The Effect of Increased Standardized Ileal Digestible Lysine through Increased Soybean Meal During Late Gestation on Lactating Sow Performance

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Summary

A total of 87 sows (Line 241, DNA) and their offspring were used to evaluate the effect of increasing SID Lys through increasing soybean meal concentration in late-gestating sow diets on sow and litter lactation performance. Sows were blocked by parity and body weight (BW) on approximately d 90 of gestation and allotted to one of three treatments of increasing SID Lys (0.60, 0.80, or 1.00%) through increased soybean meal (14, 21, or 29% of the diet). Sows received approximately 4.5 lb/d of their treatment diet for an average SID Lys intake of 11.9, 15.8, or 19.9 g/d, respectively. Diets were fed from d 90 of gestation until farrowing. After farrowing, all sows were fed a common lactation diet containing 1.10% SID Lys. Litters were cross-fostered within sow treatment by 48 h after farrowing to equalize litter size. Parity was included in the statistical model as a fixed effect with sows being classified as either as primiparous (n=35) or multiparous (n=52). Weight gain from d 90 to d 110 of gestation increased as SID Lys increased (linear, $P < 0.001$). Change in urinary creatinine level from d 90 until d 110 of gestation tended to decrease as SID Lys level in the late gestation diet increased (linear, $P = 0.063$) indicating less muscle catabolism. Piglet ADG from d 2 to d 10 of lactation increased as SID Lys fed in gestation increased (linear, $P = 0.017$). There was a quadratic effect of late gestation sow diet on litter gain from d 2 until weaning (quadratic, $P = 0.044$). Litters from sows fed the 0.80% SID Lys diet tended to have numerically greater lactation litter gain. Sows fed the 0.80% SID Lys diet had numerically the highest (quadratic, $P = 0.025$) piglet mortality during the first two days of lactation. There was a parity × gestation diet interaction for d 2-to-weaning pre-weaning mortality ($P = 0.049$) where pre-weaning mortality increased as SID Lys increased in primiparous sows but decreased as SID Lys increased in multiparous sows. In conclusion, increasing SID Lys through increased SBM linearly increased late-gestation sow BW gain and piglet ADG during the first portion of lactation. However, litters from sows fed 0.80% SID Lys in late gestation had the highest litter ADG during late lactation and overall. These results suggest that increasing SID Lys intake to 0.80% during late gestation may be beneficial in improving lactation performance.

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Introduction

During late gestation, there is a substantial increase in fetal and mammary growth with the first limiting amino acid being lysine. The average born alive reported in a 2021 industry productivity analysis was 13.6 and trending upward,[2] this may point to an increased requirement of Lys during late gestation. Previous research has demonstrated an increase in fetal weight (d 110 of gestation) and mammary parenchymal tissue in gilts fed 40% above the estimated SID Lys requirement set by the NRC.[3] However, this study only utilized gilts, and because the gilts were euthanized for sample collection on d 110 it is unclear if the subsequent lactation performance was influenced by the increased Lys. Therefore, the objective of this trial was to determine if increased Lys accomplished through increased soybean meal fed in late-gestation diets improves sow and litter performance in the subsequent lactation.

Materials and Methods

The protocol for this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. The 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 Innovation Center, Manhattan, KS.

Animals and diets

A total of 87 sows (Line 241, DNA, Columbus, NE) were used across three batch-farrowing groups from May to September 2023. On approximately d 90 of gestation, sows were weighed, then blocked by body weight and parity and assigned to one of three dietary treatments. Two corn-soybean meal-based diets were formulated to contain 0.60% or 1.00% SID Lys with increasing levels of soybean meal (14 or 29% of diet) and feed-grade L-Lys (0.10 or 0.15% of diet; Table 1). An electronic feeding system (Gestal Solo Feeders, Jyga Technologies, Quebec City, Quebec, Canada) was used to blend the two diets (50:50 blend) to provide the intermediate 0.80% SID Lys diet. Sows were fed approximately 4.5 lb/day of their treatment diet from d 90 of gestation until farrowing. After farrowing, sows had ad libitum access to a common lactation diet. Gestation and lactation diets were formulated to meet or exceed NRC (2012)[4] nutrient requirement estimates.

Sow BW was measured on d 90 and 110 of gestation, after farrowing, and at weaning. Sow backfat depth and loin depth were measured on d 90 and 110 of gestation and at weaning at the last rib, three inches from the midline using an IBEX Pro ultrasound machine (E.I. Medical Imaging, Loveland, CO). Sow caliper score was measured at the last rib on d 90 and 110 of gestation and at weaning. Piglets were cross fostered by 48 h of birth within sow treatment to equalize litter size. Litters were weighed at birth, on d 2 and 10, and at weaning. An electronic feeding system (Gestal Quattro Opti feeder, Jyga Technologies, Quebec City, Quebec, Canada) was used to track lactation feed intake.

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[2] MetaFarms. 2022. Production Analysis Summary for U.S. Pork Industry: 2017-2021. National Pork Board, Des Moines, IA.

[3] Farmer, C., M.F. Palin, R.C. Hovey, T.D. Falt, and L.A.Huber. 2022. Dietary supplementation with lysine (protein) stimulates mammary development in late pregnant gilts. J. Anim. Sci. 2022. 100:1-11.

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

Colostrum was collected from each sow from the third, fourth, and fifth teat on both sides of the underline within 1 h of the start of farrowing to ascertain crude protein content. Sow urine samples were collected on d 90 and 110 of gestation to obtain urinary creatinine levels. All samples were frozen and stored at -20°F until analysis.

Chemical analysis

Protein content of colostrum samples was determined by combustion using a Leco TruMac N with TruMac operating software (Leco Corporation, St. Joseph, MI). Urinary creatinine content was measured via a urinary creatinine colorimetric assay kit (Cayman Chemical Company, Ann Arbor, MI).

Statistical analysis

Performance data for the trial were analyzed using the lme4 package of R (Version 4.0.0, R Foundation for Statistical Computing, Vienna, Austria) as a randomized complete block design. Blocking structure accounted for parity and BW. Sow served as the experimental unit. Treatment and parity (multiparous or primiparous sows) and the interaction of the two were included as fixed effects. Block and farrowing group were included as random effects. Count data were analyzed using a Poisson distribution using a log link function. Proportion data, including litter born alive, stillborn, born mummified, and pre-weaning mortality were analyzed using a binomial distribution using a logit link function. Differences were considered significant at $P \leq 0.05$ and marginally significant at $0.05 < P \leq 0.10$.

Results and Discussion

Multiparous sows were heavier than primiparous sows at d 90, entry into the farrowing house, and weaning ($P < 0.001$; Table 2). As SID Lys increased, gestation BW change increased (linear, $P < 0.001$) resulting in a tendency for increased BW at entry to the farrowing house (linear, $P = 0.071$). Multiparous sows had more backfat at d 90 of gestation ($P = 0.010$) and tended to have more backfat at entry to the farrowing house ($P = 0.053$) compared to primiparous sows. Late gestation SID Lys level tended to influence backfat thickness at farrowing house entry where sows fed the 0.80% SID Lys diet had numerically the greatest backfat depth (quadratic, $P = 0.077$). There was an SID Lys by parity interaction for sow loin depth at entry into the farrowing house ($P = 0.031$; Table 3) where primiparous sows fed 0.80% SID Lys had the lowest loin depth whereas multiparous sows fed 0.60% SID Lys had the lowest loin depth relative to the other sows. There was a tendency for SID Lys to impact gestation and lactation loin depth change (quadratic, $P \leq 0.076$; Table 2) where sows fed 0.60% or 1.00% SID Lys had a greater increase in loin depth during late gestation but lost more loin depth over lactation when compared to sows fed 0.80% SID Lys in gestation. Multiparous sows had a higher ADFI during gestation and lactation when compared to primiparous sows ($P \leq 0.002$). Sows fed 0.80% SID Lys had lower late gestation ADFI ($P = 0.075$) compared to sows fed 0.60 or 1.00% SID Lys; however, treatment differences were small (0.03 lb/day). As expected, increasing SID Lys increased Lys intake/d during gestation (linear, $P < 0.001$).

During lactation, sows fed 0.80% SID Lys during late gestation had the greatest backfat loss compared to those fed 0.60 or 1.00% SID Lys diets (quadratic, $P = 0.054$; Table 2). There was a significant treatment by parity interaction on caliper score at weaning ($P = 0.040$; Table 3) where primiparous sows fed 0.80% SID Lys had the lowest caliper score compared to the primiparous sows on 0.60 or 1.00% SID Lys diets, whereas multiparous sows fed 0.80% SID Lys had the highest caliper score at weaning when compared to the multiparous sows fed 0.60 or 1.0% SID Lys diets. There was a tendency for a treatment by parity interaction on sow BW change from d 90 of gestation until weaning ($P \leq 0.072$). For primiparous sows, BW loss decreased as SID Lys increased, with primiparous sows fed the diet with 1.00% SID Lys in late gestation gaining weight overall. However, as SID Lys increased in late gestation, multiparous sows lost more BW. There was also a tendency for a main effect of parity on sow BW change from d 90 of gestation until weaning ($P = 0.062$; Table 2). Primiparous sows tended to lose less weight from d 90 of gestation until weaning compared to multiparous sows ($P = 0.062$).

There was a tendency for a linear effect of SID Lys on lactation length that as SID Lys increased, lactation length tended to decrease (linear, $P = 0.098$; Table 2). This was due to a numerical increase in gestation length where sows fed the 1.00% SID Lys diet had the longest gestation length and, thus, shortest lactation length. There was a tendency for an interaction between SID Lys and parity on wean to estrus interval ($P = 0.089$; Table 3). Wean to estrus interval decreased as SID Lys increased in primiparous sows but was longest in multiparous sows fed 0.80% SID Lys in late gestation.

The total number of pigs born was greater in multiparous sows compared to primiparous sows ($P = 0.015$; Table 4). Primiparous sows had a greater percentage born alive and lower incidence of mummies compared to multiparous sows ($P \leq 0.042$). The percentage born alive tended to decrease, and stillborns tended to increase as SID Lys increased (linear, $P \leq 0.095$).

Litter weight was greater in multiparous sows than primiparous sows at all time points ($P \leq 0.013$; Table 4). Litters from sows fed 0.80% SID Lys during late gestation tended to have the heaviest weaning weight when compared to litters from sows fed 0.60 or 1.0% SID Lys (quadratic, $P = 0.074$). Mean piglet BW was greater in pigs born from multiparous sows compared to primiparous sows on d 2 and at weaning ($P \leq 0.046$). Litter ADG from d 2 to 10 of lactation tended to increase as SID Lys fed in late gestation increased (linear, $P = 0.060$). There was a tendency for an interaction between sow treatment and parity for litter gain and litter ADG from d 10 to weaning ($P = 0.060$) where primiparous sows fed 1.00% SID Lys treatment had the lowest litter gain and litter ADG, while multiparous sows fed 0.60% SID Lys had the lowest litter gain and litter ADG. Sows fed 0.80% SID Lys in late gestation had the highest litter gain (quadratic, $P = 0.044$). Multiparous sows had greater litter ADG compared to primiparous sows ($P = 0.090$). Piglet ADG from d 2 to 10 increased as SID Lys increased (linear, $P = 0.017$). Litters from sows fed 0.80% SID Lys had the highest birth-to-d 2 piglet mortality compared to sows fed either 0.60 or 1.00% SID Lys ($P = 0.025$). There was a parity by SID Lys inclusion interaction on d 2-to-wean pre-weaning mortality where primiparous sows fed 1.00% SID Lys during gestation had the highest d 2-to-weaning mortality but multiparous sows fed 1.00% SID Lys during gestation had the lowest ($P = 0.049$).

Colostrum protein content did not differ based on late gestation diet ($P > 0.10$; Table 5). Urinary creatinine concentration did not differ at either time point with increasing SID Lys. However, change in urinary creatinine concentration tended to decrease as SID Lys increased in late-gestation diets (linear, *P* = 0.063; Table 5). This indicates a decrease in muscle catabolism in sows fed higher levels of Lys in late gestation.

In conclusion, increased SID Lys through increased SBM in late-gestation diets linearly increased sow BW gain in late gestation and piglet ADG during early lactation, while sows fed 0.80% SID Lys weaned the heaviest litters. These results suggest that increasing SID Lys intake to 0.80% during late gestation may be beneficial in improving lactation performance.

Table 1. Diet composition (as-fed basis)

Ingredient, %	Gestation[1] Low lysine	Gestation[1] High lysine	Common lactation
Corn	82.30	67.55	65.95
Soybean meal, 46.5% CP	14.00	28.75	28.15
Soybean oil	---	---	2.00
Calcium carbonate	1.15	1.10	1.25
Monocalcium P, 21.5% P	1.35	1.15	1.15
Sodium chloride	0.50	0.50	0.50
L-Lysine-HCl	0.10	0.15	0.30
DL-Methionine	0.05	0.15	0.08
L-Threonine	0.05	0.16	0.11
L-Tryptophan	---	---	0.01
Trace mineral premix	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated analysis			
SID AA, %			
Lys	0.60	1.00	1.10
Ile:Lys	76	70	63
Leu:Lys	189	148	132
Met:Lys	42	42	31
Met and Cys:Lys	76	69	55
Thr:Lys	75	75	63
Trp:Lys	21	20	19
Val:Lys	88	77	68
His:Lys	54	47	41
Total Lys, %	0.70	1.14	1.23
ME, kcal/lb	1,481	1,479	1,523
NE, kcal/lb[2]	1,156	1,144	1,186
SID Lys:NE, g/Mcal	2.36	3.96	4.21
CP, %	13.6	19.6	19.3
Ca, %	0.80	0.79	0.89
P, %	0.60	0.63	0.62
STTD P, %	0.50	0.50	0.50

[1]Diets were fed from d 90 of gestation until farrowing. Low- and high-lysine diets were blended at a 50:50 ratio to form the intermediate treatment.

[2]NE value for soybean meal (91.4% of corn) was derived based on Sotak et al. (2015) that used the equation from Noblet (1994) to determine NE from ME. Other ingredient NE values based on NRC (2012).

Table 2. Effects of increased SID Lysine through increased soybean meal in late gestation on sow lactation performance[1,2]

SID Lysine, %[3]:	0.60	0.80	1.00		P=				
Soybean meal, %:	14	21	29	SEM	TRT × parity	TRT	Parity	Linear	Quadratic
Count, n	29	29	29	---	---	---	---	---	---
Parity	1.7	1.7	1.7	0.28	0.999	1.000	0.001	0.970	0.983
Gestation length, d	117.0	116.9	117.4	0.23	0.425	0.292	0.385	0.214	0.330
Lactation length, d	18.0	17.9	17.5	0.23	0.170	0.213	0.787	0.098	0.539
Sow BW, lb									
d 90	493.2	489.0	490.8	8.29	0.905	0.704	< 0.001	0.638	0.499
Entry	518.3	522.4	528.9	8.23	0.916	0.189	< 0.001	0.071	0.815
Wean	474.6	474.1	481.2	8.35	0.115	0.652	< 0.001	0.445	0.610
Gestation change (d 90 to entry)	25.3[b]	33.8[a]	38.2[a]	2.61	0.794	0.001	0.352	< 0.001	0.473
Lactation change (entry to wean)	-42.5	-46.7	-44.8	5.76	0.113	0.872	0.142	0.772	0.662
Overall change (d 90 to wean)	-17.0	-13.1	-7.0	5.33	0.072	0.373	0.062	0.166	0.858
Sow backfat, mm									
d 90	12.7	13.7	13.5	0.42	0.862	0.177	0.010	0.169	0.211
Entry	12.8	13.8	13.2	0.37	0.448	0.149	0.053	0.422	0.077
Wean	11.7	12.3	12.1	0.37	0.109	0.511	0.126	0.432	0.391
Gestation change (d 90 to entry)	0.2	0.1	-0.2	0.29	0.711	0.564	0.181	0.344	0.615
Lactation change (entry to wean)	-1.2	-1.7	-1.2	0.28	0.745	0.147	0.683	0.769	0.054
Overall change (d 90 to wean)	-1.0	-1.5	-1.3	0.37	0.292	0.637	0.260	0.552	0.458
Sow caliper score									
d 90	16.1	16.4	16.2	0.30	0.145	0.722	0.343	0.809	0.445
Entry	14.9	15.4	15.3	0.44	0.181	0.452	0.612	0.395	0.363
Wean	12.6	12.8	12.7	0.45	0.040	0.952	0.131	0.853	0.799
Gestation change (d 90 to entry)	-1.2	-1.0	-1.0	0.27	0.671	0.673	0.809	0.432	0.691
Lactation change (entry to wean)	-2.4	-2.9	-2.5	0.49	0.302	0.305	0.441	0.681	0.138
Overall change (d 90 to wean)	-3.6	-3.7	-3.5	0.43	0.301	0.906	0.382	0.911	0.669
Sow loin depth, mm									
d 90	49.4	50.1	49.6	0.84	0.367	0.795	0.739	0.819	0.528
Entry	50.6	50.2	51.3	0.78	0.031	0.359	0.902	0.343	0.275
Wean	50.5	50.8	50.9	0.66	0.107	0.867	0.934	0.600	0.925
Gestation change (d 90 to entry)	1.2	0.1	1.7	0.58	0.290	0.119	0.564	0.480	0.051
Lactation change (entry to wean)	-0.4	0.5	-0.4	0.49	0.232	0.204	0.998	0.950	0.076
Overall change (d 90 to wean)	0.8	0.7	1.3	0.69	0.519	0.791	0.657	0.611	0.653

continued

Table 2. Effects of increased SID Lysine through increased soybean meal in late gestation on sow lactation performance[1,2]

SID Lysine, %[3]:	0.60	0.80	1.00		P=				
Soybean meal, %:	14	21	29	SEM	TRT × parity	TRT	Parity	Linear	Quadratic
Sow ADFI, lb									
Gestation (d 90 to farrow)	4.40	4.37	4.40	0.013	0.766	0.200	0.002	0.850	0.075
Farrow to wean	14.05	14.57	14.04	0.331	0.916	0.410	< 0.001	0.976	0.184
Late gestation average lysine intake, g/d	11.94[c]	15.76[b]	19.88[a]	0.074	0.286	< 0.001	0.006	< 0.001	0.090
Wean to estrus interval, d	5.4	5.4	5.2	0.09	0.089	0.307	0.516	0.206	0.385

[1]A total of 87 mixed-parity sows (Line 241, DNA, Columbus NE) and litters were used from day 90 of gestation until weaning. Litters were cross-fostered within treatment group to equalize litter size within 48-h post farrowing.
[2]Parity was included as a fixed effect in the data analysis model. Sows were either classified as primiparous (n=35) or multiparous (n=52).
[3]Sow treatment consisted of providing a low-lysine control diet (SID Lys= 0.60%), a high-lysine diet, accomplished by adding additional SBM and L-lysine HCl (SID Lys = 1.00%), or a 50:50 blend of the two diets (SID Lys = 0.80%) from d 90 of gestation until farrowing. After farrowing, sows were fed a common lactation diet until weaning.

Table 3. Interactive effects of increased SID Lysine through increased soybean meal in late gestation and parity on sow lactation performance[1]

Parity[2]:	Primiparous			Multiparous				*P* =		
SID Lysine, %[3]:	0.60	0.80	1.00	0.60	0.80	1.00				
Soybean meal, %:	14	21	29	14	21	29	SEM	TRT × parity	TRT	Parity
Sow BW change (d 90 to wean), lb	-15.1[ab]	-11.9[ab]	9.0[a]	-18.9[ab]	-14.4[ab]	-23.0[b]	8.22	0.072	0.373	0.062
Sow caliper score (wean)	12.6[ab]	11.5[b]	12.6[ab]	12.6[ab]	14.1[a]	12.8[ab]	0.70	0.040	0.952	0.131
Sow loin depth (entry), mm	51.7	49.0	51.1	49.4	51.3	51.6	1.22	0.031	0.359	0.902
Litter gain (d 10 to wean), lb	64.26[ab]	64.24[ab]	52.86[b]	61.41[ab]	67.60[a]	65.71[ab]	3.756	0.060	0.128	0.152
Litter ADG (d 10 to wean), lb/d	8.03[ab]	8.03[ab]	6.61[b]	7.68[ab]	8.45[a]	8.21[ab]	0.470	0.060	0.128	0.152
d 2 to wean mortality, %	1.3	2.7	5.4	7.7	6.4	4.3	1.90	0.049	0.146	0.015
Wean to estrus interval, d	5.5	5.3	5.2	5.2	5.4	5.2	0.15	0.089	0.307	0.516

[1]A total of 87 mixed-parity sows (Line 241, DNA, Columbus NE) and litters were used from day 90 of gestation until weaning. Litters were cross fostered within treatment group to equalize litter size within 48-h post farrowing.
[2]Parity was included as a fixed effect in the data analysis model. Sows were either classified as primiparous (n=35) or multiparous (n=52).
[3]Sow treatment consisted of providing a low-lysine control diet (SID Lys= 0.60%), a high-lysine diet, accomplished by adding additional SBM and L-lysine HCl (SID Lys = 1.00%), or a 50:50 blend of the two diets (SID Lys = 0.80%) from d 90 of gestation until farrowing. After farrowing, sows were fed a common lactation diet until weaning.

Table 4. Effects of increased SID Lysine through increased soybean meal in late gestation on sow lactation performance[1,2]

SID Lysine, %[3]:	0.60	0.80	1.00		*P* =				
Soybean meal, %:	14	21	29	SEM	TRT × parity	TRT	Parity	Linear	Quadratic
Litter characteristics									
Total born, n	16.0	16.3	15.6	0.82	0.450	0.539	0.015	0.740	0.624
Born alive, %	91.5	92.5	87.6	1.87	0.649	0.209	0.008	0.095	0.156
Stillborn, %	5.0	4.9	8.4	1.40	0.405	0.129	0.115	0.068	0.301
Mummy, %	3.2	2.3	3.1	1.18	0.864	0.898	0.042	0.970	0.507
Litter size, n									
d 0	14.6	15.0	14.0	0.75	0.975	0.854	0.511	0.548	0.465
d 2	14.2	14.1	13.8	0.72	0.968	0.967	0.568	0.651	0.894
Wean	13.6	13.6	13.2	0.72	0.765	0.780	0.759	0.706	0.804
Litter weight, lb									
d 2	52.0	51.1	49.2	1.35	0.912	0.268	< 0.001	0.113	0.724
d 10	95.0	99.4	94.6	2.89	0.583	0.432	0.013	0.935	0.198
Wean	158.6	165.4	153.9	4.14	0.267	0.144	0.005	0.425	0.074
Mean piglet BW, lb									
d 2	3.7	3.6	3.6	0.10	0.823	0.879	0.016	0.616	0.943
d 10	7.0	7.3	7.2	0.20	0.202	0.521	0.131	0.418	0.427
Wean	11.7	12.2	11.8	0.30	0.344	0.420	0.046	0.802	0.197
Litter gain, lb									
d 2 to d 10	42.9	48.3	45.5	2.41	0.417	0.297	0.686	0.445	0.177
d 10 to wean	62.8	65.9	59.3	2.44	0.060	0.128	0.152	0.278	0.088
d 2 to wean	106.3	114.4	104.8	3.55	0.191	0.124	0.118	0.769	0.044
Litter ADG, lb/d									
d 2 to d 10	5.40	6.05	6.14	0.276	0.855	0.120	0.771	0.060	0.406
d 10 to wean	7.85	8.24	7.41	0.304	0.060	0.128	0.152	0.278	0.088
d 2 to wean	5.92	6.41	5.97	0.199	0.259	0.164	0.090	0.854	0.060
Piglet ADG, lb/d									
d 2 to d 10	0.40[b]	0.44[ab]	0.47[a]	0.022	0.582	0.050	0.479	0.017	0.661
d 10 to wean	0.58	0.61	0.57	0.022	0.479	0.436	0.385	0.808	0.209
d 2 to wean	0.44	0.47	0.46	0.016	0.788	0.217	0.561	0.219	0.213
Preweaning mortality, %									
Birth to d 2	1.7	4.0	1.8	1.14	0.443	0.127	0.141	0.910	0.025
d 2 to wean	3.2	4.2	4.8	1.17	0.049	0.146	0.015	0.339	0.879
Colostrum protein content, %	18.5	19.0	19.0	0.41	0.171	0.582	0.918	0.361	0.632

[1]A total of 87 mixed-parity sows (Line 241, DNA, Columbus NE) and litters were used from day 90 of gestation until weaning. Litters were cross fostered within treatment group to equalize litter size within 48-h post farrowing.
[2]Parity was included as a fixed effect in the data analysis model. Sows were either classified as primiparous (n=35) or multiparous (n=52).
[3]Sow treatment consisted of providing a low-lysine control diet (SID Lys= 0.60%), a high-lysine diet, accomplished by adding additional SBM and L-lysine HCl (SID Lys = 1.00%), or a 50:50 blend of the two diets (SID Lys = 0.80%) from d 90 of gestation until farrowing. After farrowing, sows were fed a common lactation diet until weaning.

Table 5. Evaluation of increased SID Lysine level through increased soybean meal in late gestation on sow urinary creatinine excretion[1]

SID Lysine, %[2]:	0.60	0.80	1.00		*P* =		
SBM inclusion, %:	14	21	29	SEM	Treatment × Sample	Treatment	Sample
Urinary creatinine, mg/dL							
d 90	425.7	299.0	436.9	57.5	0.154	0.124	0.877
d 110	435.0	316.4	312.1				
Change in urinary creatinine, mg/dL[3]	54.1	19.0	-130.4	76.6	---	0.137	---

[1]A total of 87 mixed-parity sows (Line 241, DNA, Columbus NE) and litters were used from day 90 of gestation until weaning. Litters were cross-fostered within treatment group to equalize litter size up to 48-h post farrowing.
[2]Sow treatment consisted of providing a low lysine control diet (SID Lys= 0.60%), a high lysine diet, accomplished by adding additional SBM and L-lysine HCl (SID Lys = 1.00%), or a 50:50 blend of the two diets (SID Lys = 0.80%) from d 90 of gestation until farrowing. After farrowing, sows were fed a common lactation diet until weaning.
[3] Linear, *P* = 0.063; Quadratic, *P* = 0.495.