STUDY REPORT

STUDY TITLE: Evaluation of Cheese Powder (PRO 88) in the diets of early-weaned pigs.

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QUALITY STATEMENT

The experiment was reviewed and approved by the Institutional Animal Care and Use Committee of the University of Minnesota and animals were cared for according to The Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 1998). The animal nutrition laboratory at the Southern Research and Outreach Center, University of Minnesota at Waseca, MN performed all chemical analyses and follows strict GLP and QC guidelines under the supervision of a highly qualified Head Technician.

1. SUMMARY

One hundred and twenty-eight high lean genotype, ((Large White X Landrace, Topigs) X Compact Duroc)) crossed bred piglets (TOPIGS), with average body weight 6.27 ± 0.22 kg were used in the study. The objective of the study was to evaluate the dietary effect of increased level of Cheese meal (Pro 88) on nursery pigs' performance. Four pigs comprising of both sexes (2 barons and 2 gilts) were kept in pen and constituted the experimental unit. Randomized Complete Block design was employed in the study with 4 treatments and 8 replicates per treatment. Treatment 1 was the control diet without (Pro 88) Cheese meal; treatment 2, diet with 4% Cheese meal plus 3% spray dried bovine plasma; treatment 3, diet with 8% Cheese meal plus 1.5% spray dried bovine plasma; treatment 4, diet with 12% Cheese meal without spray dried bovine plasma. Experimental diets were formulated for 2 phases and a common diet provided during the third phase to meet NRC, 2012 nutrient requirements of swine (Table 1, 2 and 3). Pigs were weighed at d 0, 14, 28, and 42 of the study. Inclusion of Cheese meal in the nursery phase I and II at numerically increased BW, ADG, and feed efficiency of piglets compared with the control pigs. However, supplementation of Cheese meal at 8% during nursery phase I and 4%

during nursery phase II diets, appear to maximize feed efficiency. The current data suggest that Cheese meal can substitute spray dried porcine plasma partially or completely in swine diet without any adverse effect on piglet's performance.

STUDY OBJECTIVE

To evaluate the effect of dietary supplementation of cheese meal in the diets of early weaned pigs.

To estimate the economic impact of including cheese meal as a protein supplement in the diets of early weaned pigs.

2. MATERIALS

a. TEST PRODUCT

The cheese meal was provided to the testing facility in a ready to use form for inclusion into the diet at the rate specified in Table 1.

b. ANIMALS

One hundred and twenty-eight crossbred piglets with average body weight 6.27 ± 0.22 kg were used in 42 d nursery performance trial. All pens had dimension of 1.2 × 1.0 meters with plastic tenderfoot floor. Four pigs comprising of 2 gilts and 2 barrows were kept in each pen to represent the experimental unit.

c. ANIMALS AND MAINTENANCE CONDITIONS

Animals were observed daily for signs of illness or poor condition. Feeders and nipple waterers provided pigs with ad libitum access to water and feed.

d. ENVIRONMENT

Pigs were housed in an environmentally controlled building. Maximum and minimum daily temperatures were recorded every morning for each room.

e. WATER

Pigs had unlimited access to water via a single nipple drinker in each pen. The nipple drinkers were situated on the opposite side of the pen from the feeder making it impossible for a single pig to monopolize both the feed and water at the same time.

3. EXPERIMENTAL DESIGN

a. ASSIGNMENT OF TREATMENT GROUP

One hundred and twenty-eight (Large White X Landrace) X Duroc crossed bred piglets 18 days old wean piglets with initial BW 6.27 ± 0.22 kg were blocked by body weight and randomly assigned to 1 of 4 treatments in randomized complete block design with 4 pigs (balanced sex) per pen. There were 8 replicated pens per treatment.

b. STUDY DESIGN AND DIETS

Experimental diets were formulated to meet NRC, 2012 nutrient requirements of swine (Table 1 and 2).

Treatments during phase 1:

1. Control diet with spray dried plasma without Cheese meal
2. 4% Cheese meal + 3% spray dried bovine plasma
3. 8% Cheese meal + 1.5% spray dried bovine plasma
4. 12% Cheese meal + 0% spray dried bovine plasma

Treatments during phase 2:

1. Control diet with spray dried plasma without Cheese meal
2. 2% Cheese meal + 3% spray dried bovine plasma
3. 4% Cheese meal + 1.5% spray dried bovine plasma
4. 6% Cheese meal + 0% spray dried bovine plasma

Phase 3:

1. After nursery phase 2, all the pigs received the same common diet with no spray dried plasma and Cheese meal products.

4. METHODS

a. DIET MIXING AND SAMPLING

Diets were manufactured using the University of Minnesota feed mill at the Southern Research and Outreach Center. Samples were taken in the mill as each diet was being transferred to the grain truck, and again as feed was being administered from the grain bins at the nursery. The two samples were composited and sub-sampled for analysis.

Table 1. Ingredient composition of Cheese meal (Pro 88) in the diets of early weaned pigs from phase I to III.

Ingredients, %	Phase I				Phase II				Phase III
	Trt1	**Trt2**	**Trt3**	**Trt4**	**Trt1**	**Trt2**	**Trt3**	**Trt4**	**Common diet**
Corn	50.02	48.79	46.43	44.52	57.78	56.25	55.05	54.07	69.80
SBM	24.00	24.00	24.00	24.00	24.00	25.00	25.00	25.00	25.00
Fish meal	4.00	4.00	4.00	4.00	3.00	3.00	3.00	3.00	0.00
Whey powder	9.00	9.00	9.00	9.00	5.00	5.00	5.00	5.00	0.00
SDPP	**6.00**	**3.00**	**1.50**	**0.00**	**3.00**	**1.50**	**0.75**	**0.00**	**0.00**
Pro 88	**0.00**	**4.00**	**8.00**	**12.00**	**0.00**	**2.00**	**4.00**	**6.00**	**0.00**
Blended fat	3.00	3.00	2.70	2.40	3.00	3.00	2.88	2.76	1.00
Limestone	0.95	0.92	0.82	0.80	0.99	0.92	0.82	0.80	1.20
Mono-calcium phosphate	0.60	0.75	0.95	1.00	0.70	0.75	0.95	1.00	0.90
Zinc oxide	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.35
Mecadox	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vit -Mineral premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.30	0.35	0.30	0.22	0.39	0.39	0.36	0.29	0.50
Threonine	0.08	0.09	0.22	0.01	0.12	0.09	0.18	0.08	0.14
Methionine	0.15	0.18	0.16	0.15	0.11	0.18	0.09	0.08	0.10
Tryptophan	0.00	0.02	0.02	0.00	0.01	0.02	0.02	0.02	0.01
Celite	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.00
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 2. Calculated nutrient analysis of Cheese meal (Pro 88) diets of early weaned pigs.

Items	Phase I				Phase II				Phase III
	Trt1	Trt2	Trt3	Trt4	Trt1	Trt2	Trt3	Trt4	Common diet
Net Energy (NE) kcal, kg	2484	2486	2484	2482	2466	2467	2466	2466	2384
SID C. Protein	20.27	19.67	19.96	20.24	17.88	17.25	16.70	16.16	15.00
Arg	1.33	1.21	1.14	1.08	1.20	1.16	1.13	1.10	1.04
Lys	1.57	1.57	1.58	1.57	1.40	1.40	1.40	1.40	1.19
Met	0.48	0.52	0.52	0.54	0.41	0.41	0.41	0.41	0.35
Met+Cys	0.87	0.86	0.74	0.68	0.73	0.69	0.65	0.61	0.60
Thr	0.92	0.89	1.03	0.84	0.82	0.79	0.88	0.79	0.68
Trp	0.28	0.28	0.29	0.27	0.24	0.25	0.25	0.25	0.19
Val	1.03	1.00	1.03	1.06	0.88	0.88	0.97	0.91	0.70
STTD P	0.51	0.52	0.54	0.55	0.44	0.44	0.46	0.46	0.32
Total C. Protein	24.27	23.91	24.13	24.18	21.57	21.68	21.80	21.88	18.34
Ca	0.87	0.91	0.94	0.97	0.83	0.81	0.83	0.84	0.85
Total P	0.73	0.75	0.80	0.82	0.68	0.67	0.70	0.70	0.57
Na	0.42	0.33	0.29	0.25	0.3	0.30	0.24	0.22	0.19
SID Lys/NE (g/Mcal)	6.320	6.315	6.361	6.325	5.677	5.675	5.677	5.677	4.99

b. OBSERVATIONS DURING THE STUDY

i. ENVIRONMENT

Daily maximum and minimum temperatures were recorded for each of the 2 rooms used in the study.

ii. FEED INTAKE

Feed was weighed when added to the feeders, and feed levels were checked regularly. At the end of each phase, remaining feed was removed and weighed for determination of average daily feed intake and feed efficiency. Pigs were observed daily throughout the study period for poor performance and feed wastage.

iii. DAILY WEIGHT GAIN

Individual body weights were recorded for every pig on Days 0, 14, 28, and 42 of the study period. Average body weights for each pen were used to calculate average daily gain and feed efficiency.

iv. FEED EFFICIENCY

Pen average daily gain and pen average daily feed intake were used to calculated pen gain-to-feed ratio.

v. HEALTH AND CONDITIONS

A qualified individual observed pigs at least once a day at the nursery.

c. MEDICATION

Piglets received prophylactic dose of antibiotic medication the first 3 day in water during the study.

d. STATISTICAL ANALYSIS

Normality of the data set were checked using PROC UNIVARIATE procedure of SAS (version 9.4, SAS Institute Inc., Cary, NC). All response variables were analyzed using PROC MIXED procedure of SAS with treatment as main effect and random effect of replicate. Pen with 4 pigs was the experimental unit. Least squares means were calculated for each independent variable and evaluated with the PDIFF option of SAS. Significant differences were declared at $P < 0.05$ and a trend considered between $0.05 < P \leq 0.10$.

5. STUDY RESULTS

a. EFFECT OF CHEESE POWDER (PRO 88) PLASMA ON NURSERY PIGLET'S PERFORMANCE.

Effect of cheese meal on nursery piglet's performance is provided in table 3. During phase I, supplementing nursery diet with Cheese powder at 4%, 8%, and 12% numerically increased BW of piglets by 3.9% ($P = 0.451$), 5.3% ($P = 0.303$), and 6.4% ($P = 0.227$) compared with the control pigs, respectively. Consequently, ADG numerically increased by 9.9% ($P = 0.318$) and 14.2% ($P = 0.148$) for piglets fed 4% and 8% Cheese powder, respectively, relative to the control pigs. However, piglets that were fed 12% Cheese powder tended to have 16.7% increased ADG compared with the control pigs (0.282 vs 0.329; $P = 0.092$). Piglets fed at 12% Cheese powder had

17.5% increased ADFI relative to the control pigs (0.372 vs 0.437; $P = 0.007$). Piglets fed at 4% Cheese powder had 9.4% increased ADFI compared with the control pigs (0.372 vs 0.407; $P = 0.129$). Although not significant, the supplementation of nursery diet with 8% Cheese powder improved feed efficiency by 11% compared with the control pigs (0.747 vs 0.830; $P = 0.189$) in phase I.

During phase II, supplementation of nursery diet with Cheese powder at 2%, 4%, and 6% numerically increased BW of piglets by 5.3% ($P = 0.313$), 5.2% ($P = 0.316$), and 6.8% ($P = 0.194$) compared with the control pigs, respectively. Similarly, Cheese meal at inclusion rate of 2%, 4%, and 6% numerically increased ADG of piglets by 7.1% ($P = 0.349$), 4.9% ($P = 0.518$), and 7.5% ($P = 0.332$) relative to the control pigs, respectively. During phase II, ADFI did not differ among dietary treatments ($P > 0.10$). During phase II, feed efficiency did not significantly change but Cheese powder supplementation at 2%, 4%, and 6% numerically increased feed efficiency of nursery piglets by 5.2% ($P = 0.314$), 8.1% ($P = 0.127$), and 7.1% ($P = 0.176$) compared with the control pigs, respectively.

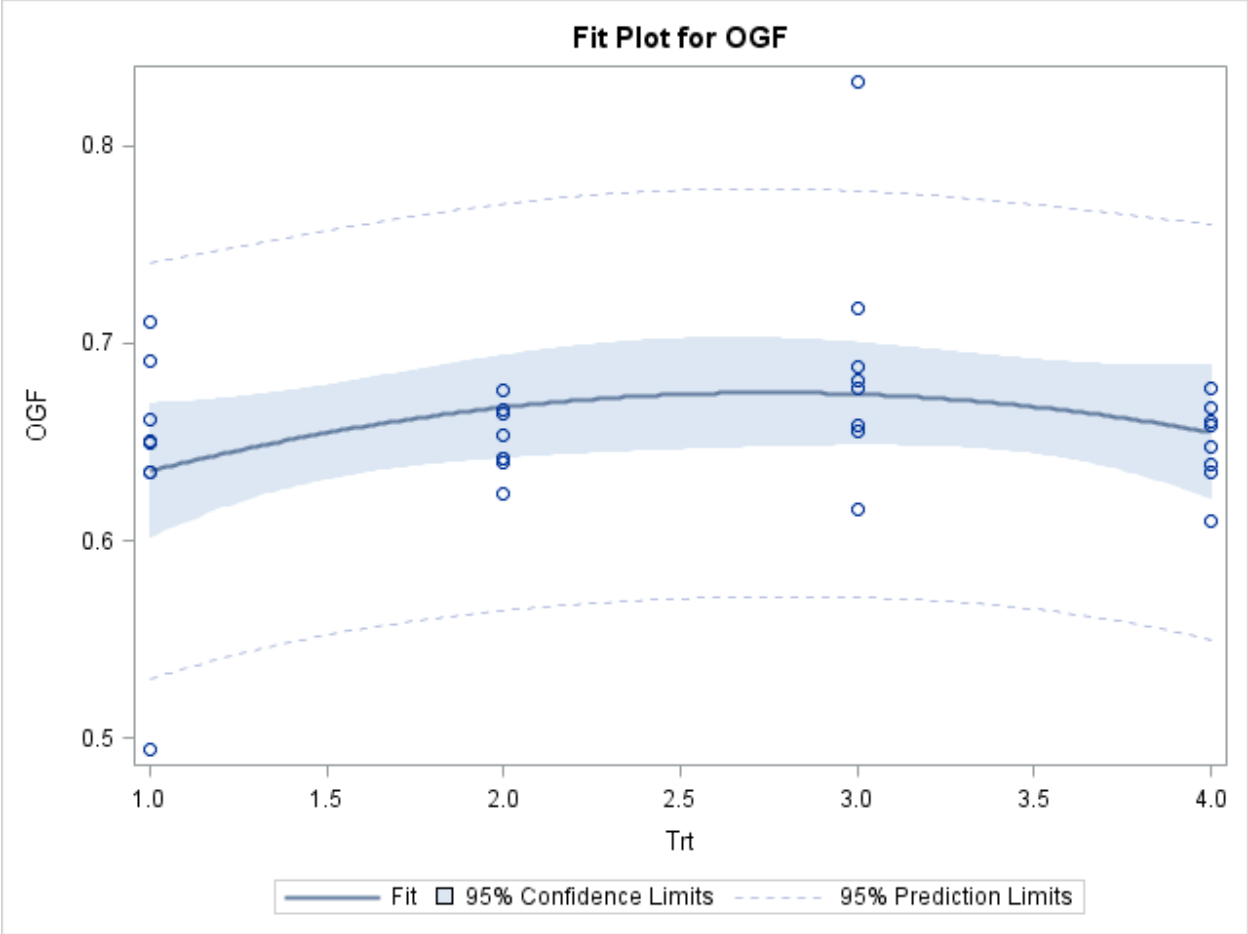
In phase III, there was carrying over effect from phase I and II. Pigs on 2%, 4%, and 6% Cheese powder supplemented diets in phase II had 2.6% ($P = 0.527$), 3.8% ($P = 0.370$), and 3.5% ($P = 0.407$) numerical increased in BW compared with control pigs. During phase III, ADFI and ADG did not appreciably differ among dietary treatments ($P > 0.10$). Although not significant, feed efficiency numerically increased by 2.8% with pigs fed 4% Cheese powder during phase II compared with the control pigs ($P = 0.301$).

During the overall period, ADG was not different among dietary treatments ($P > 0.10$). Piglets on 2% and 6% Cheese powder during phase II, had 2.5% ($P = 0.420$) and 4.2% ($P = 0.166$) improvement in ADFI compared with the control pigs. However, piglets on 8% and 4% Cheese

powder during phase I and II, respectively, had similar ADFI relative to the control (P = 0.721). Consequently, feed efficiency was significantly improvement in piglets, which received 8% and 4% Cheese powder during phase I and II, respectively, compared with the control (P = 0.045). During the overall period, there was linear (P = 0.114) and a quadratic (P = 0.144) response of GF as Cheese powderlevel increase from 0% to 12% in phase I or 0% to 6% in phase II (Figure 1).

Table 3. Effect of Cheese meal (Pro 88) on nursery pig's performance.											
		Treatment					P-value				
		1	2	3	4	*SE*	Trt1 vs Trt2	Trt1 vs Trt3	Trt1 vs Trt4	Linear	Quadratic
	BW0, kg	6.26	6.29	6.26	6.27	*0.22*	0.938	0.998	0.991	0.963	0.961
	BW1, kg	10.22	10.62	10.77	10.87	*0.38*	0.451	0.303	0.227	0.531	0.681
Phase I	ADG1, kg	0.282	0.310	0.322	0.329	*0.02*	0.318	0.148	0.092	0.396	0.589
d 0 to 14	ADFI1, kg	0.372	0.407	0.393	0.437	*0.02*	0.129	0.359	0.007	0.868	0.785
	GF1	0.747	0.759	0.830	0.755	*0.04*	0.842	0.189	0.892	0.295	0.328
	BW2, kg	17.32	18.23	18.22	18.50	*0.63*	0.313	0.316	0.194	0.471	0.611
Phase II	ADG2, kg	0.507	0.543	0.532	0.545	*0.03*	0.349	0.518	0.332	0.562	0.661
d 14 to 28	ADFI2, kg	0.803	0.816	0.780	0.804	*0.03*	0.723	0.518	0.969	0.779	0.814
	GF2	0.631	0.664	0.682	0.676	*0.02*	0.314	0.127	0.176	0.271	0.391
	BW3, kg	26.82	27.53	27.83	27.75	*0.79*	0.527	0.370	0.407	0.513	0.613
Phase III	ADG3, kg	0.679	0.664	0.687	0.661	*0.02*	0.663	0.812	0.594	0.854	0.811
d 28 to 42	ADFI3, kg	1.243	1.255	1.233	1.280	*0.02*	0.728	0.755	0.268	0.547	0.445
	GF3	0.545	0.529	0.560	0.517	*0.02*	0.565	0.589	0.301	0.563	0.484
	OADG, kg	0.489	0.506	0.514	0.512	*0.02*	0.464	0.283	0.322	0.442	0.555
Overall period	OADFI, kg	0.806	0.826	0.802	0.840	*0.02*	0.420	0.863	0.166	0.727	0.593
d 0 to 42	OGF, kg	0.641	0.651	0.691	0.649	*0.02*	0.672	0.045	0.721	0.114	0.144

Figure 1. Response of increase level of Cheese meal supplementation on feed efficiency during the overall period.



6. CONCLUSION

In conclusion, supplementation of Cheese powder at 8% during nursery phase I and 4% during nursery phase II diets, appear to maximize feed efficiency. The current data suggest that Cheese meal can substitute spray dried porcine plasma partially or completely in swine diet without any adverse effect on piglet's performance.