NUTRITION OF GESTATING AND LACTATING SOWS

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Gestation Nutrition

When designing a feeding program for gestating sows, we must remember the overall goals for the nutrition program: 1) prepare sows to be in proper body condition at farrowing; 2) maximize reproductive performance (farrowing rate and litter size); and 3) meet the daily nutrient requirements at the lowest cost possible (measured as cost per sow per day).

The problems with overfeeding gestating sows include the unnecessary expense, potential problems with impaired mammary development, and reduced feed intake in lactation. Over-conditioned sows used to be the main problem on swine farms. In recent years, thin sows have become a more prevalent problem. Too little backfat reserves can reduce reproductive performance and increase sow mortality. Low backfat reserves also can be an animal welfare concern as thin sows have a greater chance of developing shoulder sores.

The success of a limit-feeding program depends upon controlling the intake of each gilt or sow. Care must be taken to see that each female gets her share. Individual sow feeding stalls are an effective device for controlling boss sows. If sows are group fed, it is imperative that the feed be spread across a large area to reduce the amount of fighting and to ensure that all animals consume their feed allotment.

Management techniques for accurate feeding levels

There is little disagreement on the importance of having sows in the correct body condition at farrowing. Although there is some disagreement on whether the ideal backfat level at farrowing should be 16 to 18 mm or 18 to 21 mm, most people agree that the most important point is to have as few of sows as possible over 24 mm or under 15 mm at farrowing. The big disagreement among nutritionists, veterinarians, and barn managers is the best way to set feeding levels to make sure this happens.

Backfat scanning on commercial farms has convinced us that body condition score is a poor predictor of actual backfat levels. The best correlation that we have found between backfat and condition score on any farm that we have measured is an r^2 of 0.23, suggesting that body condition score only explains about 23% of the variation in backfat levels. If body condition score is used to set feeding levels, feed usage should be tracked (see side bar) and backfat at farrowing should be monitored periodically to try to reduce swings in backfat levels for the entire farm. If over 75% of the sows are between 15 and 24 mm at farrowing, you are doing a pretty good job of setting feeding levels during gestation.

Because of our frustration with condition scoring, we have tested and implemented a method to feed sows based on backfat and body weight estimates using the concepts proposed by Dr. Frank Aherne. The methods that we use are presented in a following section. Whether you feed sows based on body weight and backfat or on body condition score, it is useful to understand the energy requirements of the sows and the energy level of your gestation diet to determine feeding range for your situation.

How much feed do gestating sows require?

The maintenance requirement of the sow accounts for the majority of the feed requirement. Thus, an estimate of body weight is extremely important to accurately feed the sow. Because weighing individual sows is not feasible on many farms, we have established weight categories that can be estimated by using a girth or flank measurement. Girth is measured with a cloth tape directly behind the front legs and in front of the first mammary glands. The flank measurement is measured immediately in front of the back legs from the point of one flank over the back of the sow to the point of the other flank. The flank measurement is much easier to obtain, especially when sows are housed in gestation crates. Because of the importance of body weight in determining the daily feed allotment, it is essential that a high percentage of sows are measured for their body weight estimate. The daily feed requirement for the sows to maintain body weight increases approximately 0.3 lb for every 50 lb increase in sow weight for sows fed a corn-soy diet (Table 1). The sows' maintenance requirement will increase as sows gain weight during gestation.

Table 1. Energy and feed (lb/day) required to maintain body weight

Sow weight, lb	ME, kcal	Dietary energy, kcal/lb	
		1400	1500
350	4,741	3.4	3.2
400	5,240	3.7	3.5
450	5,724	4.1	3.8
500	6,195	4.4	4.1
550	6,654	4.8	4.4
600	7,103	5.1	4.7

The next biggest component of the gestation feed requirement is the amount of weight or backfat that you want the sow to gain. If you only feed the sows the maintenance feeding level, they will maintain body weight, but will lose backfat. Sows require approximately lb of feed daily for a low level of weight gain to maintain backfat. The daily feed requirement increases approximately 0.4 to 0.5 lb/d for every 3 mm increase in desired backfat gain during gestation (Table 2). Backfat can be measured with one of several different ultrasound machines. The Renco machine is used on some farms because of the relatively low cost. Real-time ultrasound is used by many farms that own these machines for pregnancy diagnosis. Individuals conducting ultrasound measurements must be trained on how to use the machine and where to take the measurement. Sows are scanned at the last rib approximately 10cm off the midline. We recommend scanning the sow on both sides and averaging the values to determine backfat.

Table 2. Energy and feed (lb/day) required for backfat gain

Backfat gain, mm	ME, kcal	Dietary energy, kcal	
		1400	1500
0	342	0.24	0.23
3	991	0.71	0.66
6	1,649	1.18	1.10
9	2,307	1.65	1.54

The last component of the gestation feed requirement is fetal and uterine gain. Fetal gain in late gestation increases exponentially in late gestation and thus, feeding levels should be increased by 1 to 2 lb/d during the last two weeks of gestation to meet this need. The daily energy requirement for fetal and uterine gain (330 kcal) during the rest of gestation can be met by a relatively low feed level of 0.25 lb.

The requirements for maintenance, weight or backfat gain and fetal growth are added together to determine the total daily feed requirement (Table 3).

Table 3. Feeding levels (lb/day) for gestating sows based on backfat and weight category at breeding [a]

Flank to flank, inches	Estimated weight, lb	Backfat at breeding, mm			
		9 to 11	12 to 14	15 to 17	>18
< 35.5	250 to 325	5.0	4.4	3.9	3.4
35.6 to 38.0	325 to 400	5.5	5.0	4.4	3.9
38.1 to 41.0	400 to 475	5.9	5.4	4.9	4.3
41.1 to 44.0	475 to 550	6.4	5.9	5.4	4.8
> 44.0	550 to 650	6.9	6.4	5.8	5.3

[a] Based on a diet containing 1,500 kcal ME/lb.
Feeding level should be increased by 2 lb/d on day 101 of gestation.

Procedures to set feeding levels using weight and backfat method

Once each week, the person responsible for setting feeding levels scans sows for backfat and determines the weight category for all sows bred during the previous week. The backfat is written on the sow card and the feeding level is adjusted using a table customized for the farm based on the energy density of their diet and volume of their feed boxes.

At approximately 7 weeks post mating, sows that visibly appear to be very thin are marked and scanned to determine if backfat gains are on target. Approximately 10 to 15% of the sows will have to be scanned at this time. If the sows are not reaching targets, feed intake is increased by 1.0 lb/day. Sows remain on their feeding level until day 100 of gestation. On day 100, the feeding level is increased by 2 lb/day for the last 2 weeks before farrowing.

The procedure is relatively simple and easy to implement. The three main issues critical to be successful with this feeding method are: 1) A person must be trained to scan and estimate weight; 2) you must know the energy level of the gestation diet; and 3) you must know the volume being dropped at each feed box setting. Full details on procedures and the spreadsheet can be found at the website: www.asi.ksu.edu/swine under the swine extension sow feeding tools link.

Feeding pattern in gestation

Feeding levels in particular stages of gestation have been shown to influence sow productivity and performance of their offspring. The periods when excessive feed intake is most detrimental are immediately after breeding (d 0 to 2) and from day 75 to 90 of gestation for gilts. High levels of feed intake after breeding can reduce embryo survival in gilts. Providing gilts high levels of feed from day 75 to 90 of gestation can increase fat deposition in the mammary gland and reduced milk production. From a practical perspective, feeding pattern is less important than providing a total energy level over the entire gestation period that prevents excessive fat gain or inadequate body reserves at farrowing.

Once or twice per day feeding

Although research on this subject is limited, feeding sows once versus twice per day doesn't appear to change production parameters. Thus, the choice of feeding frequency is a personal choice. Some people cite improved sow satiety and decreased ulcer potential as the reason for choosing twice per day feeding. Others will argue that feeding twice per day increases sow agitation and noise levels in the barn. A real advantage with twice per day feeding is that synthetic amino acids can be used without worrying about the reduced utilization that occurs when sows are fed once per day. A real concern with twice per day feeding is that most gestation boxes are relatively large and difficult to set accurately at the low feeding levels required with twice per day feeding.

Feeding every day or every other day

Interval feeding during gestation is a possible alternative to limit-feeding. Interval feeding is accomplished by feeding the sows every other or every third day. Of course, the amount fed is adjusted accordingly. For an example, instead of feeding 4 pounds each day during gestation, 8 pounds is fed every 2 days. With interval feeding, it is necessary to have sufficient feeder space. Research results have shown that a minimum of 2 to 6 hours out of every 72 hours is an adequate feeding time. Interval feeding is not recommended for gilts or during the last two weeks before farrowing.

Genetic and parity differences

Genotype of the sow doesn't have a major impact on the feed requirements for maintenance or fetal gain. However, sow genetics can vary in their levels of milk production and lactation feed intake. Sows with high levels of milk production and low lactation feed intake will require higher levels of feed during the subsequent gestation period to recover the weight and backfat lost during lactation. If the sows are fed with the weight and backfat procedure, feeding levels will automatically be adjusted to meet the requirement of different genetics.

Similarly, older sows require higher levels of feed intake to meet their maintenance requirement because they are heavier than younger sows. If feed levels are adjusted as sows become heavier, the higher feed requirements for older parities will automatically be met.

Amino acid levels

Similar calculations to those for energy can be made to determine the requirement for amino acids. The individual amino acid requirements are influenced greatly by the expected lean tissue gain during pregnancy. A mature sow gaining 45 pounds from breeding to farrowing requires less than 9 g/d of lysine, similar to NRC (1988) requirement. Younger gilts bred at 285 pounds with an expected gain of 65 pounds would require 11 g/d of lysine. As the expected weight gain increases, the lysine need may increase to as high as 14 g/d in some first parity gilts. However, these levels can be achieved with a relatively low lysine diet (0.60 to 0.65% total or 0.5 to 0.55% TID lysine for most sows), depending on the level of feed intake.

If parity segregation is being practiced, two different gestation diets can be used. The gestation diet for first parity sows can be formulated to a higher lysine level (0.55% TID lysine) and the diet for older sows can be formulated to a lower lysine level (Ex. 0.45% TID lysine). Excessive protein intake during gestation unnecessarily increases feed cost. In one trial, high protein intake during gestation actually reduced feed intake during lactation. Because theonine requirements are higher for maintenance than many other amino acids, L-threonine must be added with L-lysine HCl if synthetic lysine is used in the diet. Remember that synthetic amino acids are only used at about 50% efficiency when sows are fed one time per day.

Vitamin and Mineral Requirements

Recommended daily allowances for vitamins and minerals can be controversial. Relatively little information is available on some vitamins and trace minerals to make recommendations. Our suggested vitamin and mineral levels are shown in amount per day and amount per ton in Table 4. The suggested diets in Table 5 will meet the suggested vitamin and mineral requirements when fed at the recommended levels.

Water availability

Like all areas of production, clean, fresh water should be made available at all times. While this suggestion seems simple, it can be a source of concern if water is not an area of focus. Plugged nipples, poorly designed water troughs, or incomplete filling of troughs because of feed blockage can all lead to inadequate water intake in gestation. A part of the daily schedule on sow farms should be to ensure that all sows have access to feed and water.

Table 4. Recommended Daily Nutrient Levels during Gestation

Nutrient	Amount/head/day	Amount/ton
TID Lysine	9.5 g	.53 %
TID Met & Cystine	6.2 g	.34 %
TID Tryptophan	1.8 g	.10 %
TID Threonine	7.1 g	.39 %
TID Valine	6.4 g	.36 %
Calcium	16 g	.90 %
Available Phosphorus	9 g	.45 %
Salt	9 g	.50 %
Trace minerals[a]		
Copper	30 mg	15 g
Iodine	0.54 mg	.27 g
Iron	300 mg	150 g
Manganese	72 mg	36 g
Selenium	0.54 mg[b]	.27 g
Zinc	300 mg	150 g
Chromium	0.36 mg	181 mg
Vitamins		
Vitamin A	20,000 USP	10,000,000 USP
Vitamin D	3,000 USP	1,500,000 USP
Vitamin E	80 IU	40,000 IU
Vitamin K[c]	8 mg	4,000 mg
Riboflavin	18 mg	9,000 mg
Niacin	100 mg	50,000 mg
d-Pantothenic acid	60 mg	30,000 mg
Vitamin B12	0.08 mg	40 mg
Folic acid	3 mg	1,500 mg
Biotin	0.4 mg	200 mg
Choline	1,000 mg	500,000 mg
Pyridoxine	9 mg	4,500 mg
Carnitine	90 mg	45,000 mg

[a] Trace minerals and vitamins levels added to the diet.
[b] Legal addition if fed at 4 lb per head per day.
[c] Menadione.

Table 4a. Example gestation diets

Ingredient	Mixed parity diet		Young parity Diet	Old parity Diet
	Corn-soy Diet	Soy hull Diet		
Corn or milo	1624	1546	1546	1614
Soybean meal, 46.5%	291	271	271	202
Soy Hulls		100	100	100
Monocalcium Phosphate, 21% P	36	35	35	35.5
Limestone	26	25	25	25
Salt	10	10	10	10
Vitamin premix with phytase	5	5	5	5
Trace mineral premix	3	3	3	3
Sow add pack	5	5	5	5
TOTAL	2000	2000	2000	2000
TID Lysine, %	0.56	0.55	0.55	0.46
Total lysine, %	0.65	0.65	0.65	0.55
TID Lysine:ME ratio, g/Mcal	1.71	1.71	1.71	1.44
TID Isoleucine:lysine ratio, %	85%	85%	85%	88%
TID Leucine:lysine ratio, %	217%	214%	214%	237%
TID Methionine:lysine ratio, %	38%	38%	38%	41%
TID Met & Cys:lysine ratio, %	78%	78%	78%	85%
TID Threonine:lysine ratio, %	76%	76%	76%	80%
TID Tryptophan:lysine ratio, %	23%	22%	22%	23%
TID Valine:lysine ratio, %	101%	100%	100%	107%
ME, kcal/lb	1,483	1,449	1,449	1,449
Protein, %	13.7	13.4	13.4	12.1
Calcium, %	0.90	0.90	0.90	0.89
Phosphorus, %	0.71	0.69	0.69	0.68
Available phosphorus, %	0.43	0.42	0.42	0.42
Available phosphorus equiv, %	0.48	0.47	0.47	0.47
Avail P:calorie ratio g/mcal	1.48	1.48	1.48	1.48

Lactation Nutrition

The three main goals of the nutrition program for lactating sows are: 1) maximize intake of a properly formulated diet; 2) match the amino acid and other nutrient levels to the level of feed intake that is achieved; 3) maintain a reasonable feed cost per weaned pig.

Should sows be full fed or restricted during lactation?

It is recommended that sows during lactation be full-fed in order to obtain maximum milk production. A sow will normally consume 9 to 15 pounds per day. This intake will depend upon diet composition, sow's condition, previous gestation feed intake, and environmental temperature of the farrowing facilities. For maximum milk production, it is recommended that the sow be maintained in an environment of 60 to 70 F. At higher temperatures, a reduction in feed intake will be evident. The full listing of recommended minimum nutrient levels is provided in Table 8.

What is the best way to maximize the feed intake of lactating sows?

The most practical method of increasing energy intake is to increase total food consumption. While most nutritionists and veterinarians agree that maximal intake throughout lactation is the correct goal, considerable debate exists on the method to achieve maximal intake. The debate concerns how quickly feed intake should be increased in early lactation. Some advocate feeding extremely low levels of feed (2 lb or less) prior to and immediately after farrowing. Field experience indicates that extremely low intake during this period limits the producers ability to increase feed intake rapidly

during early lactation. In extreme cases, ulcers can be created by the extended period of low intake around farrowing. After the long period without feed, sows often overeat if provided free access to feed. The sows will go off feed or have a noticeable dip in feed intake. Then to compensate for this dip 5 to 10 days into lactation, people prescribe limit feeding as a cure instead of correcting the management that originally caused the problem (the extended period of little or no feed intake prior to and immediately after farrowing). Therefore we recommend that immediately prior to farrowing sows be fed at least 4 lb/d.

Many different feeding methods will work to obtain maximum feed intake. The most important facet of any feeding method is to ensure that the sow always has access to feed. Lactating sows should be fed three or four times per day to ensure that feed is always available. We would suggest using the procedure diagrammed in Table 5 and outlined below to maximize sow feed intake:

Morning Feeding — All sows are fed 1 scoop (4 pounds) if small amount of feed is left in the feeder and 2 scoops if the feeder is empty.

Late Morning Feeding — A second feeding is done later in the morning or immediately after lunch using the same scheme (1 scoop if a small amount of feed remains and 2 scoops if the feeder is empty). If no feed has been consumed since the morning feeding, the sow is then investigated to determine if she has a fever, retained pig, or other detectable reason for being off feed.

Afternoon/Evening Feeding — A similar scheme is used for the afternoon/evening feeding; however, some judgment will have to be used if there is some feed left in the feeder. The sows that have had good appetites prior to this feeding but still have greater then 2 lb of feed remaining should receive 1 scoop. Sows that have eaten all or that have 2 lb or less of previously provided feed should receive 2 scoops, and again if the feed has not been touched since the last feeding, the sow is investigated to see if there is a detectable reason for being off feed.

The only deviation from this pattern is for day 0 to 2 after farrowing. During this time, the decision is to give 0 or 1 scoop at each meal. The sows should not receive 2 scoops at a single feeding during this period.

A key to this method of feeding is developing a communication method between various employees to gauge an individual sow's appetite for the previous 2 or 3 meals. The communication method is needed to aid in the decision making process as to how long the sow has been off-feed. Various methods are used including daily feed intake recording, clothes pins clipped on the feeder, or movement of the farrowing card to indicate poor appetite in previous meals.

Table 5. Feeding Strategy for Lactating Sows

Number of 4-pound scoops to feed at each feeding from day 0 to 2 of lactation		
Feed in Feeder	**Feeding**	
	AM	PM
Empty	1	1
< 2 lb	0	0.5
> 2 lb	0	0

Number of 4-pound scoops to feed at each feeding from day 2 to weaning			
Feed in	**Feeding**		
Feeder	AM	Noon	PM
Empty	2	2	2
< 2 lb	1	1	2
> 2 lb	0	0	1

How do I determine the appropriate dietary lysine level for my sow lactation diets?

To customize lactation diets based on sow productivity, dietary lysine level can be calculated if a producer knows the average litter weaning weight and sow feed intake averaged over the entire lactation period. By dividing litter weaning weight by lactation length, daily litter weight gain can be calculated. Sows require approximately 11.9 grams of lysine per pound of daily litter weight gain. Table 6 can be used to determine the approximate lysine dietary level to accommodate the herd's average milk production.

If the previous lactation diet being fed on the farm is higher in lysine than the recommended level from Table 6, it may be possible to reduce the dietary lysine level without sacrificing performance. If the previous lysine level being fed is lower or the same as the recommendation, the producer may want to increase the lysine (protein) level and reexamine performance records to determine whether litter weaning weight increases. This relatively simple approach allows the sow lactation diet to be customized to an individual farm.

Table 6. Dietary TID Lysine Level Based Upon Litter Weaning Weight and Sow Feed Intake.

Adj. 21-day litter weaning weight,	Lactation feed intake, lb/day								Lysine, Grams/day	
lb	8	9	10	11	12	13	14	15	TID	Total
100	0.88	0.78	0.71	0.64	0.59				32	36
110	1.02	0.91	0.82	0.74	0.68	0.63			37	42
120		1.03	0.93	0.84	0.77	0.71	0.66		42	48
130			1.04	0.94	0.86	0.80	0.74	0.69	47	53
140				1.04	0.96	0.88	0.82	0.76	52	59
150					1.05	0.97	0.90	0.84	57	65

What about other amino acids?

Considerations of other essential amino acids critical to lactation performance that may become limiting include valine, isoleucine, threonine, and methionine. More research is needed with these amino acids; however, results to date indicate these amino acids must be carefully considered in diet formulation to prevent costly limitations during lactation. In practical diet formulation, we formulate to meet the lysine requirement of the sow and attempt to maintain valine, isoleucine, and methionine as high as possible without incurring excess cost. Usually, this is accomplished by limiting the use of synthetic lysine in these diets. Practical ratios that can be used when formulating diets for gestating and lactating sows are provided in Table 7.

Table 7. Suggested true digestible amino acid ratios for sows.

	Gestation	Lactation
Lysine	100%	100%
Methionine	28%	28%
Met & Cys	70%	55%
Threonine	80%	62%
Tryptophan	20%	19%
Isoleucine	60%	55%
Valine	67%	90%

Should the lactation diet contain added fat?

Adding fat to the lactation diet is an effective means of increasing the fat content of the milk and improving litter weaning weight. However, adding fat to the diet will not benefit sow reproductive performance. It is important to remember that dietary fat is preferentially used by the mammary gland and results in production of "high fat" milk rather than used by the sow as an energy source. Use of high dietary fat levels during lactation will improve litter weaning weights, but may actually impair subsequent reproductive performance by reducing the number of LH peaks in early lactation. Therefore, while some added fat (0 to 5%) may be beneficial to improving litter performance, high levels of added dietary fat (greater than 5%) should not be used as a remedy for poor lactation feed intake.

Producers should take all steps possible to increase lactation feed intake whether fat is added to the diet or not. As a general guideline, if it is economical to add fat to the late nursery diets, it will be economical to use 3 to 5 percent fat in the sow lactation diet.

Do vitamin and mineral requirements change for lactation?

Producers can use similar levels of added dietary vitamins and minerals for both gestation and lactation. While the daily requirement for vitamins and minerals increases approximately 1.5 to 3 times in lactation compared to gestation, feed intake is higher in lactation, thus the need to additional fortification above the gestation diet is not necessary. Our suggested vitamin and mineral levels are shown in amount per day and amount per ton in Table 8. The suggested diets in Table 9 will meet the suggested vitamin and mineral requirements when fed at the recommended levels.

What grain particle size should be used?

In lactation, research data clearly shows that nutrient utilization, milk production and weaning weights decrease with increasing particle size. Also, if grain particle size is too fine, ulcers may develop which may jeopardize performance and/or sow health. We recommend that lactation sow diets have grain particle size in the range form 600 to 800 microns. However, little evidence suggests that higher particle sizes in gestation adversely affect sow performance. While the ideal particle size has not been identified, it is a practical recommendation that grain particle size may be slightly higher in gestation then in lactation.

Table 8. Recommended Nutrient Levels for Lactating Sows and Gilts[a]

Nutrient	Amount/head/day	Amount/ton
TID Lysine	48 g	0.87 %
TID Met & Cystine	26 g	0.47 %
TID Tryptophan	9 g	0.16 %
TID Threonine	30 g	0.55 %
TID Valine	43 g	0.78 %
Calcium	49 g	.90 %
Available Phosphorus	24.5 g	.45 %
Salt	27 g	.50 %
Trace minerals[b]		
Copper	90 mg	15 g
Iodine	1.6 mg	.27 g
Iron	900 mg	150 g
Manganese	216 mg	36 g
Selenium	1.6 mg	.27 g
Zinc	900 mg	150 g
Chromium	1.09 mg	181 mg
Vitamins		
Vitamin A	60,000 USP	10,000,000 USP
Vitamin D	9,000 USP	1,500,000 USP
Vitamin E	240 IU	40,000 IU
Vitamin K[c]	24 mg	4,000 mg
Riboflavin	54 mg	9,000 mg
Niacin	300 mg	50,000 mg
d-Pantothenic acid	180 mg	30,000 mg
Vitamin B12	0.24 mg	40 mg
Folic acid	9 mg	1,500 mg
Biotin	1.2 mg	200 mg
Choline	3,000 mg	500,000 mg
Pyridoxine	27 mg	4,500 mg
Carnitine	270 mg	45,000 mg

[a] Assumes 12 lb/day feed intake of a diet containing 0.87% TID lysine.
[b] Trace minerals and vitamins levels added to the diet.
[c] Menadione.

Table 9. Example Lactation Diets

Ingredient, lb/ton	TID Lysine, %					
	0.80	0.85	0.90	0.95	1.00	1.05
Corn	1443	1394	1355	1315	1266	1237
Soybean meal, 46.5%	486	526	566	605	645	685
Choice White Grease[a]	0 to 5%	0 to 5%	0 to 5%	0 to 5%	0 to 5%	0 to 5%
Monocalcium Phosphate, 21% P	33	32.5	32	32	32	31.5
Limestone	25	24.5	24.5	24.5	24	24
Salt	10	10	10	10	10	10
Vitamin premix with phytase	5	5	5	5	5	5
Trace mineral premix	3	3	3	3	3	3
Sow add pack	5	5	5	5	5	5
Total	2000	2000	2000	2000	2000	2000
TID Lysine, %	0.80	0.85	0.90	0.95	1.00	1.05
Total lysine, %	0.91	0.97	1.02	1.08	1.13	1.19
TID Lysine:ME ratio, g/Mcal	2.35	2.49	2.64	2.79	2.93	3.08
TID Isoleucine:lysine ratio, %	79%	79%	78%	77%	77%	76%
TID Leucine:lysine ratio, %	177%	172%	168%	164%	160%	157%
TID Methionine:lysine ratio, %	32%	31%	30%	30%	29%	28%
TID Met & Cys:lysine ratio, %	65%	64%	62%	61%	60%	59%
TID Threonine:lysine ratio, %	69%	68%	68%	67%	66%	66%
TID Tryptophan:lysine ratio, %	22%	22%	22%	22%	22%	22%
TID Valine:lysine ratio, %	90%	88%	87%	86%	85%	84%
ME, kcal/lb	1,546	1,546	1,546	1,546	1,546	1,546
Protein, %	17.1	17.9	18.7	19.4	20.2	20.9
Calcium, %	0.88	0.88	0.88	0.88	0.88	0.88
Phosphorus, %	0.71	0.71	0.71	0.72	0.73	0.73
Available phosphorus, %	0.41	0.41	0.41	0.41	0.41	0.41
Available phosphorus equiv, %	0.51	0.51	0.51	0.51	0.51	0.51
Avail P:calorie ratio g/mcal	1.50	1.49	1.49	1.49	1.50	1.49

[a] If adding fat, substitute for grain on an equal weight basis.

Should all sows receive the same lactation diet?

First parity sows require special consideration when formulating lactation diets for two reasons. First, their level of feed intake is typically about 20% less than the average of the herd. Thus, if the average sow is consuming 12 lb/d, the first parity sows will average about 10 lb/d. Using Table 6, first parity sows would require approximately 0.20% higher lysine lactation diet to maintain the same level of litter weaning weight. Second, researchers have demonstrated that first parity sows require higher lysine for maximum reproductive performance than required for maximal milk production.

When all sows are housed in the same facility, management is faced with a choice. They must either provide higher amino acid levels than required by the multi parity sows in order to meet the requirements of young sows or formulate closer to the requirements of the older sows and not meet the requirements of the young sows. In most situations, the choice is to formulate closer to the requirements of the young sows and over-supply nutrients to the older sows. An advantage of segregated parity flow is that old sows can be fed diets formulated closer to their nutrient requirements in gestation and lactation, resulting in reduced feed cost.

What about laxatives during lactation?

Feed ingredients with high fiber content such as soy hulls, beet pulp, oats, wheat bran and wheat midds may be used as laxatives to keep sows from becoming constipated. However, they also reduce the energy density of the diet and limit sow energy intake and may increase diet cost. If laxatives must be used, top dressing individual sows would be the preferred method of choice. Chemical laxatives, such as magnesium-, potassium-, or sodium-sulfate, may be a preferred

method of controlling constipation problems. The recommended level of magnesium sulfate (Epsom Salts) is 10 to 20 pounds per ton or top dressing about 1 to 2 tablespoons per feeding.

Can the gestation and lactation diets be the same?

We discourage the use of the same diet for both gestation and lactation. In smaller swine operations, it may not be practical to use two different diets for the sow herd. The lactation diet, if properly formulated, can be fed at the rate of 4 to 6 pounds per sow per day during gestation. Feed cost will be higher if the lactation diet is fed during gestation and research has shown that feeding excess protein during gestation can reduce feed intake during lactation.

Tracking gestation and lactation sow feed usage

Regardless of whether backfat and weight or body condition scoring is used to set the daily feed allowance for each sow, it is useful to get a global picture of gestation feed usage for a swine farm to determine whether any long-term trends towards over or under-feeding is occurring. This can be done relatively simply by dividing the total feed delivery for the period by the number of gestation places in the farm and the number of days in the period. Certainly, if the sow space is not fully utilized on the farm, this measure will need to be adjusted for actual inventory; however, for most farms simply knowing the number of gestation spaces is adequate. This calculation is especially useful in production systems with multiple sow farms to determine if one sow farm routinely feeds 5.5 lb/d while another farm routinely feeds 4.6 lb/d when provided the same gestation diet. In reality, most farms should have gestation feed usage of 7.2 to 7.8 Mcal ME per sow per day, which equated to 5.1 to 5.5 lb/d of a gestation diet containing 1.4 Mcal ME/lb or 4.8 to 5.1 lb of a diet containing 1.5 Mcal ME/lb. If feed usage for the farm is outside of these bounds, reasons for the discrepancy should be explored.

For example, a 3,000 sow farm containing 2,800 gestation crates used 1,210 tons of feed in a 6 month period. The calculations are as follows:

$$\frac{\text{Total Feed}}{\text{Crates X Days}} = \frac{1{,}210 \text{ tons} \times 2{,}000 \text{ lb}}{2{,}800 \text{ crates} \times 182 \text{ days}} = 4.75 \text{ lb/d}$$

For lactation feed intake, the calculations are similar; however, two different calculations are helpful to determine actual lactation feed intake. The first calculation uses crate days and feed delivery and estimates the lowest amount of feed disappearance per sow per day. The second calculation relies on the number of farrowings and lactation length and estimates the highest amount of disappearance that could have occurred. The average of these two values should be used as the feed intake estimate.

Because these calculations rely on feed delivery, which can be sporadic, a period of 4 to 6 months should be the shortest period used for the calculations. A six month rolling average is a good way to view feed intake when using this method.

A 3,000-sow farm with 450 farrowing crates will be used for an example. During the 6-month period, 3,615 litters were weaned with an average litter weaning weight of 46 kg at 19 d of age. During this 6-month period, 419 metric tons of lactation feed was delivered to the farm.

The first method using crate days estimates feed disappearance as:

$$\frac{\text{Total Feed}}{\text{Crates X Days}} = \frac{419 \text{ tons} \times 2000 \text{ lb}}{450 \text{ crates} \times 182 \text{ days}} = 10.2 \text{ lb/d}$$

The second method using number of lactating day's estimates feed disappearance as:

$$\frac{\text{Total Feed}}{\text{Litters X Lactation Length}} = \frac{419 \text{ tons} \times 2000 \text{ lb}}{3{,}615 \times 19 \text{ d}} = 12.2 \text{ lb/d}$$

The first method should underestimate average lactation feed intake because of days that crates are empty or contain prefarrowed sows that are eating lactation feed. The second number overestimates lactation feed intake because the feed to prefarrowing sows is counted as feed fed to lactating sows. The true daily lactation feed intake has to be somewhere between 10.2 and 12.2 lb.

Gilt Developer Diets

Developing gilts can be fed diets similar to normal grow-finish diets except calcium and phosphorus levels should be higher to increase bone mineralization. For at least the last 30 days before becoming eligible for breeding, gilts should

also receive the vitamins normally added to only sow diets (biotin, folic acid, pyridoxine). Thus, after gilts reach approximately 220 lb, the sow add pack should be added to the diet or gilts should be switched to the gestation diet. An example of a series of gilt developer diets is provided in Table 10. These diets can be used in either a five or three phase program following the feed budgets provided in Table 11.

Table 10. Example Gilt Developer Diets

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	Gilt Development Weight Range, lb				
	50	75	130	170	220
Ingredient	75	130	170	220	250
Corn	1360	1465	1579	1651	1692
Soybean meal, 46.5%	584	481	369	298	250
Monocalcium Phosphate, 21% P	23	21	19	18	17
Limestone	17	17	17	17	17
Salt	7	7	7	7	7
Vitamin premix with phytase	3	3	3	3	5
Trace mineral premix	3	3	3	3	3
Sow add pack					5
Lysine HCl	3	3	3	3	3
TOTAL	2000.0	2000.0	2000.0	2000.0	2000.0
TID Lysine, %	1.05	0.92	0.78	0.69	0.63
Total lysine, %	1.18	1.03	0.88	0.78	0.72
TID Lysine:ME ratio, g/Mcal	3.16	2.77	2.34	2.07	1.89
TID Isoleucine:lysine ratio, %	69%	70%	70%	71%	71%
TID Leucine:lysine ratio, %	150%	158%	169%	179%	187%
TID Methionine:lysine ratio, %	27%	28%	30%	31%	33%
TID Met & Cys:lysine ratio, %	55%	58%	62%	65%	67%
TID Threonine:lysine ratio, %	60%	61%	62%	63%	64%
TID Tryptophan:lysine ratio, %	20%	19%	19%	19%	18%
TID Valine:lysine ratio, %	78%	79%	82%	84%	85%
ME, kcal/lb	1,506	1,508	1,511	1,512	1,509
Protein, %	19.5	17.6	15.4	14.1	13.2
Calcium, %	0.66	0.62	0.59	0.56	0.56
Phosphorus, %	0.63	0.59	0.55	0.52	0.51
Available phosphorus, %	0.31	0.29	0.26	0.24	0.24
Available phosphorus equiv, %	0.39	0.37	0.34	0.32	0.32
Avail P:calorie ratio g/mcal	1.18	1.10	1.02	0.97	0.96

Table 11. Example Gilt Feed Budgets for five and three phase programs

Diet, lb/pig	Five phase	Three phase
Diet 1	53	- - -
Diet 2	137	240
Diet 3	116	- - -
Diet 4	165	230
Diet 5	109	110
Total	**580**	**580**