Table 1. Apparent total tract digestibility (ATTD) of gross energy (GE), nitrogen (N), total dietary fiber (TDF), Ca, and P, and standardized total tract digestibility (STTD) of P in regional diets without or with spray dried plasma (SDP)[1]

Diet	ATTD, %					STTD[2], %
	GE	Nitrogen	TDF	Ca	P	P
U.S.A.	86.8	83.1	63.9	71.6	68	71
U.S.A. + SDP	87.6	85.8	66.2	70.9	71.9	74.5
European Union	86.2	82.3	63.4	70	67.2	70.2
European Union + SDP	87.5	85.5	67.7	72.5	72.4	75.2
Canada	84.9	80.7	63.1	70.9	67.7	70.6
Canada + SDP	87.2	85.1	62.1	74.5	71.8	74.7
Asia	91.4	83.8	71.7	68.2	72	75.1
Asia + SDP	92.9	88.3	72.6	75.3	78.2	81
Pooled SEM	0.67	0.81	1.35	2.1	1.6	1.6
P-value (SDP)	<0.001	<0.001	0.085	0.041	<0.001	<0.001
P-value (Region)	<0.001	0.003	<0.001	0.894	<0.001	<0.001
P-value (SDP × Region)	0.568	0.578	0.214	0.303	0.832	0.848

[1]Data are least squares means of 8 observations for U.S.A., the European Union, Asia, and Asia + SDP diets; 7 observations for the European Union, Canada, and Canada + SDP diets; and 6 observations for the U.S.A. + SDP diet.

[2]The STTD of P in diets was calculated by correcting ATTD of P for basal endogenous P loss (193 mg/kg dry matter intake) that was obtained from pigs fed the P-free diet.

Table 2. Differences[1] between measured and predicted apparent total tract digestibility (ATTD) values for gross energy, nitrogen, Ca, P, and total dietary fiber (TDF) and for standardized total tract digestibility (STTD) of P in regional diets with spray dried plasma from the U.S.A., European Union, Canada, and Asia[2,3]

Item	U.S.A.	European Union	Canada	Asia	Overall[4]
ATTD, %					
Gross energy	0.14	0.71	1.65*	1.29*	3.36*
Nitrogen	0.12	0.47	1.29	2.20*	2.36*
Ca	-0.83	2.45	3.56*	6.95*	3.10*
P	0.44	1.79	0.92	3.31*	2.77*
TDF	2.76*	4.89*	-0.52	2.41	3.48*
STTD, %					
P	-0.26	1.03	0.41	2.62*	1.64

[1]Difference is calculated by subtracting predicted ATTD of gross energy, nitrogen, IDF, SDF, TDF, Ca, or P from measured value. Likewise, for the difference between predicted value for STTD of P from measured value.

[2]Data are least square means of 6 to 8 observations, except for the calculation of overall which are least square means of 30 to 32 observations.

[3]* = $P \leq 0.05$.

[4]Overall was calculated as sum of the differences from all the diets with spray dried plasma.

Keywords: additivity, apparent total tract digestibility, spray dried plasma

136 Optimum Concentration of Spray Dried Plasma for Maximized Growth Performance, Improved Intestinal Health, and Reduced Inflammation in Weaned Pigs Housed in a Challenged Environment.

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Abstract: This study aimed at testing the hypothesis that greater inclusion of spray dried plasma (SDP) in diets improves growth performance, intestinal morphology, and reduces inflammation in weaned pigs. Four-hundred weaned pigs (body weight: 6.05 ± 0.80 kg) were allotted to a randomized complete block design with 5 diets and 2 blocks (16 pens/diet; 5 pigs/pen). Pens were not cleaned between groups to create a sanitation challenge. Phase-1 diets containing 0, 2, 4, 6, or 8% SDP were formulated. One pig per pen was sacrificed on d 14 and samples of intestinal tissue and mucosa were collected. Data were analyzed using PROC MIXED of SAS and linear, quadratic, and cubic contrast statements were used. During phase-1, ADG, ADFI, G:F, and body weight of pigs on d 14 increased (linear, $P < 0.05$) with increasing levels of SDP in the diet (Table 1). Villus width in the jejunum of pigs on d 14 tended to increase (linear, $P < 0.10$) with increasing inclusion of SDP (Table 2), and villus height:crypt depth tended to increase (quadratic, $P < 0.10$) with the greatest value observed for pigs fed a diet with 8% SDP. Secretory immunoglobulin A in the jejunal mucosa was decreased when 4 or 8% SDP was included in the diet (cubic, $P < 0.05$). Interleukin- (IL-) 2 (quadratic, $P < 0.10$) and IL-18 (cubic, $P < 0.10$) in the jejunal mucosa tended to decrease at 8% inclusion of SDP and IL-8 (linear, $P < 0.10$) tended to increase as SDP inclusion increased in the diet. In conclusion, the optimal inclusion of SDP in diets for weanling pigs was 8% as indicated by improvements in growth performance, but the collective intestinal morphology and health data do not result in a clearly conclusive optimum concentration in SDP.

Table 1. Growth performance from d 1 to 14 of weaned pigs fed diets with increasing levels of spray dried plasma[1,2]

Item	Phase-1 diets by % SDP					Pooled	*P*-value[3]	
	0	2	4	6	8	SEM	Linear	Quadratic
Initial BW, kg	6.05	6.05	6.04	6.05	6.04	0.388	0.422	0.692
ADG, g	76	99	107	116	125	29.1	<0.001	0.315
ADFI, g	152	179	180	178	188	24.8	0.004	0.219
G:F	0.47	0.54	0.57	0.64	0.65	0.095	<0.001	0.376
Final BW, kg	7.06	7.44	7.54	7.67	7.79	0.797	<0.001	0.192

[1]Data are least square means of 15 or 16 pens per diet.

[2]ADFI, average daily feed intake; ADG, average daily gain; BW, body weight; G:F, gain to feed ratio; spray dried plasma, SDP.

[3]The cubic effect of increasing levels of spray dried plasma in the diet was not significant for any variable.

Table 2. Jejunum morphology and mucosal concentrations of secretory immunoglobulin A (sIgA) and interleukins (**IL**) of pigs fed phase-1 diets with increasing levels of spray dried plasma

Item	Phase-1 diets by % SDP					Pooled	*P*-value[3]	
	0	2	4	6	8	SEM	Linear	Quadratic
Tissue[1]								
Villus height, µm	349	335	347	336	371	14.8	0.330	0.154
Villus width, µm	124	122	131	127	132	4.5	0.085	0.861
Crypt depth, µm	320	320	331	333	317	11.1	0.805	0.253
Villus height:crypt depth	1.12	1.07	1.09	1.05	1.20	0.056	0.355	0.051
Lamina propia, µm	81.4	80.8	87.5	84.0	86.5	5.48	0.167	0.720
Villus surface area, mm	138	129	144	136	154	8.8	0.143	0.346
Mucosa[2]								
sIgA[3], µg/mg of protein	2.50	1.89	1.39	2.89	1.66	0.370	0.541	0.569
IL-2, ng/mL	0.075	0.078	0.081	0.081	0.074	0.004	0.989	0.080
IL-6, ng/mL	0.022	0.019	0.024	0.019	0.020	0.003	0.768	0.797
IL-8, ng/mL	15.88	15.15	17.01	17.17	17.91	1.697	0.096	0.770
IL-10, ng/mL	0.051	0.050	0.051	0.051	0.047	0.004	0.420	0.496
IL-18[3], ng/mL	35.31	33.25	38.05	37.76	36.41	4.573	0.154	0.509

[1]Tissue data are least square means of 14, 15, or 16 pens per diet.

[2]Mucosa sIgA and IL- data are least square means of 10 to 15 pens per diet.

[3]The cubic effect of increasing levels of spray dried plasma in the diet was not significant for any variable, except sIgA ($P = 0.011$) and IL-18 ($P = 0.094$).

Keywords: cytokines, weanling pigs, spray dried plasma

145 Effects of Increasing Dietary Standardized Ileal Digestible Lysine Levels on Growth Performance of 12- to 23-Kg Boars and Gilts.

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Abstract: Our objective was to determine the effects of increasing dietary standardized ileal digestible (SID) lysine (Lys) on growth performance of late nursery boars and gilts. A total of 1,920 pigs (PIC 337×Camborough, initially 12.1±1.34kg) were used in a 21-d trial. Pens of pigs were weighed, blocked by body weight, and randomly allotted to 1 of 5 treatments containing 1.10, 1.16, 1.29, 1.42, and 1.48% SID Lys (corresponding to 85, 90, 100, 110 and 115.0% of PIC SID Lys recommendations). Diets were corn-soybean-meal-based and contained 3,300 Kcal of ME/kg. There were 6 split gender pens/treatment and 32 pigs/pen. Data were analyzed using generalized linear and nonlinear mixed models with pen as the experimental unit. Competing models included linear, quadratic polynomial (QP), broken-line linear (BLL), and broken-line quadratic (BLQ). There was no evidence of linear or quadratic SID Lys concentration by gender interaction. Increasing SID Lys concentration improved average daily gain (ADG; quadratic, $P < 0.05$) and gain to feed ratio (G:F; quadratic, < 0.01). The QP, BLL, and BLQ had similar fit for the ADG and G:F. In the QP model, 95% and 100% of the ADG were at 1.18 and 1.36% of SID Lys, respectively, and 1.17 and 1.35% for G:F. The BLL and BLQ models estimated the breakpoint at 1.20% (95% CI: 1.06-1.35%) and 1.22% SID Lys (95% CI: 0.97-1.47%), for ADG, respectively. For G:F, the BLL and BLQ models estimated the breakpoint at dietary SID Lys of 1.20% (95% CI: 1.07-1.33%) and 1.20% (95% CI: 1.03-1.38%), respectively. There was no evidence that increasing dietary SID Lys levels impacted average daily feed intake or the removal and mortality rate. In the current trial with dietary ME level at 3,300 kcal/kg, the estimated optimum SID Lys concentration for 12- to 23-kg boars and gilts ranged from 1.20-1.36%, depending on the statistical model.

Keywords: growth performance, lysine, nursery pigs