180 Daily amino acid uptake by the mammary gland in the lactating sow: A new approach for estimating amino acid requirements. N. L. Trottier* and R. A. Easter, University of Illinois, Urbana.

Seven lactating sows were used to estimate daily amino acid uptake by the mammary gland. At parturition, litter size was standardized to 10 and sows were selected for mammary gland soundness. Cannulas were fitted in the right anterior main mammary vein and the carotid artery between d 6 and 8 of lactation. Arterial (A) and venous (V) blood samples were obtained on d 11, 14, 17 and 20 of lactation. Prior to sampling, the dam was separated from the litter (0 min) and given 3 kg of a standard corn-soy diet formulated to meet or exceed NRC requirements. Piglets were returned to the sow 90 min later and the first blood samples were withdrawn. Subsequent samples were taken at 20 min intervals for the next 2 h. Milk production was measured by the weigh-suckle-weigh method and milk samples were obtained between d 11 and 14 (period 1 (P1)) and d 17 and 20 (period 2 (P2)) of lactation. Plasma and defatted milk samples were analyzed for amino acid concentration. The ratio of plasma volume flowing to the mammary system per L of milk produced was estimated by the metabolic Fick method using the A-V difference for lysine and milk lysine concentration. The plasma to milk ratio for P1 was 544:1 and for P2 was 434:1. Average daily milk production was 7.77 ± .82 L and 9.09 ± .63 L, thus daily plasma flow through the mammary system was calculated to be 4196.2 ± 338.7 L and 3945.66 ± 260 L for P1 and P2 ($P > .05$), respectively. The A-V differences did not vary ($P > .05$) over each 2 h sampling period. All essential amino acid A-V differences tended to increase ($P < .2$) from P1 to P2 while milk amino acid concentrations tended to decrease ($P < .1$). Arterial-venous differences (μg/dL) of amino acids averaged over d 11 to d 20 were 862.31 ± 65.06 (leucine), 710.61 ± 61.67 (arginine), 567.81 ± 48.54 (lysine), 508.67 ± 41.00 (valine), 433.65 ± 29.78 (isoleucine), 380.27 ± 47.41 (phenylalanine), 350.21 ± 42.77 (threonine), 277.59 ± 47.84 (tyrosine), 186.50 ± 32.43 (histidine), 146.97 ± 15.67 (methionine), 25.57 ± 6.06 (cysteine). The A-V differences and the plasma flow through the mammary system were used to calculate the following daily amino acid uptakes (g) by the mammary gland: 35.06 ± 1.45 (leucine), 28.9 ± 1.35 (arginine), 26.69 ± 1.81 (phenylalanine + tyrosine) 23.1 ± .5 (lysine), 20.66 ± .85 (valine), 17.63 ± .61 (isoleucine), 15.43 ± .9 (phenylalanine), 14.25 ± .85 (threonine), 7.57 ± .66 (histidine), 7.01 ± .48 (methionine + cysteine), 5.97 ± .35 (methionine). These values, when combined with estimates of daily amino acid needs for maintenance and corrected for efficiencies of digestion and absorption, should be indicative of dietary needs for essential amino acids in the lactating sow.

Key Words: Sow, Mammary Gland, Amino Acids.

182 The effect of protein (lysine) intake during gestation and lactation on lactational performance of the primiparous sow. J. Kusina*, J.E. Pettigrew, A.F. Sower, B.A. Crooker, M.E. White, M.R. Hathaway and G.D. Dial, University of Minnesota, St. Paul.

An experiment was conducted to evaluate effects of lysine intake during gestation and lactation on yield of milk and its components, litter weight gain, sow BW and backfat changes. On d 25 of pregnancy, gilts were allocated to 6 dietary treatments in a 3 x 2 factorial design. Treatments consisted of 3 protein levels in gestation, providing approximately 4, 8 and 16 g of lysine/d and 2 protein levels in lactation, providing approximately 15 and 45 g of lysine/d. Equal amounts of ME (6.5 Mcal/d in gestation, 16.5 Mcal/d in lactation) and all other nutrients were provided. Litters were standardized to 9 piglets/sow by d 3 of lactation. Sow BW and backfat (P2) thickness were determined at farrowing and weaning. Milk composition was measured on samples manually expressed from mammary glands following i.v. injection of 10 IU of oxytocin on d 7 and 17 of lactation. Milk yield was estimated for a 24 h period from d 8 to 9 and d 18 to 19 of lactation by the deuterium oxide dilution method. Litters were weaned at 21 days of age. Increase in protein intake (PI) during gestation and lactation increased ($P < .05$) litter growth (Table). On day 8, total milk yield and milk lactose production were increased ($P < .05$) by increase in PI during gestation. Day 8 total milk yield means for gestation treatments 4, 8, and 16 g of lysine intake/d were 7.2, 8.2, and 9.4 (SD=1.68) kg respectively. Milk fat and protein production on d 8 were increased ($P < .05$) by increase in PI during lactation. On d 18, total milk yield and milk protein production were increased ($P < .05$) by increase in PI during lactation. Day 18 total milk yield means for lactation treatments 15 vs 45 g lysine intake/d were 7.4 and 9.7 (SD=2.34) kg respectively. Milk fat production was increased ($P < .05$) by increase in PI during both gestation and lactation. Lactation sow BW loss was decreased ($P < .05$) by increase in PI during lactation throughout the whole period, but the effect of increase in PI during gestation was apparent in wk 3 only ($P < .05$), with sows fed 8 g of lysine/d losing the most weight. Sow backfat thickness loss was not affected ($P > .05$) by either gestation or lactation treatment. There was no significant interaction between gestation and lactation treatment on any of the parameters measured. Feeding primiparous sows higher protein during gestation than is currently recommended by NRC (1988) may increase sow milk production and litter weight gain.

	Litter weight gain in lactation (kg/piglet) Lysine Intake g/d (Gestation - Lactation)							
	4-15	4-45	8-15	8-45	16-15	16-45	Mean	SD
No. of sows	5	4	8	8	6	5		
Week 1 [a]	1.00	1.25	1.19	1.25	1.40	1.63	1.27	0.22
Week 2 [a]	0.75	1.30	1.24	1.49	1.39	1.60	1.32	0.27
Week 3 [b]	0.69	1.29	0.53	1.29	1.18	1.55	1.06	0.69
Total 21d [a]	2.43	3.84	2.96	4.03	3.97	4.78	3.65	0.97

[a]Gestation treatment effect ($P < .05$) [b]Lactation treatment effect ($P < .05$)

Key Words: Milk Yield, Litter weight, Sows

181 Valine and lysine independently improve sow productivity during lactation. B.T. Richert*, R.D. Goodband, M.D. Tokach, and J.L. Nelssen, Kansas State University, Manhattan, and S. Kershaw, and R.G. Campbell, Bunge Meat Industries Ltd., N.S.W., Australia.

Sows (98 parity 1 and 104 parity 2) were used to determine the effect of dietary valine and lysine on sow lactation performance. Treatments were arranged in a 2 × 3 factorial with two levels of lysine (.8 or 1.2%), and three valine to lysine ratios (80, 100, 120% of lysine). All other amino acids were formulated to be at least 110% of their implied ratio to lysine as suggested by the NRC (1988) and ARC (1981). This experiment was conducted in New South Wales, Australia from January to March, 1994. For all sows, increasing dietary lysine increased litter weaning weight ($P < .001$), and litter weight gain ($P < .002$), and reduced sow weight loss ($P < .001$). Increasing dietary valine had no influence on sow or litter performance ($P > .19$). The data was further divided by production level into two groups based upon number of pigs weaned (< 10 or ≥ 10 pigs). Sows that weaned ≥ 10 pigs had a greater increase ($P < .001$) in litter weaning weight and litter weight gain when dietary lysine was increased from .8 to 1.2% than sows weaning < 10 pigs. Sows weaning ≥ 10 pigs also had a linear increase in litter weaning weight ($P < .04$) and litter weight gain ($P < .04$) as valine increased. Sows that weaned less than 10 pigs had no response to increasing lysine ($P > .45$) or valine ($P > .13$). Serum urea nitrogen increased ($P < .001$) with increased dietary lysine, but was not affected by valine ($P > .25$). This research demonstrates the high producing sow (weaning ≥ 10 pigs) requires increased lysine and valine to maximize litter growth rate. The independent increases in litter weaning weights due to adding lysine and valine suggest separate modes of action for these amino acids in milk synthesis in high producing sows.

Item, Val:Lys, %	.8% Lysine 80	100	120	1.2% Lysine 80	100	120	CV
≥ 10 Pigs weaned							
Number of sows	22	20	24	23	25	19	
Number of pigs weaned	10.6	10.4	10.4	10.5	10.5	10.5	4.7
ADFI, kg[a]	4.37	4.22	4.59	4.76	4.65	4.86	18.2
Sow weight loss, kg[b]	21.6	23.2	24.5	11.9	13.1	13.7	71.7
LW gain d 2 to 24, kg[b,c,d]	47.5	46.0	49.7	51.3	49.8	55.7	14.5
< 10 Pigs weaned							
Number of sows	14	11	13	11	10	10	
Number of pigs weaned	8.6	8.7	8.6	8.7	8.9	8.6	5.3
ADFI, kg	4.75	4.61	4.37	4.46	4.06	4.37	22.5
Sow wt loss, kg	15.8	14.1	10.6	9.6	13.0	8.9	135.9
LW gain d 2 to 24, kg[c]	41.4	42.3	41.4	40.5	45.3	39.8	17.5

[a,b]Lysine effect ($P < .02$, $P < .001$, respectively).
[c,d,e]Valine effect (Linear $P < .04$, Quadratic $P < .02$, $P < .13$, respectively).

Key Words: Lysine, Valine, Lactation, Sows

183 Impact of amino acid nutrition during lactation on subsequent reproductive function of sows. D.B. Jones* and T.S. Stahly, Iowa State University, Ames.

Six trials, involving 36 primiparous Y x L sows, were conducted to determine the impact of dietary amino acid regimen during lactation on LH secretion and return to estrus post-partum. Sows averaged 190 d of age at breeding and gained 40.2 ± 1.0 kg from breeding to d 110 of gestation. After parturition, sows were randomly assigned to either a high (HL, 1.20%) or low (LL, .34%) lysine diet and litters were standardized to 13 pigs within 8 h. The high and low lysine diets were formulated by adjusting the ratio of corn and soybean meal, and were calculated to provide the estimated lysine needs of a 165 kg sow nursing a litter of 13 pigs, and 30% of that amount, respectively. Sows were allocated 6.0 kg of feed daily. Sow BW, backfat thickness, and piglet BW was recorded on d 0, 5, 10, 15, 20, and at weaning on d 23 post-partum. Sow feed intake was recorded daily. Blood samples for LH analysis were collected every 15 min for 6-h on d 0, 5, 10, 15, and 20. Muscle fractional breakdown rate (FBR) was determined on d 0, 10 and 20 by using a 3-compartment, kinetic model of 3-methylhistidine metabolism. For up to 45 d after weaning, sows were checked daily for estrus using a mature boar. Data were analyzed as a randomized complete block design with stage of lactation considered a repeated measure. Effects tested were: trial, diet (D), stage of lactation (S) and the interactions. Sows in the LL and HL groups, respectively, had similar ($P > .10$) BW (164.4 vs 169.0 kg), backfat thickness (22.5 vs 21.7 mm), litter size (12.8 vs 13.0), and litter weight (39.2 vs 38.4 kg) on d 0 post-partum and litter size at weaning (12.7 vs 12.5). Feed intake was similar between dietary groups up to d 10, but sows fed the LL diet consumed less feed from d 10 to 23. Daily BW loss and muscle FBR was greater for sows fed the LL diet and the magnitude of the differences, relative to sows fed the HL diet, increased with stage of lactation. Backfat loss was not affected ($P > .10$) by diet or stage of lactation. Litter weight gain was less for sows fed the LL diet, and the magnitude of the reduction was greater at later stages of lactation. LH secretion, expressed as mean concentration and pulses/6-h, remained lower in LL sows until later stages of lactation. Weaning-to-estrus interval for LL sows was extended ($P < .05$) (6.2 vs 14.0 d) but percent of sows displaying estrus did not differ ($P > .10$) (78 vs 89%) among dietary groups. Mean LH on d 5 and 10 was correlated ($r = -.54$ and $-.56$, respectively, $P < .01$) with days-to-estrus. Based on these data, in sows receiving sufficient energy but inadequate amino acid intakes, LH secretion is suppressed and this is associated with prolonged days-to-estrus.

Item	Diet	Stage of lactation, d 0-5	5-10	10-15	15-20	20-23	P values D	S	DxS
ADFI, kg	HL	4.0	5.0	5.3	5.5	5.4	.10	.01	.04
	LL	3.9	4.7	4.5	4.5	4.7			
Sow BW	HL	-.15	-.12	-.58	.04	-.70	.01	.02	.15
change, kg/d	LL	-.63	-1.3	-1.6	-1.4	-1.3			
Litter gain,	HL	1.8	2.2	2.2	2.2	1.9	.01	.01	.01
kg/d	LL	1.7	2.1	1.8	1.6	1.4			
		Stage of lactation, d 0	5	10	15	20			
Mean LH,	HL	.28	.15	.16	.19	.24	.01	.01	.02
ng/ml	LL	.28	.14	.14	.14	.17			
LH	HL	.56	.24	.22	.94	1.22	.04	.01	.01
pulses/6 h	LL	.83	.06	.28	.39	.48			
Muscle	HL	2.6		2.3		2.9	.09	.08	.15
FBR, %/d	LL	3.1		3.6		8.1			

Key Words: Sows, reproduction, amino acids