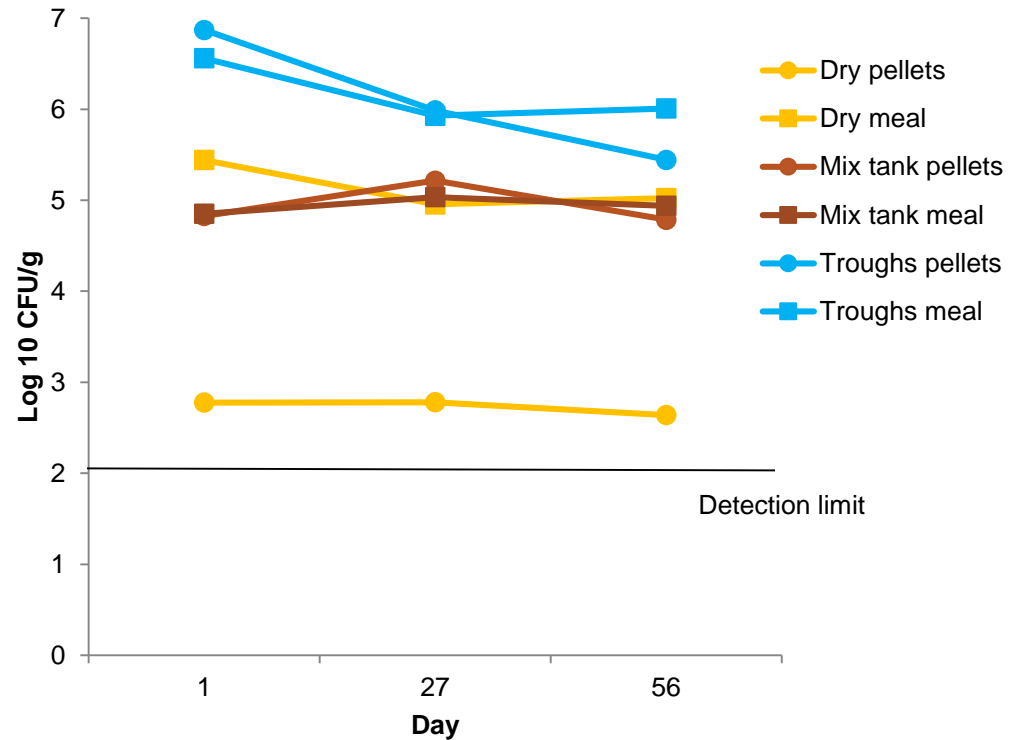
- Dry feed < Mixing tank < Troughs
- Dry feed: Pelleted < Meal

Microbial Counts

Batch 1, *Enterobacteriaceae*

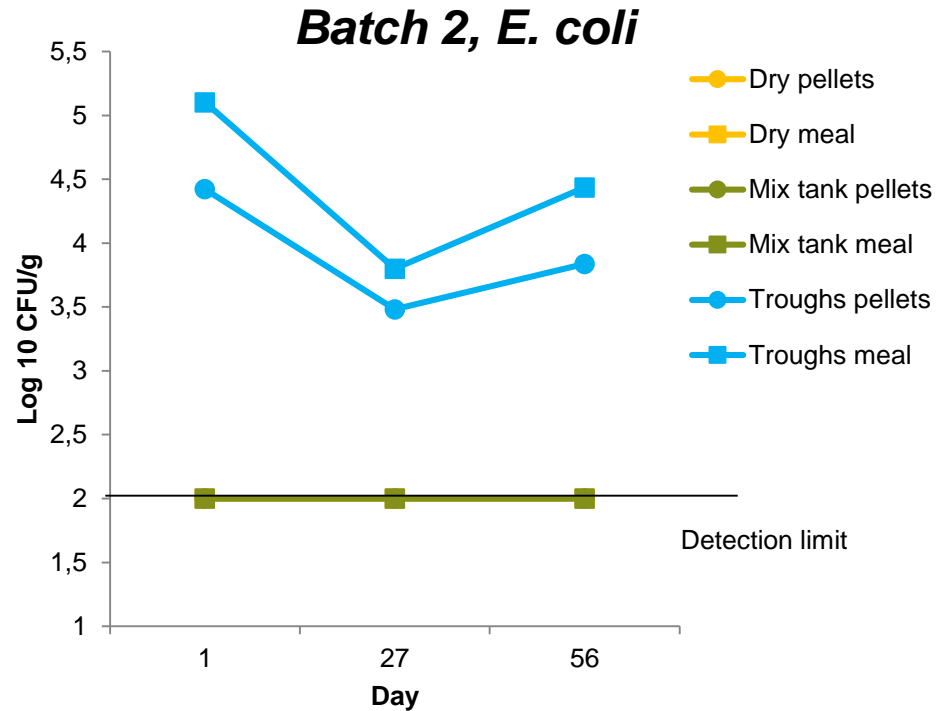
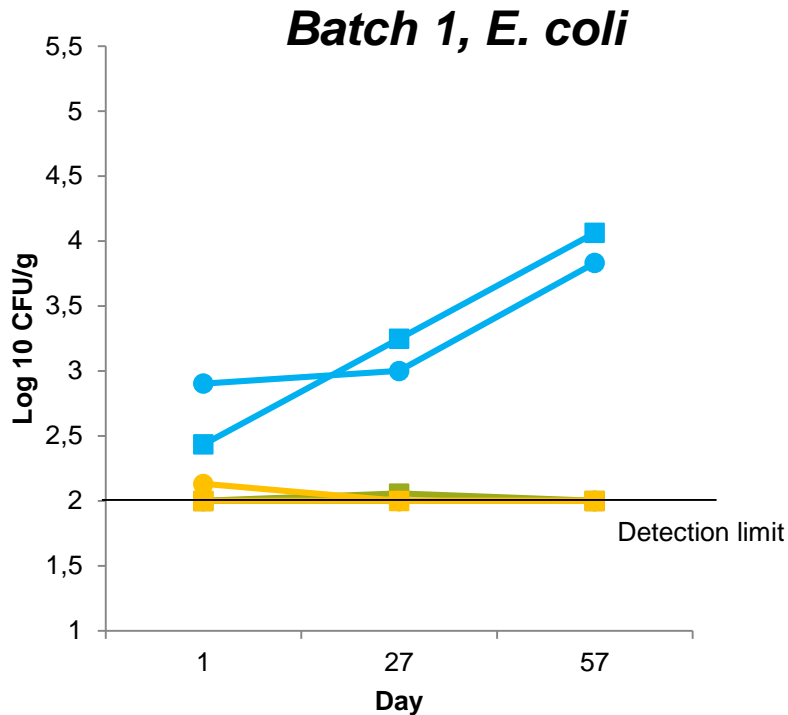


Batch 2, *Enterobacteriaceae*



- Highest in troughs, intermediate in mixing tanks
- Dry feed: Pelleted < Meal

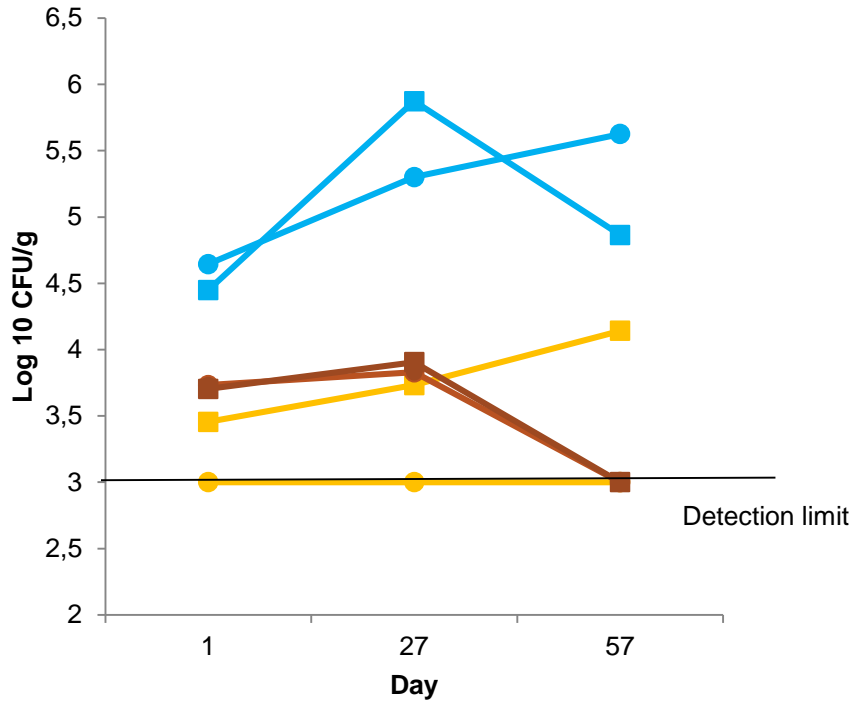
Microbial Counts



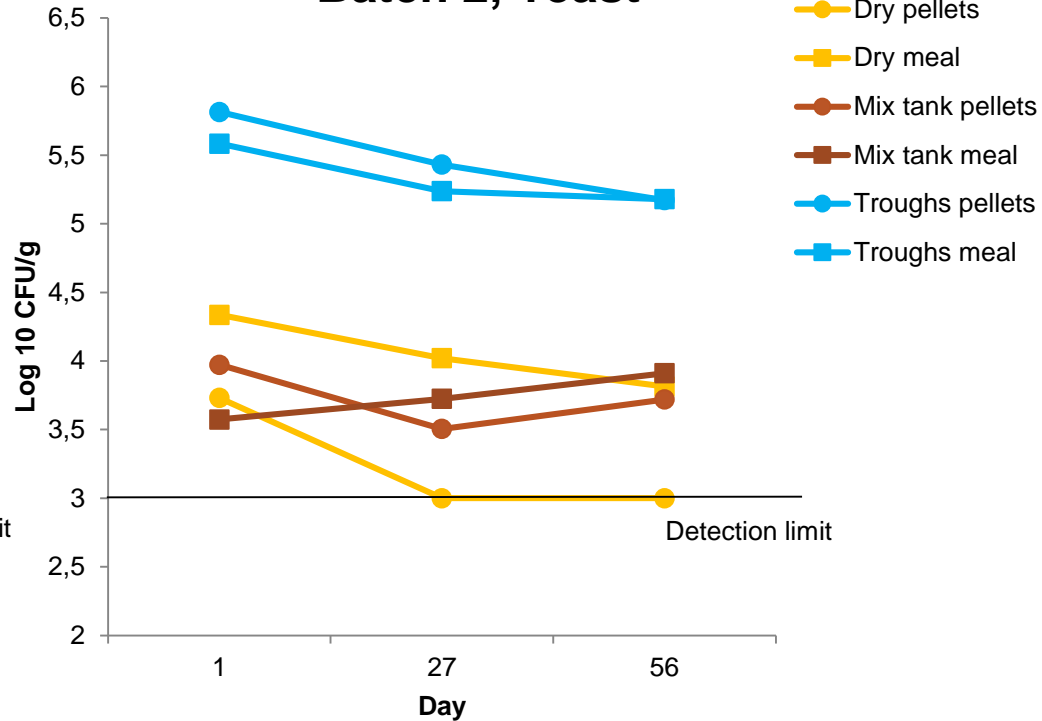
- Troughs – faecal contamination?
- At or below detection limit in all other samples

Microbial Counts

Batch 1, Yeast



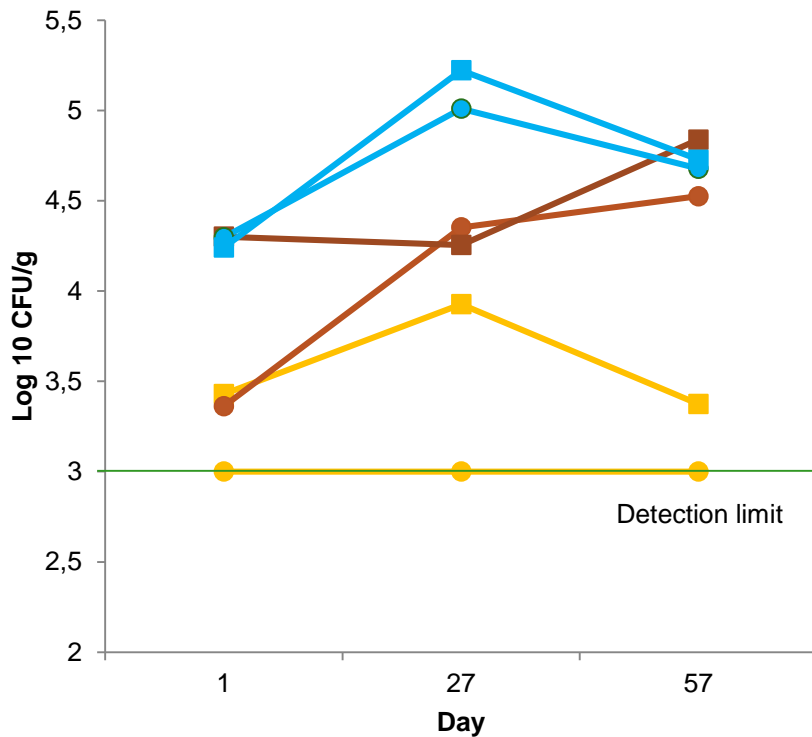
Batch 2, Yeast



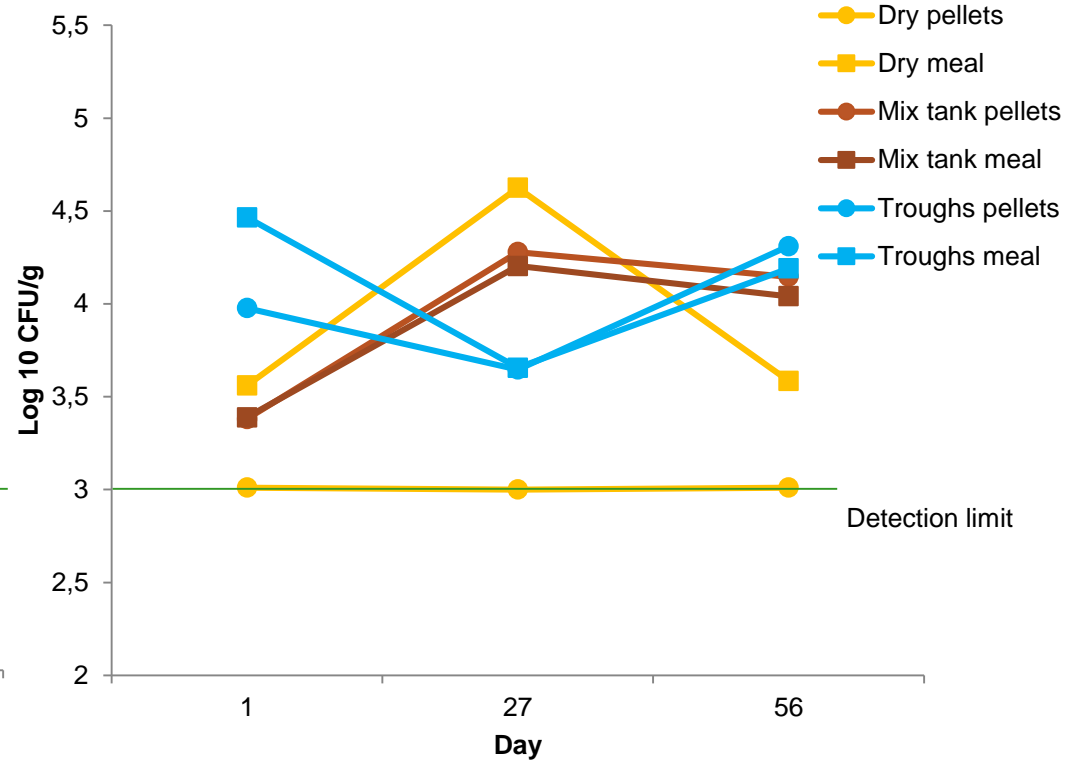
- Highest in troughs
- Temperature good for yeast growth

Microbial Counts

Batch 1, Mould



Batch 2, Mould

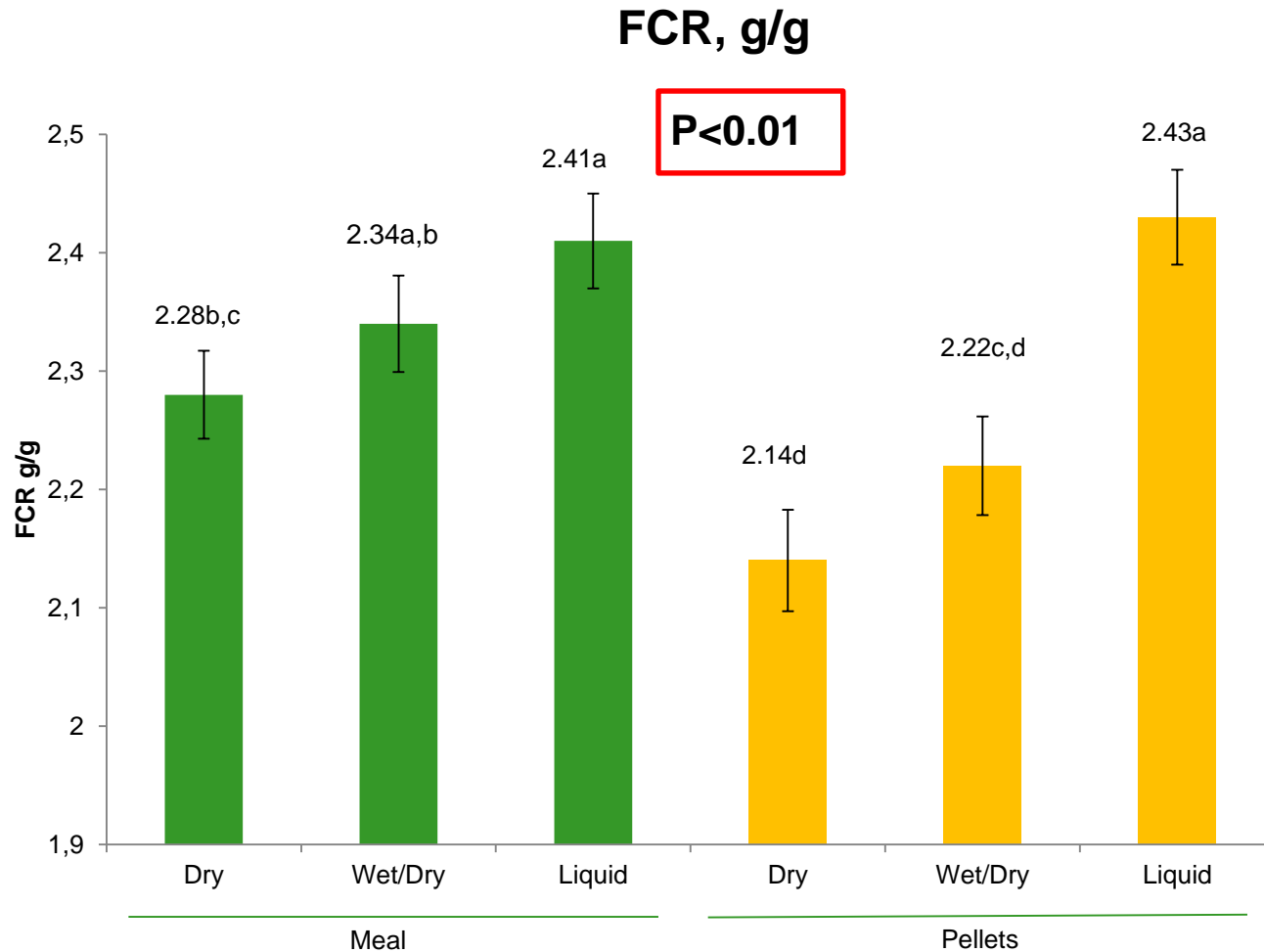


- Variable counts
- Batch variation? Hotspots?
- Pelleting the diet reduced mould (dry)

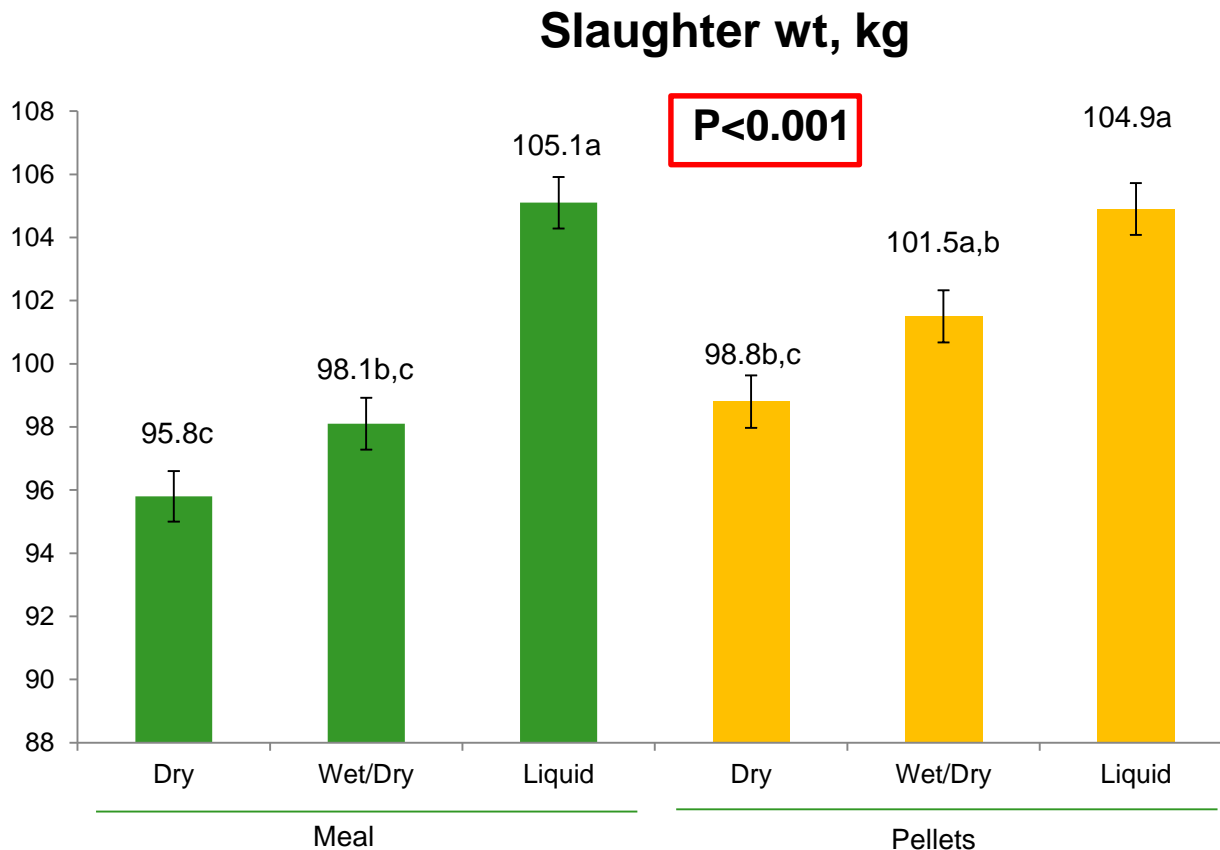


Results: Statistical Analysis

Form*Delivery Interaction

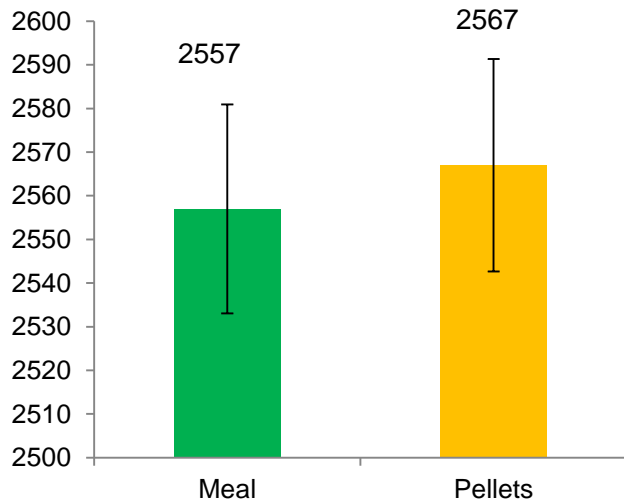


Form*Delivery Interaction

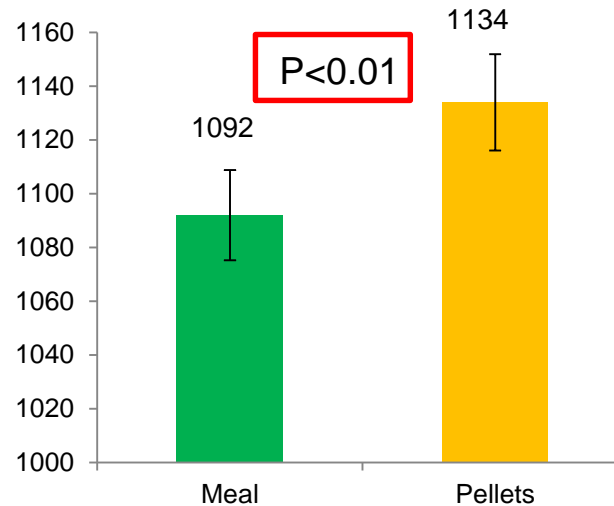


Main effects, Feed Form

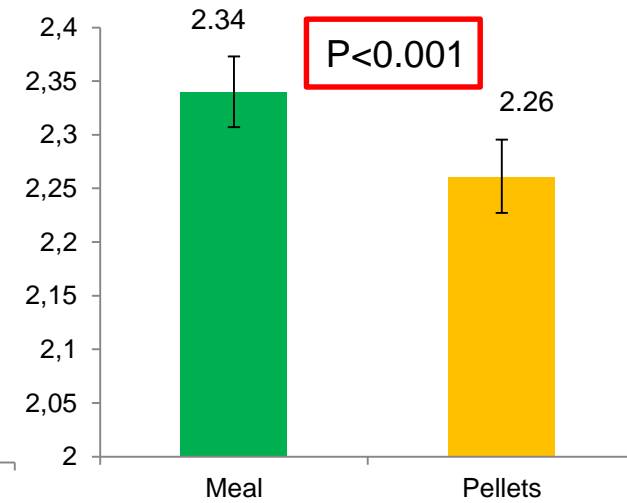
ADFI (g/day)



ADG (g/day)

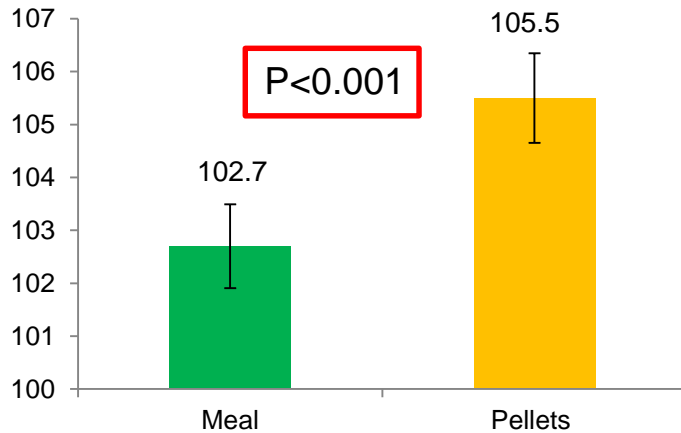


FCR (g/g)

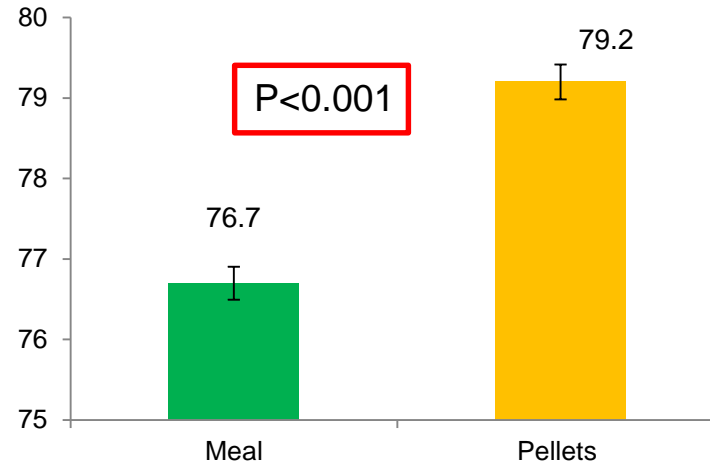


Main effects, Feed Form

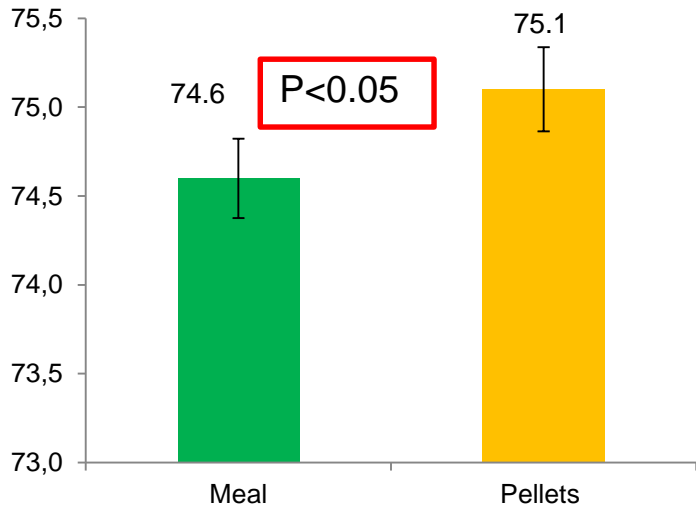
Live-weight (kg)



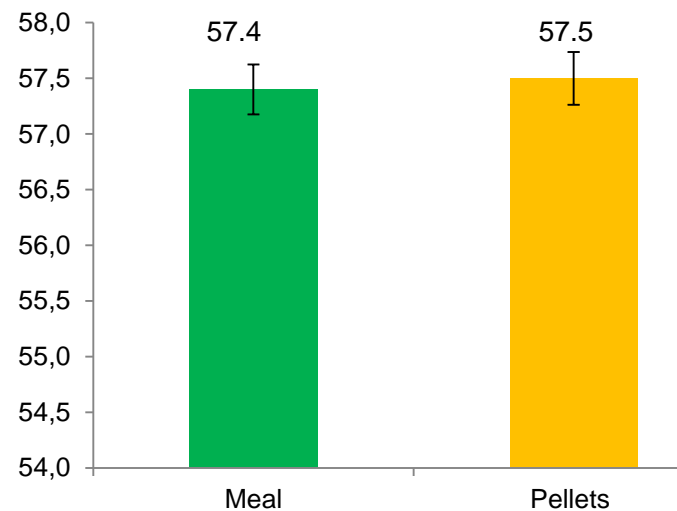
Carcass weight (kg)



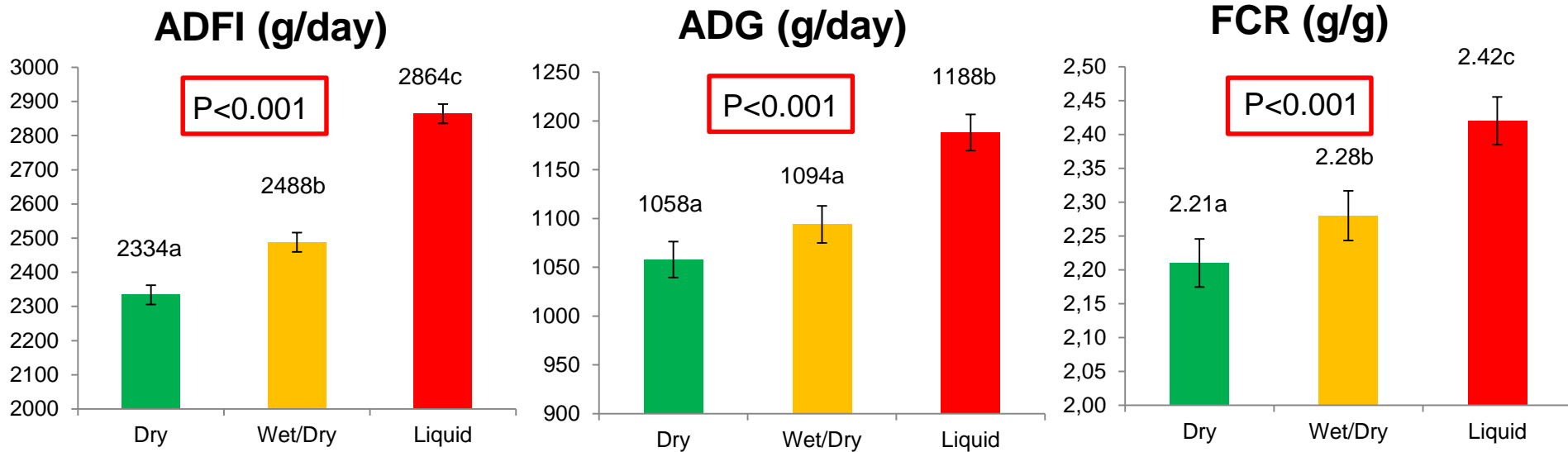
Kill out (%)



Lean meat (%)

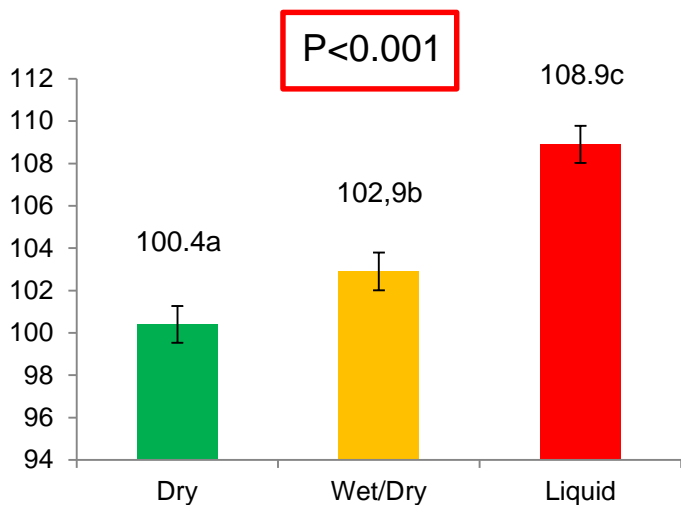


Main effects, Feed Delivery

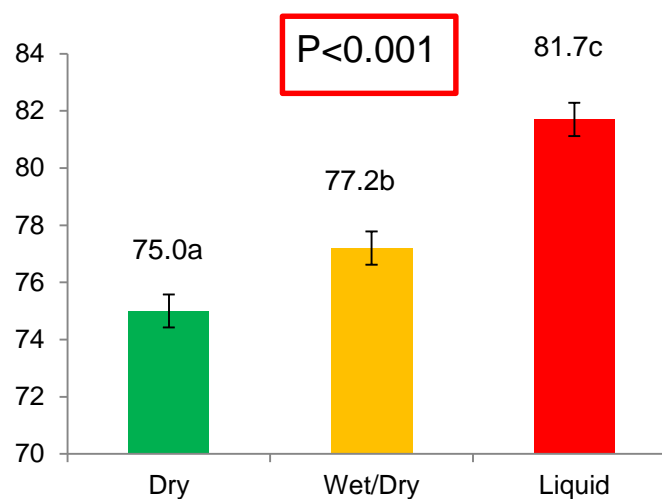


Main effects, Feed Delivery

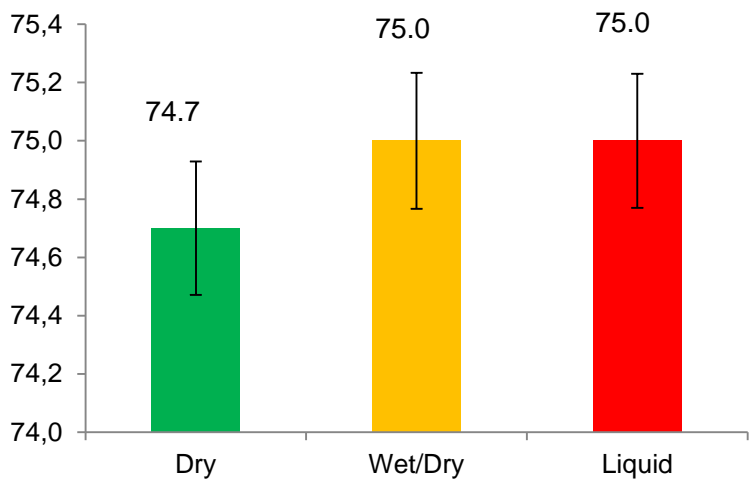
Live-weight (kg)



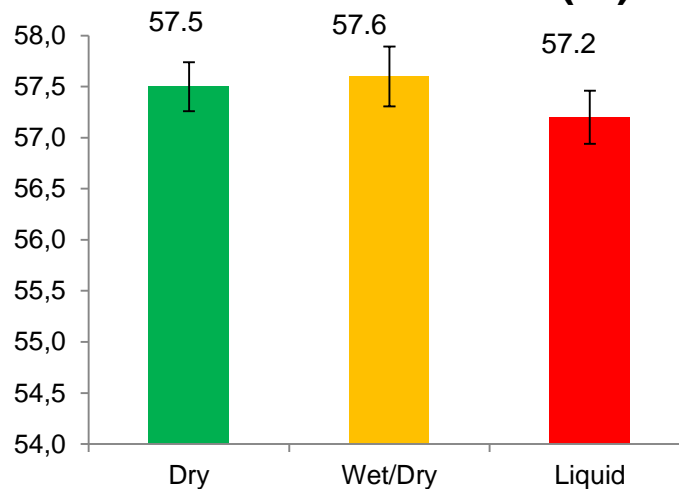
Carcass weight (kg)



Kill out (%)



Lean Meat (%)



Main findings

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Main findings

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- ➔ Dry feeding resulted in better FCR compared with all other methods of feed delivery, especially liquid feeding
- ➔ Overall, in dry form, pelleted diets had lower *Enterobacteriaceae*, *E. coli*, yeast and mould counts
- ➔ Data pending, ongoing analyses will help to further explain results

Conclusions

- If maximising growth rate is a priority, liquid feeding is preferable
- If maximising feed efficiency is a priority, dry feeding a pelleted diet is preferable
- Pelleting reduces the pathogen load of dry feed & increases growth rate over meal feeding

Acknowledgements

- Farm staff and technicians in Pig Development Department, Teagasc

- Project partners:



- Industry partners:



Big Dutchman

- Funding body:



SUPPLEMENTARY SLIDES

Industry Application

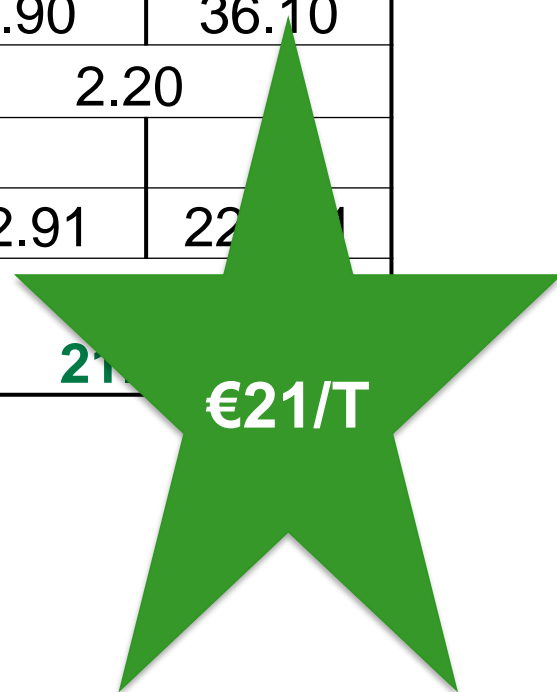


- If Dry or Wet/Dry feeding:
 - ➔ Feeding a pelleted diet is worth €20-21/tonne of feed
- If finishing pigs to a target slaughter weight and space is not an issue:
 - ➔ Dry and Wet/Dry feeding will increase margin over feed by €3.47 and €2.62 /pig, respectively
- If space is an issue and maximising growth is essential:
 - ➔ Liquid feeding will increase margin over feed per pig by €0.30/pig

Cost Benefit of Pelleting

1. To a target slaughter weight of 105kg

	Meal	Pellet
Final weight (kg)	105	105
Margin over feed (€/pig)	33.90	36.10
Benefit of feeding pellets (€/pig)	2.20	
Margin over feed (€/tonne of feed)	202.91	223.11
Benefit of feeding pellets (€/tonne of feed)	21	



Cost Benefit –

2. Finishing over a fixed number of days

	Meal	Pellet
Final weight (kg)	102.7	105.5
Margin over feed for period (€/pig)	32.91	36.33
Benefit of feeding pellets (€/pig)	3.42	
Margin over feed (€/tonne of feed)	203.53	206.6
Benefit of feeding pellets (€/tonne of feed)		



€20/T

Cost Benefit –

1.To a target slaughter weight of 105kg

	Dry	Wet/Dry	Liquid
Final weight (kg)	105	105	105
Margin over feed for period (€/pig)	36.44	35.59	32.98
Benefit of dry over liquid feeding (€/pig)	3.47		
Benefit of wet/dry over liquid feeding (€/pig)		2.62	

Cost Benefit –

2. Finishing over a fixed number of days

	Dry	Wet/Dry	Liquid
Final weight (kg)	100.4	102.9	108.9
Margin over feed for period (€/pig)	34.30	34.64	34.60
Benefit of dry over liquid feeding (€/pig)	-0.30		
Benefit of wet/dry over liquid feeding (€/pig)		0.04	

Results: Interaction

FORM*DELIVERY

	Dry meal	W/D meal	Liq meal	Dry pellets	W/D pellets	Liq pellets	SEM	P-value
ADFI, g/day	2343	2472	2855	2325	2504	2873	38.7	0.7845
ADG, g/day	1029 ^b	1058 ^b	1188 ^a	1086 ^b	1130 ^a	1187 ^a	23.1	0.084
FCR, g/g	2.28 ^{b,c}	2.34 ^{a,b}	2.41 ^a	2.14 ^d	2.22 ^{c,d}	2.43 ^a	0.043	0.0108
Initial wt, kg	33.5	33.7	33.6	33.8	33.6	33.7	0.83	1
Slaughter wt, kg	95.8 ^c	98.1 ^{b,c}	105.1 ^a	98.8 ^{b,c}	101.5 ^{a,b}	104.9 ^a	0.83	<.0001

Results: Interaction

FORM*DELIVERY

	Dry Meal	W/D Meal	Liq meal	Dry pellets	W/D pellets	Liq pellets	SEM	P-value
Liveweight,kg	98.1	101.0	108.9	102.8	104.8	108.8	1.08	0.0074
Carcass wt, kg	73.1	75.7	81.3	76.8	78.8	82.1	0.74	0.0525
Kill out, %	74.6	74.9	74.5	74.8	75.1	75.5	0.29	0.1915
Muscle depth, mm	51.1	51.2	51.0	51.1	52.0	52.2	0.62	0.3942
Fat depth, mm	12.1	12.4	12.3	12.1	12.0	12.9	0.51	0.3923
Lean meat, %	57.5	57.3	57.4	57.6	57.8	57.0	0.42	0.4642

Pelleting method

- Step 1, Conditioning: Feed subject to steam and pressure prior to pelleting, important to produce good quality pellets with low levels of fines (*Lawlor et al., 2000*)
- Step 2: Feed is forced through the die of the pelleting machine to give a frictional heating effect (*Lawlor et al., 2000*)
- 3mm pellets manufactured at Moorepark feed mill at 55-60° C

Feeder Space

- 'We concluded that 12 pigs can be fed from a single-space feeder without affecting productivity' (*Gonyou and Lou, 2000*)
- Advised feed space per pig:
 - *Ad-libitum* feeding: 7.5cm per pig
 - Restricted feeding: 30cm per pig

My space allowance:

- Single-space feeders: 30.48cm @ 6 pigs/pen = 5.08cm/pig
- Double-space feeders: 60.96cm @ 6 pigs/pen = 10.16cm/pig

Feeder Space

- 'The general rule of thumb is that **2 inches** per pig space are needed for conventional dry and tube feeders, with 1 inch per pig space needed for wet-dry feeders.' (De Rouchey and Richert, 2010)
- Single space wet/dry feeder: 12 inches /6 pigs=2 inches per pig
- Double space dry feeder: 24 inches /6 pigs= 4 inches per pig

Cost Benefit of Pelleting

1.To a target slaughter weight of 105kg

	Meal	Pellet
FCR	2.34	2.26
Initial wt (kg)	33.6	33.7
Kill Out (%)	74.6	75.1
Final weight (kg)	105	105
Feed price (€/tonne)	262	262
Total Feed/ pig (Kg)	167.08	161.14
Total feed cost (€/pig)	43.77	42.22
Price per kg DW (€/kg)	1.40	1.40
Carcass weight increase (kg)	55.48	55.94
Value of increased Carcass weight (€)	77.67	78.31
Margin over feed (€/pig)	33.90	36.10

Table 1. Calculated chemical composition of the basal diet

Nutrient	Content
DM, g/kg	875.138
Protein, g/kg	170
Ash, g/kg	43.332
Fat, g/kg	25.656
Fibre, g/kg	36.878
Starch + Sugar, g/kg	480.755
Sugar, g/kg	34.277
Starchew g/kg	446.478
NDF, g/kg	132.313
ADF, g/kg	42.49
DE Pig, MJ/kg	13.814
NE IFIP, MJ/kg	9.8
Lysine, g/kg	11
SID LYSpig, g/kg	9.97
SID M+C as % LYS	60
SID THR as % LYS	67.393
SID TRP as % LYS	20.013
SID LYS/MJDE	0.722
Ca, g/kg	6.585
Phosphorus, g/kg	4.065
Digestible P, g/kg	2.554
Na, g/kg	1.321

Table 2. Ingredients of the diet

Ingredient, kg/tonne	Basal diet
Barley	382.67
Wheat	400
Soya Hi-Pro	183.01
Limestone flour	11
Lysine HCl (78.8)	3.75
Mono DiCal Phos	1.0
Salt feed grade	3.0
L-Threonine (98)	1.7
Fat, soya oil	9.69
Vit-Min Mpk Finisher	1.0
DL-Methionine	0.93
Celite	2.0
L-Tryptophan	0.15
Natuphos	0.1