Nutrition and management of the newly weaned pig

Spring Producer Meetings

Alberta
April 2013

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Nutrition group, PSCI

Nutrition Program

"The ultimate goal for the Nutrition Research Program at Prairie Swine Centre is to assist in the development of optimum feeding strategies that not only enable swine producers to enhance pork quality but also allows their businesses to be successful and sustainable"

Nutrition and management of the newly weaned pig

Weaning

Natural weaning

- shift from reliance on milk to other food
- occurs usually 12 to 17 weeks of age
- sow begins to spend more time away from piglets

At weaning, a piglet experiences a different ;

- Diet
  - Nutrients, composition, form, temperature
- Environment
  - Pen, penning, flooring
  - Temperature
  - Humidity
  - Feeder and waterer
  - Immune challenges
- Social environment
  - Pen-mates
  - No access to sow

Weaning age

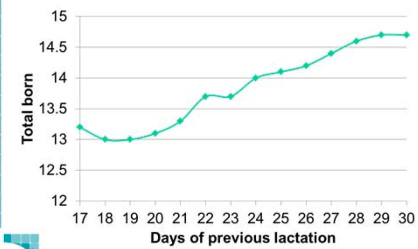
Theoretically:

$$\text{Litters/sow/year} = \frac{365}{\text{Gest} + \text{WI} + \text{Lact}}$$

Gest = gestation
WI = weaning interval
Lact = lactation interval

If Lact = 21 then LSY = 2.58
If Lact = 28 then LSY = 2.48

Effect of the duration of lactation on total born in the following litter



22,000 sows
10 farms

Oliva, J. (Spain) www. Pig333. 2009

Increasing weaning age improves pig performance in a multisite production system

	Weaning age				
	12	15	18	21	P < (linear)
Day 3 pre wean wt, kg	3.42	4.26	4.89	5.75	0.001
Off-test wt, kg	104	109	112	117	0.001
ADG, postweaning g	643	671	686	714	0.001
Mortality, %	9.39	7.88	6.80	3.68	0.001
Weight sold per pig weaned, kg	94.1	100.5	104.4	113.1	0.001

Main et al. 2004

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Weight weane					0.001

"…improvements in wean-to-finish growth and productivity observed with increasing wean age …is likely a function of both weight and physiological maturity at weaning…

Main et al. 2004

Lactation and nursery feeding programs which maximize economic returns

Development of diets for low birth-weight piglets which optimize net returns to the producer

- Light-weight piglets
  - always "lag behind"
  - contribute to variability in grow-out
  - Some piglets do not eat for at least 24 hours post-weaning
- Should a diet be formulated specifically for the light weight piglet?
- Is the problem nutrients? or access to feed?

- 2 diets, complex and simple
- 3 feeding regimes
  - a) complex 0 to 1, simple d 2-14
  - b) complex 0 to 4, simple d5-14
  - c) simple 0 to 14
- Two body weights at weaning (26 days of age)
- Creep or no creep

Phase 1 diets

Ingredient	Simple	Complex
Wheat	29.860	24.201
Soymeal	25.000	16.900
Peas	10.000	10.000
Canola meal	7.800	
Corn		20.000
Corn DDGS	20.000	
SD Whey		14.286
SD Plasma		2.500
SD Blood meal		2.500
Menhaden FM		5.000
Canola oil	2.800	1.753
Limestone	0.850	0.700
Monodicalcium	1.150	0.150
PSCI Vitamins	0.600	0.600
PSCI minerals	0.600	0.600
Salt	0.400	0.250
Lysine HCl	0.385	0.020
L-threonine	0.245	0.190
DL methionine	0.090	0.130
LS20	0.100	0.100
choline chloride	0.080	0.080
CuSO4*5H2O	0.040	0.040

The effect of feeding regime on growth in the nursery

		Dietary regime				
Kg/d		A	B	C	SEM	P value
ADG	d 0-1	-0.11	-0.12	-0.20	0.02	0.002
	d 2-4	0.03	0.14	0.06	0.01	<0.001
	d 5-7	0.14	0.13	0.15	0.01	0.21
	d 8 - 14	0.31	0.30	0.33	0.01	0.05
Final BW, kg		10.96	11.25	11.10	0.17	0.14

A- Complex 0 – 1, simple 2-14
B- Complex 0 – 4, simple 5-15
C – Simple 0 - 14

The effect of weaning weight on growth in the nursery

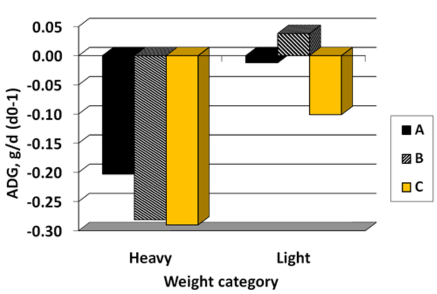
		Weaning weight			
		Heavy	Light	SEM	P <
Body weight		**10.40**	**6.44**	**0.07**	**<0.001**
Kg/d	d 0-1	-0.26	-0.02	0.02	<0.001
	d 2-4	0.07	0.08	0.00	0.04
	d 5 – 7	0.12	0.15	0.01	0.001
	d 8 – 14	0.29	0.34	0.01	<0.001
Final BW, kg		12.73	9.48	0.16	<0.001

Beaulieu et al. 2010

The response of piglets to creep feed in the farrowing room

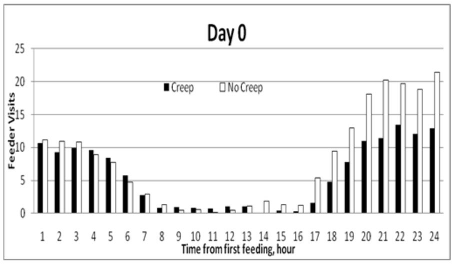
		Creep feed			
Kg/d		**No**	**Yes**	SEM	P <
ADG	d 0 – 1	-0.12	-0.16	0.02	0.36
	d 2 -4	0.08	0.07	0.01	0.43
	d 5 – 7	0.16	0.12	0.02	0.20
	d 8 – 14	0.33	0.30	0.02	0.20
Final BW, kg		8.88	8.96	0.14	0.70

Beaulieu et al. 2010

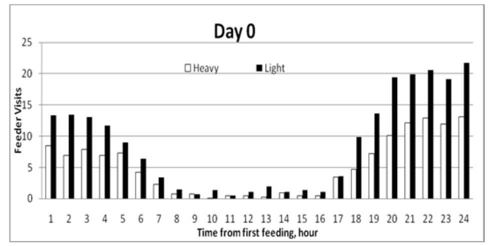


Diet by BW, P < 0.01

Feeder visits were monitored to estimate adaptation to weaning and feed intake



	Creep	No creep	SEM	P =
Day 0	6.3	8.6	0.45	0.02
Day 1	7.0	9.1	0.32	0.04
Day 4	7.4	8.0	0.29	0.12



	Heavy	Light	SEM	P =
Day 0	5.61	9.34	0.44	0.08
Day 1	6.83	9.28	0.32	0.07
Day 4	7.37	8.00	0.27	0.007

Conclusions

- In a "non-competitive" environment light-weight piglets performed equal to their heavier littermates
- Benefits of creep feeding were not maintained
- "Complex" diet didn't improve performance, --in these conditions

In other work….

- Piglets weaned at 3 wk of age
  - Simple or complex diets
  - With or without antibiotics
  - 3 phase feeding program
- "…these results show that feeding antibiotic-free and low complexity diets compromises growth performance during the starter phase, but induces compensatory growth thereafter…"

Skinner et al. 2012
Levesque et al. 2012

However……

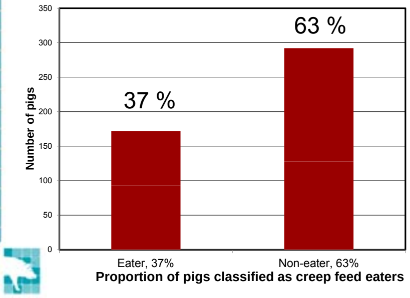
In our experiment, the response to creep feed was based on the response of the litter

We didn't measure creep feed intake, or which pigs consumed the creep feed

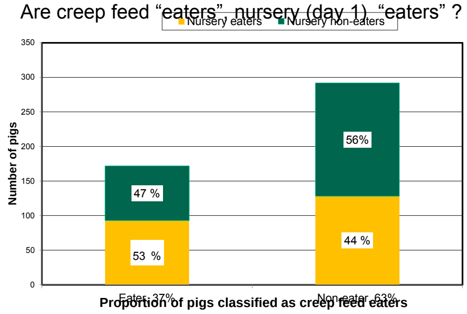
107 sows randomly assigned to creep or no creep. Creep (commercial stage 1) feed supplied from day 21 to weaning (about day 26 post-farrowing)

	Creep	No creep	SEM	P value
N	578	538		
BW, kg				
Birth	1.49	1.47	0.02	ns
Day 21	5.81	6.04	0.08	<0.01
Weaning	7.58	7.74	0.10	0.11

107 sows randomly assigned to creep or no creep. Creep feed supplied from day 21 to weaning (about day 26 post-farrowing)



Are creep feed “eaters” nursery (day 1) “eaters” ?



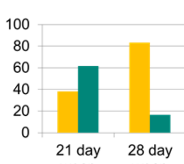
53% of piglets who consumed creep had evidence of phase 1 diet intake 24 hours post weaning, vs. 43 % of non-creep eaters

	Creep-eaters	Creep non-eaters		SEM	P value
N	175	296			
BW, kg					
Birth	1.47	1.45		0.02	ns
Day 21	5.52	5.82		0.08	<0.01
Weaning	7.64	7.61		0.10	0.11
ADG, nursery, kg/d					
Wean to d 3	0.16	0.11		0.02	0.001
Day 4 to d 7	0.15	0.12		0.02	0.006
Day 8 to d14	0.36	0.32		0.02	0.001
Day 15 to exit	0.64	0.61		0.02	0.005
Wean to exit	0.45	0.42		0.01	0.001
BW, kg nursery exit	20.60	19.79		0.44	0.007

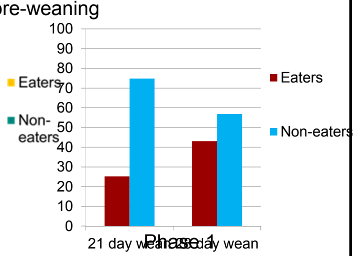
Response to creep is observed, if they eat it!

Interaction of creep feeding and weaning age

80 litters, randomly assigned to weaning age / creep provision for 1 week pre-weaning



Creep feed



Phase 1

Implications

- Feeding creep in farrowing may provide benefits, - if consumed!
- Weaning age – need to consider barn throughput, - all the way to market!
- Phase 1 complexity ($$) – monitor results all the way through to market

PSCI has a program this summer, - offering “dye pellets” to producers who want to know which pigs (or if) are consuming the creep feed

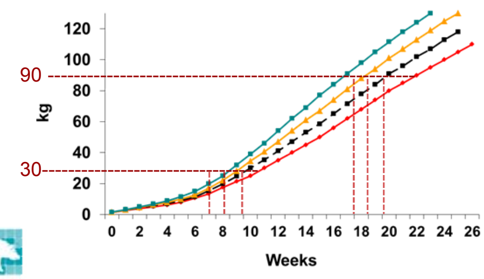
Does early growth rate predict performance in finishing?

- Piglets characterized from birth to nursery exit as “slow, average, or fast”
- From 30 to 60 kg BW or 90 to 120 kg BW fed 2.18 or 2.40 kcal NE/kg

Eastwood et al. 2013

Methods

Allocation to experimental diets at 30 or 90 kg BW



Item	Formulated NE Concentration, Mcal/kg			
	Growers (30 to 60 kg)		Finishers (90 to 120 kg)	
	2.18	2.40	2.18	2.40
Ingredient, % as-fed				
Barley	65.6	4.0	67.8	11.2
SBM	25.6	25.6	23.2	22.0
Wheat	4.0	63.0	4.0	59.1
Canola Oil	1.00	3.50	1.00	3.50
L-Lysine HCl	0.105	0.155	0.200	0.335
L-Threonine	0.000	0.030	0.035	0.100
DL-Methionine	0.000	0.005	0.045	0.070
Nutrient, as-fed				
g TID Lys/Mcal NE	4.27	4.00	4.37	4.24
DE, Mcal/kg	3.25	3.56	3.20	3.52
ME, Mcal/kg	3.04	3.32	3.01	3.29

Effect of growth potential and dietary NE on performance of barrows growing from 90 to 120 kg BW

	Potential Growth			NE, Mcal/kg		P value	
	Slow	Avg	Fast	2.18	2.40	GP	NE
Pretrial BW DOA, g	335	397	457	392	400	<0.001	0.18
Initial BW, kg	90	90	91	90	90	0.12	0.50
Final BW	119	120	119	119	119	0.44	0.93
n days on test	33	32	31	32	33	0.48	0.68
ADG, kg/d	0.93	0.93	0.93	0.95	0.91	1.00	0.24
ADFI, kg/d	3.04	3.01	3.02	3.09	2.96	0.91	0.02
G:F	0.31	0.31	0.31	0.31	0.31	0.87	0.75
(F:G)	3.36	3.27	3.31	3.34	3.29	0.75	0.56

Effect of growth potential and dietary NE on nutrient deposition or body composition of barrows slaughtered at 120 kg BW

- GP had no effect on body composition of pigs slaughtered at either 60 or 120 kg BW
- Efficiency of energy utilized for BW gain (Mcal NE/kg gain) was unaffected by GP or NE
- Protein, lipid or water deposition in the carcass was unaffected by GP

No advantage to be gained from segregating pigs and developing feeding strategies based on GP at nursery exit

Eastwood et al. 2013

Nursery pigs and corn DDGS

- Evaluated the preferences of nursery pigs for diets containing increasing DDGS, HP-DDG, varying in colour, +/ flavourings
- The DDGS replaced corn and SBM

Seabolt et al. 2010

	DDGS inclusion in starter 2 and 3 diets, %			SEM	P value
	0	10	20		
ADG, g					
Starter 1	169	164	167	15	0.98
Starter 2	242	195	212	13	0.06
Starter 3	443	432	418	19	0.62
ADFI					
Starter 1	211	195	214	12	0.88
Starter 2	354	320	325	11	0.03
Starter 3	712	667	665	28	0.52
G:F					
Starter 1	803 (1.25)	834 (1.20)	775 (1.29)	46	0.83
Starter 2	679 (1.27)	604 (1.66)	641 (1.56)	30	0.36
Starter 3	661 (1.51)	658 (1.52)	650 (1.54)	15	0.67

Initial BW, 6.74 kg

Seabolt et al. 2010

The effect of DDGS inclusion on diet preference in nursery pigs[a]

	Inclusion comparison, %[b]				P value
	0 vs 0	10 vs 0	20 vs 0	30 vs 0	P value
Day 1[c]	48	41	27	17	0.001
Day 2	52	29	28	18	0.001

[a] Results were similar with HP-DDGS
[b] Preference is expressed as the intake of the test diet as a % of total intake
[c] The preference test was conducted 2 wk post-weaning. The pigs were fed a complex starter diet during this period

Seabolt et al. 2010

Nursery pigs and corn DDGS

- Evaluated the preferences of nursery pigs for diets containing increasing DDGS, HP-DDG, varying in colour, +/ flavourings

Temporary decrease in ADFI and ADG when corn DDGS introduced
"Generally, nursery pig preferred a diet without DDGS or HP-DDG and this was unrelated to colour differences between sources"

Seabolt et al. 2010

Wheat DDGS for weanling pigs [a]

Diets

	Wheat DDGS, %				
	0	5	10	15	20
Wheat	57.1	56.9	56.7	56.3	56.4
SBM	20.0	15.0	10.0	5.0	----
Wheat DDGS	---	5	10	15	20
DE, Mcal/kg (measured)	3.49	3.51	3.49	3.49	3.49

[a] Diets formulated to be comparable in AA, fat, minerals and vitamins

Avelar et al. 2010

Wheat DDGS for weanling pigs [a]

	Wheat DDGS, %					
Day 0 to 28[b]	0	5	10	15	20	P value
ADG, g/d	375	376	375	362	191	0.001
ADFI, g/d	539	533	531	511	341	0.001
G:F	0.73	0.73	0.73	0.73	0.56	0.001
F:G	1.37	1.37	1.37	1.37	1.79	

[a] Initial BW 6.2 kg
[b] Similar results, day 0 to 7, 8 to 14, 15 to 21 or 22 to 28

Avelar et al. 2010

Lentils

1.8 million tonnes produced in Western Canada in 2011
Up to 10 % downgraded

%	Lentils	Peas
CP	24.5	21
Starch	36.5	45
Crude fat	1	1
NDF	15	12

% protein	Lentils	Peas	SBM	CM
Lysine	6.1	7.3	6.1	5.5
Threonine	4.1	3.8	3.9	3.5
SAA	2.0	2.3	2.9	3.3
Tryptophan	1.0	0.9	1.3	1.1

Nutritional value of lentils in pigs

%	Lentils	Peas
Ileal dig protein, %	63	73
DE (Mcal/kg DM)	3.712	3.900
NE (Mcal/ kg DM)	2.600	2.685

Growing pigs – 40% lentils, maintained ADG (Leterme 2007)
Weanling pigs – should not exceed 22.5 % (Zijlstra et al. 2011)

Mycotoxins in Feeds

- Chemicals produced in grain by specific molds or fungi
- 300 to 400 identified
  - Not all are detrimental to swine health and performance
- Grain is vulnerable at all stages of production
- Factors affecting production of mycotoxins
  - Moisture level
  - Temperature
  - Availability of oxygen during storage
- Increasing levels of mycotoxins in feedstuff
  - High stress growing seasons

Celebrating 20 Years of Innovation

Mycotoxins

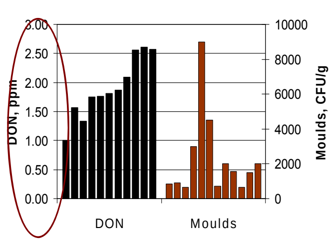
- Problem if the parent grain contained mycotoxins
- Concentrated in the DDGS
- The problem and the solutions are similar to mycotoxins in other grains

How to deal with mycotoxins in DDGS or other grains

- Recognize the presence of mycotoxins
- Dilution with uncontaminated grain
- Avoid feeding to breeding herd

One of the difficulties of "working" with mycotoxins is sampling

Variability of DON and moulds in feed (corn)

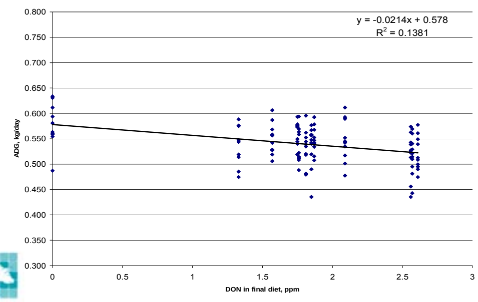


Corn had been mixed, and then sampled and several samples taken and composited into 11 single samples

What's 2 ppm?

- 2 Parts per million
- Or.. 2 inches in 16 miles
- Or… 2 cm in 10 km
- Or … 1 to 2 kernels of wheat per bushel

Effect of DON in diet on ADG weanling pigs



PRAIRIE SWINE CENTRE

Spray-dried animal plasma mitigates the negative impact of deoxynivalenol (DON) in nursery pigs

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PRAIRIE SWINE CENTRE

Spray-Dried Animal Plasma

- Increased animal performance
  - ↑ ADG and ADFI when added to starter diets (Kats et al. 1994)
- Improved gut health
  - ↑ intestinal health in pigs (Ruhong et al., 2000)
  - ↑ immune response in pigs (Frank et al., 2007)
  - ↓ toxic effects of Staphylococcus aureus enterotoxin B in rats (Perez-Bosque et al., 2010)
- Potential for positive effects in swine fed DON
  - limited research

PRAIRIE SWINE CENTRE

Objectives & Hypothesis

Determine if adding spray dried animal plasma and/or an activated clay binder would improve ADFI and ADG in weanling pigs fed DON contaminated diets

We hypothesized that SDAP and activated clay binders would mitigate the effects of DON on animal growth performance, and furthermore we hypothesized that these effects would be additive

PRAIRIE SWINE CENTRE

PRAIRIE SWINE CENTRE

Materials & Methods

- Two blocks of 100 nursery pigs
  - n = 5 pigs/pen
  - n = 8 pens/treatment
    - Assigned to treatment 3 days post wean
    - Initial BW average 6.89 kg ± 1.33 (SD)
- Five treatments
  - Treatment 1 – Negative Control (NC; 0.3 mg/kg DON)
  - Treatment 2 – Positive Control (PC; 3.9 mg/kg DON)
  - Treatment 3 – PC + clay (PC-clay)
  - Treatment 4 – PC + SDAP (PC-plasma)
  - Treatment 5 – PC + clay + SDAP (PC-both)

Celebrating 20 Years OF INNOVATION

PRAIRIE SWINE CENTRE

Materials & Methods

- Body weights and feed intakes
  - Day 0, 3, 11, and 20
- Intestinal morphology
  - 8 animals from each dietary treatment
  - Samples from jejunum & ileum
  - Mucosal thickness, villus height, and crypt depth
- Statistical analysis
  - Mixed model RCBD ANOVA in SAS
    - Contrast statements for means separation
  - P < 0.05 declared significant, 0.05 > 0.10 declared trend

Celebrating 20 Years OF INNOVATION

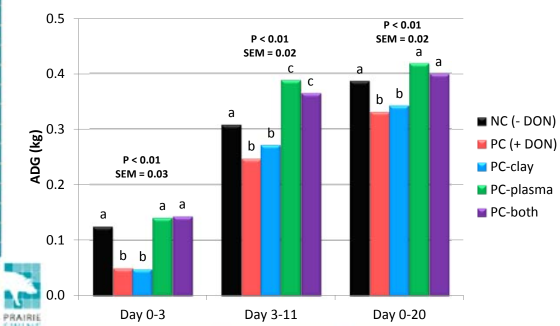
Ingredients[1,2], % as fed	NC	PC	PC-clay	PC-plasma	PC-both
			Treatment		
Wheat	50.8	28.8	28.6	27.8	27.6
DON wheat (9.3 mg/kg)	**0.0**	**22.0**	**22.0**	**22.0**	**22.0**
Soybean Meal	19.0	19.0	19.0	18.1	18.1
Whey Powder	11.7	11.7	11.7	11.4	11.4
Fish Meal	**9.0**	**9.0**	**9.0**	**0.0**	**0.0**
Barley	4.9	4.9	4.9	5.8	5.8
Canola Oil	2.3	2.3	2.3	2.4	2.4
LS 20	0.1	0.1	0.1	0.1	0.1
Activated Clay	0.0	0.0	0.2	0.0	0.2
SDAP (AP920, APC Inc)	**0.0**	**0.0**	**0.0**	**8.0**	**8.0**
Analyzed DON, mg/kg	***0.0***	***3.2***	***3.6***	***4.2***	***4.4***

[1]All diets contain equal amounts of vitamin and mineral premixes, choline chloride, salt, and $CuSO_4 \cdot 5H_2O$,
[2]Amino acids, limestone, and mono/di-cal phosphate were added to balance all diets

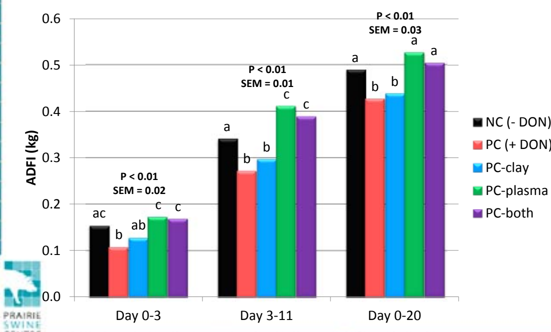
Results

- No animals showed signs of illness

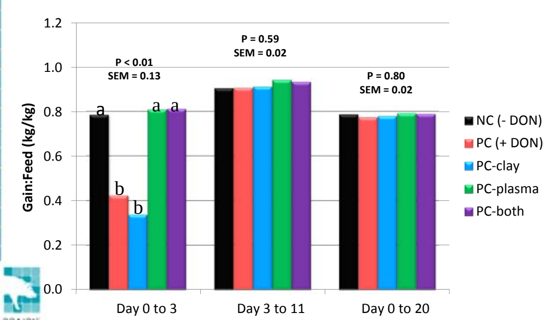
Average Daily Gain



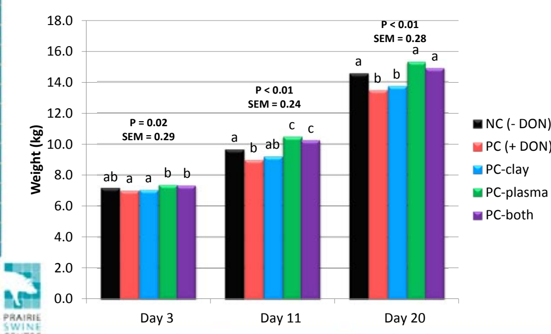
Average Daily Feed Intake



Gain:Feed

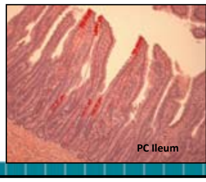


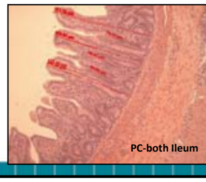
Body Weight



Intestinal Morphology

Intestinal Parameter	Dietary Treatment					SEM	P-Value
	NC	PC	PC – clay	PC – plasma	PC - both		
Mucosal Thickness, μm	415	437	433	427	398	14.1	0.27
Villus Height (VH), μm	246	261	239	259	237	15.3	0.32
Crypt Depth (CD), μm	91^{a}	92^{a}	94^{a}	87^{ab}	77^{b}	4.3	0.04
VH to CD Ratio, μm/μm	2.75	2.89	2.58	3.03	3.15	0.19	0.06





Summary of Results

- Performance
  - ADG and ADFI were reduced in nursery pigs fed diets with ~4 mg/kg DON
  - Pigs fed DON contaminated diets containing SDAP had performance similar or better than pigs fed diets containing no DON
  - ADG and ADFI were not improved in pigs fed a DON contaminated diet with activated clay relative to those fed the positive DON control, and performance was lower than the pigs fed no DON
- Intestinal morphology
  - Mucosal thickness and villus height were unaffected by dietary treatment
  - Pigs fed DON contaminated diets with SDAP had reduced crypt depth

Conclusions- Mycotoxins

- Take large samples
- Take more than 1 sample
- Piglet response
  - Reduced feed intake
  - Weight loss
  - Vomiting (high contamination)

Solution

Dilution

Or feed to beef or poultry

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