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K-STATE Research and Extension

SWINE DAY 2025

KANSAS STATE UNIVERSITY SWINE INDUSTRY DAY 2025

The Effect of a Cheese Co-product in Nursery Pig Diets from Sows Fed with and Without Cheese Co-Product in Lactation

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Summary

A total of 395 weanling pigs (DNA 241 × 600; initially 12.7 lb) were used to evaluate the effects of previous sow lactation feed treatment (control vs. cheese co-product) and nursery diets formulated with or without a cheese co-product on growth performance in a 35-d trial. Pigs were weaned at approximately 19 d from sows fed lactation diets either with or without 4% cheese co-product (Pro88, Keys Manufacturing, Paris, IL). Pigs were placed in pens (five pigs per pen) within sow treatment and were randomly assigned one of two dietary nursery treatments. There were 19 to 21 replications per treatment. Nursery treatments included either a control diet or the control diet with 4% added cheese co-product fed in phases 1 and 2, followed by a common diet fed to all pigs in phase 3. Dietary treatments were arranged in a 2 × 2 factorial with main effects of sow diet (with or without cheese co-product) and nursery diet (with or without cheese co-product). There were no sow-diet-by-nursery-diet interactions observed throughout the study. Offspring from sows fed cheese co-product were heavier ($P < 0.001$) at weaning than those not fed cheese co-product, and this weight advantage was maintained throughout the study. There was a tendency ($P = 0.058$) for fewer piglets fed the cheese co-product in the nursery to lose body weight from d 0 to 3 after weaning, regardless of the previous sow treatment. During the experimental period (d 0 to 21 post-weaning), pigs weaned from sows fed the cheese co-product tended to have improved ($P = 0.079$) F/G, leading to a tendency for improvement ($P = 0.059$) in overall F/G. There were no effects on ADG or ADFI. In addition, during the experimental period, feeding the cheese co-product in the nursery diet improved ($P = 0.008$) F/G compared to pigs fed the control diet, resulting in an improvement ($P = 0.032$) in overall F/G. There were no effects on ADG or ADFI. In conclusion, F/G tended to be improved in offspring weaned from sows fed the cheese co-product, and feeding it in phase 1 and 2 nursery diets improved F/G and tended to reduce the number of pigs that lost weight in the first three days after weaning.

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Introduction

Some believe using the same specialty ingredients in the diets of both lactating sows and their offspring could increase feed intake of pigs post-weaning. This may be driven by the attraction of the newly weaned pig to feed of a similar taste or smell as consumed by the sow. The cheese co-product used in this study (Pro 88, Keys Manufacturing, Paris, IL) has a relatively high protein, fat, and mineral content. Recently, it was evaluated to determine its standardized ileal digestible (SID) amino acid concentration and ME content. That study found that the cheese co-product has greater SID amino acid values and greater ME content compared to enzymatically treated soybean meal and fish meal.[3] In addition to the product being a good source of nutrients, it is believed that some of the components in the cheese co-product could stimulate feed intake of newly weaned pigs. In the sow lactation portion of this study, we observed that the addition of the cheese co-product to sow lactation diets did not result in changes in sow or litter performance. However, to our knowledge, there has been no published research conducted that examines the potential benefits of feeding this cheese co-product to the offspring of sows who were also fed it. Therefore, the objective of this study was to determine the effects of cheese co-product on the growth performance of nursery pigs weaned from sows fed with or without it throughout lactation.

Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. This study was conducted at the Kansas State University Swine Teaching and Research Center. All diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Center.

Animals and diets

A total of 395 weanling pigs (DNA 241 × 600; initially 12.7 lb) were used in a 35-d trial with 19 to 21 replications per treatment. Nursery pigs were weaned from sows fed either a control diet or a diet containing 4% cheese co-product (Pro 88, Keys Manufacturing, Paris, IL) from d 2 of lactation until weaning. All pigs considered healthy and viable were placed on test. Nine pigs from sows fed the control diet and 11 pigs from sows fed the cheese co-product diet were not used in the experiment due to illness or lameness. Pigs were weaned at approximately 18 days of age and allotted to either a control diet or a diet with the addition of 4% cheese co-product in phases 1 and 2, followed by a common diet fed in phase 3. The cheese co-product was added at the expense of enzymatically treated soybean meal (HP 300; Hamlet Protein, Findlay, OH) and corn with feed-grade amino acids (AA) adjusted to maintain similar SID AA concentrations as the control diets. Dietary treatments were arranged in a 2 × 2 factorial with main effects of previous sow treatment (control vs. cheese co-product) and nursery treatment (control vs. cheese co-product). There were 19 to 21 replications per treatment because of the difference in the number of pigs weaned from each sow treatment.

The phase 1 diet was pelleted and fed from d 0 to 9, while phases 2 and 3 were fed in mash form, with phase 2 fed from d 9 to 21 and phase 3 from d 21 to 35. Phase 1 and 2 diets were formulated to 1.35% SID Lys, and sodium chloride was adjusted to balance diets within phase for each diet. The diets were not isocaloric. All other nutrients

[3] Mallea, A. P., M. S. F. Oliveira, D. A. Lopez, and H. H. Stein. 2023. Nutritional value of a new source of cheese coproduct fed to weanling pigs. J. Anim Sci. 101:skad107. doi:10.1093/jas/skad107.

were formulated to meet or exceed the NRC (2012)[4] requirement estimates. Nutrient loading values for the cheese co-product were provided by the supplier, with the other ingredient loading values obtained from the NRC (2012).

Pigs and feeders were weighed on d 3, 9, 17, 21, 24, 31, and 35 to determine ADG, ADFI, and F/G. Additionally, feeders were weighed daily from d 0 to 9 to determine daily feed disappearance during phase 1. The percentage of pigs that lost weight from d 0 to 3 was calculated using the d 0 weight, which was captured at weaning.

Statistical analysis

Performance data were analyzed using R software (version 4.4.1, R Foundation for Statistical Computing, Vienna, Austria). Data were analyzed as a generalized randomized block design with pen considered as the experimental unit. Treatment and block served as fixed effects. Contrast statements were used to test the main effects of sow treatment, nursery treatment, and their interaction. The percentage of pigs that lost weight from d 0 to 3 was analyzed using a binomial distribution. Results were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

There were no interactions between sow and nursery treatment observed throughout the study (Table 2). At weaning, offspring from sows fed the cheese co-product were heavier ($P < 0.001$; Tables 2 and 3) than pigs from sows fed the control diet. While there was no overall difference in weaning weight found when combining the three farrowing groups of sows used for the overall lactation study, there was a difference with this individual weaning group.

From d 0 to 3 days post-weaning, there was a tendency for a greater percentage of pigs fed the control diet to lose weight ($P = 0.058$) compared to pigs fed diets containing the cheese co-product.

Neither sow nor nursery treatment influenced phase 1 (d 0 to 9) growth performance. Likewise, from d 0 to 9 post-weaning, there were no differences in daily feed disappearance ($P > 0.10$) (Figure 1). In phase 2 (d 9 to 21), there were no differences observed for ADG; however, pigs fed the cheese co-product in phase 2 diets had improved ($P = 0.002$) F/G and a tendency for increased ($P = 0.086$) ADFI. For the experimental period (d 0 to 21), ADG and ADFI were not affected by sow or nursery treatment, but there was a tendency for an improvement ($P = 0.079$) in F/G in offspring of sows fed the cheese co-product in lactation diets and an improvement ($P = 0.008$) in F/G when it was fed in nursery diets. In phase 3, when a common diet was fed (d 21 to 35), there was a tendency ($P = 0.076$) for pigs weaned from sows fed the cheese co-product to have improved F/G.

Overall, there were no differences observed in ADG or ADFI for offspring weaned from sows fed the cheese co-product in lactation or in phase 1 and 2 nursery diets. However, there was a tendency for an improvement in F/G when pigs were weaned from sows fed the cheese co-product ($P = 0.059$) and an improvement in F/G when it was fed in nursery diets ($P = 0.032$). In conclusion, feeding this cheese co-product to sows during lactation and subsequently to their offspring did not increase post-weaning daily feed disappearance, and therefore, an association between cheese co-product fed

[4]National Research Council. 2012. Nutrient Requirements of Swine: Eleventh Revised Edition, Washington, DC: The National Academies Press. doi./10.17226/13298

in lactation and nursery diets was not observed. While no interaction between sow and nursery treatment was observed in overall growth performance, including this cheese co-product in lactation or nursery diets improved feed efficiency of weanling pigs.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Diet composition (as-fed basis)[1]

	Phase 1		Phase 2		Phase 3
Ingredients, %	Control	Cheese co-product	Control	Cheese co-product	Common
Corn	40.75	39.37	53.42	52.22	67.80
Soybean meal	19.86	19.85	27.42	27.33	28.13
Cheese co-product[2]	---	4.00	---	4.00	---
Whey permeate	11.25	11.25	10.00	10.00	---
Spray-dried whey powder	10.00	10.00	---	---	---
Enzymatically treated SBM[3]	7.50	5.00	3.75	1.25	---
Corn DDGS	5.00	5.00	---	---	---
Corn oil	1.50	1.50	1.00	1.00	---
Monocalcium phosphate	1.35	1.40	1.30	1.30	0.95
Calcium carbonate	0.45	0.40	0.68	0.63	0.85
Sodium chloride	0.38	0.33	0.55	0.48	0.60
L-Lys-HCl	0.50	0.46	0.51	0.47	0.55
DL-Met	0.24	0.24	0.24	0.23	0.21
L-Thr	0.23	0.23	0.25	0.24	0.24
L-Trp	0.04	0.04	0.04	0.04	0.06
L-Val	0.12	0.10	0.15	0.12	0.16
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Phytase[4]	0.06	0.06	0.06	0.06	0.06
Zinc oxide	0.39	0.39	0.25	0.25	---
Total	100.0	100.0	100.0	100.0	100.0

continued

Table 1. Diet composition (as-fed basis)[1]

	Phase 1		Phase 2		Phase 3
Ingredients, %	Control	Cheese co-product	Control	Cheese co-product	Common
SID amino acids, %					
Lys	1.35	1.35	1.35	1.35	1.30
Ile:Lys	57	58	55	56	53
Leu:Lys	113	115	110	112	113
Met:Lys	38	38	37	38	36
Met & Cys:Lys	58	58	58	58	57
Thr:Lys	65	65	65	65	64
Trp:Lys	20.0	20.0	20.0	20.0	20.0
Val:Lys	70	70	70	70	70
His:Lys	34	35	35	36	35
Total Lys, %	1.50	1.49	1.49	1.49	1.44
NE, kcal/lb	1,154	1,176	1,132	1,155	1,108
SID Lys:NE, g/Mcal	5.31	5.21	5.41	5.30	5.32
CP, %	20.7	20.8	20.8	20.8	20.0
Ca, %	0.69	0.70	0.71	0.71	0.68
P, %	0.73	0.75	0.68	0.68	0.58
STTD P, %	0.63	0.63	0.56	0.55	0.46

[1]Phase 1 diets were fed from d 0 to 9. Phase 2 diets were fed from d 9 to 21. Phase 3 was fed to all pigs from d 21 to 35.
[2]Pro88 (Keys Manufacturing, Paris, IL).
[3]HP 300 (Hamlet Protein, Findlay, OH).
[4]Ronozyme HiPhos (DSM, Parsippany, NJ), included at 674 FTU/lb provided an estimated release of 0.12% STTD P.

Table 2. Interactive effects of sow and nursery pig diets with added cheese co-product on growth performance[1]

Sow treatment[2]:	Control		Cheese co-product			*P* =		
Nursery treatment[3]:	Control	Cheese co-product	Control	Cheese co-product	SEM	Sow × nursery	Sow	Nursery
Body weight, lb								
d 0	12.3	12.4	13.0	13.2	0.05	0.662	< 0.001	0.050
d 3	12.8	12.8	13.2	13.6	0.13	0.129	< 0.001	0.102
d 9	15.9	15.8	16.5	16.7	0.16	0.192	< 0.001	0.674
d 21	26.6	26.8	27.4	27.8	0.35	0.762	0.012	0.387
d 35	44.2	44.4	45.8	45.6	0.59	0.717	0.018	0.904
d 0 to 3								
Pigs lost weight, %[4]	37.2	33.0	54.4	33.0	6.78	0.202	0.203	0.058
Phase 1 (d 0 to 9)								
ADG, lb	0.40	0.38	0.38	0.40	0.02	0.212	0.788	0.916
ADFI, lb	0.43	0.41	0.41	0.41	0.02	0.348	0.571	0.632
F/G	1.10	1.07	1.10	1.04	0.03	0.709	0.195	0.717
Phase 2 (d 9 to 21)								
ADG, lb	0.90	0.93	0.90	0.92	0.02	0.745	0.994	0.394
ADFI, lb	1.28	1.23	1.29	1.24	0.03	0.991	0.803	0.086
F/G	1.44	1.34	1.41	1.37	0.02	0.271	0.943	0.002
Experimental period (d 0 to 21)								
ADG, lb	0.62	0.62	0.63	0.65	0.01	0.583	0.265	0.632
ADFI, lb	0.78	0.75	0.77	0.75	0.02	0.739	0.868	0.167
F/G	1.26	1.21	1.23	1.17	0.02	0.805	0.079	0.008
Phase 3 (d 21 to 35)								
ADG, lb	1.24	1.26	1.31	1.27	0.03	0.391	0.179	0.670
ADFI, lb	1.90	1.91	1.95	1.90	0.04	0.375	0.572	0.652
F/G	1.53	1.53	1.49	1.50	0.02	0.881	0.076	0.865
Overall								
ADG, lb	0.91	0.91	0.93	0.92	0.02	0.522	0.273	0.966
ADFI, lb	1.31	1.29	1.32	1.29	0.02	0.641	0.762	0.283
F/G	1.44	1.41	1.42	1.39	0.01	0.747	0.059	0.032

[1]A total of 395 weaned pigs (DNA 241 × 600) weaned at approximately 18 d of age were used in a 35-d nursery trial with 19 to 21 pens per treatment and five pigs per pen.

[2]Sow treatment consisted of providing a control diet or a diet with the inclusion of 4% cheese co-product (Pro88; Keys Manufacturing, Paris, IL) in lactation.

[3]Nursery treatment consisted of providing a control diet or a diet with the inclusion of 4% cheese co-product (Pro88; Keys Manufacturing, Paris, IL) in phases 1 and 2, with a common diet being fed in phase 3.

[4]Percentage of pigs that lost weight on d 3 after weaning compared to the weight obtained at weaning.

Table 3. Main effects of added cheese co-product in diets fed to sows or nursery pigs on growth performance[1]

	Sow treatment[2]				Nursery treatment[3]			
Item	Control	Cheese co-product	SEM	*P* =	Control	Cheese co-product	SEM	*P* =
Body weight, lb								
d 0	12.4	13.1	0.03	< 0.001	12.7	12.8	0.03	0.050
d 3	12.7	13.4	0.11	< 0.001	13.0	13.2	0.09	0.102
d 9	15.9	16.6	0.11	< 0.001	16.2	16.3	0.11	0.674
d 21	26.7	27.6	0.24	0.012	27.0	27.3	0.25	0.387
d 35	44.3	45.7	0.42	0.018	45.0	45.0	0.41	0.904
d 0 to 3								
Pigs lost weight, %[4]	35.1	43.7	0.48	0.203	45.8	33.0	0.47	0.058
Phase 1 (d 0 to 9)								
ADG, lb	0.39	0.39	0.01	0.788	0.39	0.39	0.01	0.916
ADFI, lb	0.42	0.41	0.01	0.571	0.42	0.41	0.01	0.632
F/G	1.10	1.06	0.02	0.195	1.08	1.07	1.02	0.717
Phase 2 (d 9 to 21)								
ADG, lb	0.91	0.91	0.02	0.760	0.90	0.92	0.02	0.520
ADFI, lb	1.26	1.26	0.01	0.803	1.28	1.24	0.02	0.086
F/G	1.39	1.39	0.02	0.943	1.42	1.36	0.02	0.002
Experimental period (d 0 to 21)								
ADG, lb	0.62	0.63	0.02	0.265	0.62	0.63	0.01	0.632
ADFI, lb	0.76	0.76	0.01	0.868	0.77	0.75	0.01	0.167
F/G	1.23	1.20	0.01	0.079	1.25	1.19	0.01	0.008
Phase 3 (d 21 to 35)								
ADG, lb	1.25	1.29	0.02	0.179	1.29	1.27	0.02	0.670
ADFI, lb	1.90	1.92	0.03	0.572	1.92	1.91	0.03	0.652
F/G	1.53	1.50	0.01	0.076	1.51	1.51	0.01	0.865
Overall								
ADG, lb	0.91	0.93	0.01	0.273	0.92	0.92	0.01	0.966
ADFI, lb	1.30	1.31	0.02	0.762	1.32	1.29	0.02	0.283
F/G	1.43	1.41	0.01	0.059	1.43	1.41	0.01	0.032

[1]A total of 395 weaned pigs (DNA 241 × 600) weaned at approximately 18 d of age were used in a 35-d nursery trial with 38 to 41 pens per treatment and five pigs per pen.

[2]Sow treatment consisted of providing a control diet or a diet with the inclusion of 4% cheese co-product (Pro88; Keys Manufacturing, Paris, IL) in lactation.

[3]Nursery treatment consisted of providing a control diet or a diet with the inclusion of 4% cheese co-product (Pro88; Keys Manufacturing, Paris, IL) in phases 1 and 2, with a common diet being fed in phase 3.

[4]Percentage of pigs that lost weight on d 3 after weaning compared to the weight obtained at weaning.

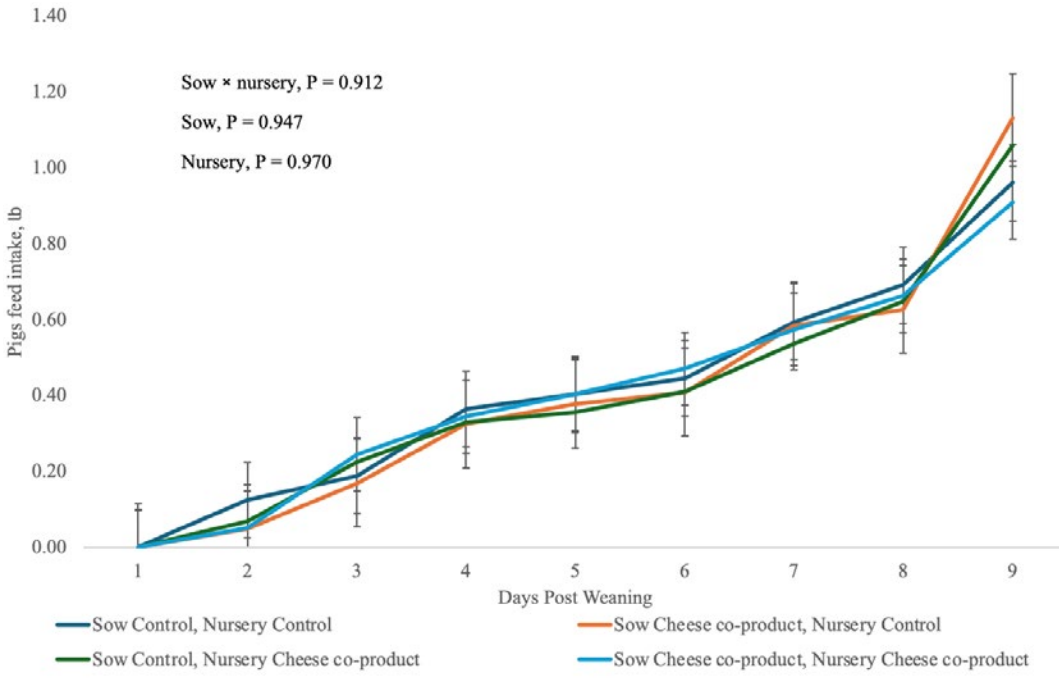

Figure 1. Average daily feed disappearance per pig for piglets weaned from sows fed diets with or without cheese co-product in lactation and/or nursery diets with or without cheese co-product. Feeders were weighed daily starting 24 h post-weaning for the first nine days post-weaning to determine daily feed disappearance in the early post-weaning phase.