	Trypsin inhibitor mg/g		Protein Dispersibility index, %		Protein Solubility-KOH, %		Urease activity/pH rise		Protein, ADF bound		Total Oligosaccharides	
State												
State	Mean	Std Error	Mean	Std Error	Mean	Std Error	Mean	Std Error	Mean	Std Error	Mean	Std Error
GA	2.24^{bc}	0.30	20.25^{abc}	3.65	81.66^{ab}	2.11	-	-	1.40	0.77^{b}	65.22^{a}	1.60
IA	2.53^{b}	0.06	25.71^{b}	0.71	80.35^{ab}	0.41	0.03	0.00	1.95	0.20^{b}	63.17^{a}	0.31
IL	2.39^{bc}	0.17	17.03^{c}	1.83	82.08^{ab}	1.06	0.04	0.02	1.68	0.45^{b}	63.69^{a}	0.80
MO	2.24^{bc}	0.30	20.40^{abc}	3.65	81.32^{ab}	2.11	-	-	2.06	0.77^{b}	65.27^{a}	1.60
MS	1.92^{c}	0.14	13.60^{c}	1.72	80.51ab	1.00	0.03	0.02	1.67	0.39^{b}	57.33^{b}	0.76
NC	2.34^{abc}	0.30	23.25^{abc}	3.65	80.31ab	2.11	-	-		-	66.59^{a}	2.27
NE	3.33^{a}	0.16	22.75^{abc}	2.58	83.88a	1.13	0.05	0.01	2.59	0.45^{b}	63.76^{a}	0.86
OH	2.75^{b}	0.09	30.49^{a}	1.08	78.89b	0.62	0.03	0.01	2.24	0.29^{b}	61.68^{a}	0.47
IN	-	-	-	-	-	-	-	-	6.37	1.09^{a}	61.60^{ab}	2.27
SEM	0.14		1.71		0.96		0.01		0.42		0.80	
p-value	<.0001		<.0001		0.02		0.72		0.01		<.0001	
Supplier												
A	2.63^{a}	0.08	25.33^{bc}	0.96	79.98	0.52	0.03	0.01	1.86	0.24	62.97^{bc}	0.32
B	2.41^{ab}	0.09	22.21^{cd}	1.03	80.43	0.61	0.04	0.01	2.10	0.30	62.69^{bc}	0.37
C	2.53^{ab}	0.49	15.43^{de}	3.03	80.61	1.83	-	-	3.51	0.67	64.92^{ab}	0.96
D	2.65^{a}	0.11	30.05^{a}	1.07	80.74	0.64	0.02	0.01	2.37	0.29	61.84^{c}	0.39
E	1.92^{b}	0.16	13.60^{e}	1.75	80.51	1.06	0.03	0.02	1.67	0.41	57.33^{d}	0.64
F	2.95^{ab}	0.49	28.10^{ab}	5.25	78.88	3.18	-	-	-	-	-	-
	2.72^{a}	0.16	28.58^{ab}	1.66	80.92	1.00	0.04	0.01	1.39	0.58	67.59^{a}	0.61
SEM	0.14		1.51		0.88		0.01			0.36	0.47	
p-value	0.00		<.0001		0.96		0.25			0.13	<.0001	
Region												
Midwest	2.59^{a}	0.06	24.34^{b}	0.69	80.92	0.37	0.04	0.00	2.11	0.18	63.32^{a}	0.27
MS Delta	1.92^{b}	0.17	13.76^{c}	1.99	80.85	1.09	0.03	0.02	1.65	0.46	57.51^{c}	0.80
Northeast	2.75^{a}	0.10	30.49^{a}	1.17	78.89	0.64	0.03	0.01	2.24	0.32	61.68^{b}	0.47
Southeast	2.29^{ab}	0.23	21.75^{bc}	2.82	80.98	1.54	-	-	1.40	0.86	65.67^{a}	1.30
SEM	0.11		1.26	-	0.68	-	0.01	-	0.34	-	0.50	-
p-value	0.00		<.0001		0.06		0.79		0.62		<.0001	
Year												
2019	2.45	0.08	17.98^{b}	0.87	81.41^{a}	0.44	0.04	0.01	2.23	0.20	63.09	0.43
2020	2.60	0.07	27.43^{c}	0.63	79.96^{b}	0.35	0.03	0.00	2.13	0.19	62.79	0.34
SEM	0.08		0.73		0.39		0.04		0.20		0.38	
p-value	0.18		<.0001		0.01		0.37		0.70		0.58	

Keywords: antinutritive factors, soybean meal, swine

PSVIII-7 Isoquinoline Alkaloids Improve Intestinal Function of Weanling Pigs Fed Corn-Soybean Meal Diets Formulated Below Amino Acid Requirements.

Carly M. Rundle[1], Valeria Artuso-Ponte[2], Hans H. Stein[1], *[1]University of Illinois at Urbana-Champaign, [2]Phytobiotics*

Abstract: An experiment tested the hypothesis that isoquinoline alkaloids (IQ) in diets for weanling pigs formulated below amino acid (AA) requirements improves intestinal health and maintains growth performance of pigs compared with pigs fed a diet formulated at AA requirements. Two-hundred weanling pigs (6.11 ± 0.61 kg) were allotted to 4 dietary treatments with 5 pigs per pen and 10 pens per treatment for a 27 d, 2-phase experiment. Diets were arranged in a 2 × 2 factorial with AA at or 10% below requirements and with IQ at 0 or 120 mg/kg. Growth performance was calculated and plasma (d 14 and 27) and tissue samples (d 27) were collected. Data were analyzed with Proc MIXED of SAS using AA level, IQ inclusion, and the interaction as main effects. Pigs fed diets with IQ tended to have greater ($P < 0.10$) ADFI, whereas G:F was reduced if dietary AA were reduced ($P < 0.05$; Table 1). If AA were at requirements, lamina propria thickness in the jejunum was not affected by IQ inclusion, but if AA were below requirements, IQ decreased lamina propria thickness (interaction, $P < 0.05$). Villus height also tended to increase with dietary IQ ($P < 0.10$). Adding IQ to the diet that met AA requirements resulted in decreased plasma interleukin 4 and 10 on d 14; however, if IQ was in the reduced AA diet, the opposite was true (interaction, $P < 0.05$). If AA were below requirements, IQ tended to increase occludin in the jejunal mucosa, whereas if AA were at requirements, IQ tended to reduce occludin (interaction, $P < 0.10$). On d 26, reducing AA in the diet reduced ($P < 0.05$) plasma albumin. In conclusion, if AA are provided below the requirement, dietary IQ modulates systemic inflammation and improves intestinal function of weanling pigs.

Table 1. Growth performance, markers of intestinal function, and cytokine expression in the plasma of nursery pigs fed diets formulated at or below amino acid (AA) requirements without or with isoquinoline alkaloid (IQ) supplementation for 27 d[1]

Item	Experimental diet					*P*-value		
	PC	PC + IQ	NC	NC + IQ	SEM	AA	IQ	AA × IQ
Growth performance								
ADG, kg	2.90	3.09	2.75	2.88	0.288	0.126	0.172	0.758
ADFI, kg	3.88	4.25	3.92	4.15	0.378	0.836	0.063	0.665
G:F	0.75	0.73	0.70	0.69	0.009	<0.001	0.086	0.615
Jejunal morphology, d 27								
Villus height, µm	463.90	473.88	475.19	528.98	17.128	0.052	0.061	0.192
Crypt depth, µm	202.76	210.97	197.67	206.51	14.755	0.476	0.206	0.963
LPT, µm	56.10^{ab}	59.34^{ab}	60.64^{a}	53.74^{b}	2.304	0.812	0.414	0.028
Gene expression[2], d 27								
OCLN	1.34	1.25	1.13	1.45	0.273	0.876	0.249	0.054
Cytokines, ng/ml								
IL-4, d, 14	1.04^{a}	0.15^{b}	0.23^{b}	0.29^{b}	0.225	0.108	0.049	0.028
IL-10, d 14	0.72^{a}	0.25^{b}	0.22^{b}	0.28^{b}	0.127	0.068	0.117	0.043

[1]PC = positive control; PC + IQ = positive control + 90 mg/kg IQ; NC = negative control, formulated 10% below amino acid requirements; NC + IQ = negative control + 90 mg/kg IQ; ADG = average daily gain; ADFI = average daily feed intake; G:F = gain:feed; LPT = lamina propria thickness; OCLN = occludin; IL = interleukin.

[2]Least square mean (log_2-backtransformed) for expression of genes in the jejunum.

[a,b]Means within a row lacking a common letter are different ($P \leq 0.05$).

Keywords: amino acids, isoquinoline alkaloids, pigs

PSVIII-14 Zinc Oxide Augments Early Nursery Pig Feed Intake. Carson M. De Mille[1], Eric R. Burrough[2], Nicholas K. Gabler[1], *[1]Iowa State University, [2]Department of Veterinary Diagnostic and Production Animal Medicine, Iowa State University*

Abstract: Pharmacological concentrations of zinc (Zn) are commonly fed in the nursery to benefit early post-weaning performance and reduces scours. Therefore, our objective was to determine the effect of pharmacological Zn on post-weaning pig daily feed intake and performance. Three-hundred weaned pigs (5.7 ± 1.03 kg BW) were selected and allotted to 1 of 3 dietary treatments (n = 10 pens/treatment, 10 pigs/pen). Diets were fed over 2 phases (phase 1: d 0-7, phase 2: d 8-21) and consisted of: 1) Control diet with no growth promoting additives, CON; 2) CON + 3,000 ppm Zn and 200 ppm Cu (phase 1), no pharmacological minerals in phase 2, ZC1; and 3) CON + 3,000 ppm Zn and 200 ppm Cu (phase 1), CON + 2,000 ppm Zn and 200 ppm Cu (phase 2); ZC2). Bodyweights were collected at d 0, 7, and 21. Feed disappearance was recorded daily from d 0-14, and within phase. In phase 1, ZC1 and ZC2 pigs had 29% greater feed consumption compared with the CON pigs (0.09, 0.09, 0.07 kg/d; $P < 0.0001$). Within 2 d of phase 2 diet change, feed intake of the ZC1 pigs sharply decreased to the same level of the CON pigs, while ZC2 pigs consumed 29% more ($P < 0.05$). In phase 1, ZC1 and ZC2 pens had increased ADG compared with CON pigs ($P < 0.001$). In phase 2, ADG was 14% greater in the ZC2 compared with ZC1 and CON pigs ($P = 0.023$). Overall, ADG was 15% greater in the ZC2 pigs and ADFI was 13 and 24% higher than ZC1 and CON pens, respectively ($P < 0.05$). In conclusion, early post-weaning feed intake was augmented with pharmacological levels of Zn. These data suggest that pharmacological Zn potentially enhances voluntary feed intake regulation in pigs.

Keywords: feed intake, pig, zinc oxide