factsheet
Pork Information Gateway

Feeding the Lactating Sow

Author
Frank Aherne, Professor Emeritus, University of Alberta

Reviewers
Mike Tokach, Kansas State University
Wayne R. Cast, Premium Standard Farms, Princeton, MO
Duane Reese, University of Nebraska
Robert Rasmussen, Hurley, SD

Introduction

It is reasonable to assume that any strategy for survival in the future will have considerable focus on breeding herd efficiency as an essential component. The data in Table 1 shows that there is considerable opportunity for improvement of reproductive efficiency within the US swine industry.

Many factors influence sow reproductive efficiency, but inadequate feeding programs for the sow during gestation and lactation are major contributors to the current problems of high sow attrition and poor sow productivity. Survey data shows that average sow feed intake during lactation is only 11.5lb per day (range 8-15lb per day for the bottom and top 10 % of producers, Aherne 2000). Some of the feed intake differences among farms may be explained by differences in genotype, lactation length, parity distribution, disease levels etc., but much of the difference is still due to feeding management. Caring, knowledgeable, skilled and experienced stockpersons who are given the time to treat each animal as an individual will probably do more to increase sow feed intake than any single factor.

Objectives

The objective of the feeding program for lactating sows is to ensure that all sows consume sufficient feed on a daily basis to meet their energy and nutrient requirements.

	Average	Upper 10%
Replacement rate %	60	40
Culling rate %	41	35
Average non-productive days	69	38.0
Farrowing rate %	76	86.0
Pigs weaned per sow per year	21	23.6

Table 1. Reproductive efficiency in the USA. Source: Deen, International Pigletter, 2003

Energy and Nutrient Requirements

The energy and nutrient requirements of the lactating sow depend on her weight, milk yield and composition, and to a lesser extent, the environmental conditions under which she is housed. Therefore, energy and nutrient requirements will be different for every sow and they will vary throughout the lactation period. NRC (1998) presented estimates of the energy and nutrient requirements of 386lb lactating sows at farrowing, with zero or 22lb weight loss during a 21-day lactation and supporting average piglet growth rates of 0.33, 0.44 or 0.55lb per day for a litter of 10 pigs (Table 2).

Unfortunately, we rarely know the sow's weight and we only know piglet weight gain, retrospectively. Therefore, in practice we simply feed lactating sows to appetite, either manually or using automatic dry or

wet/dry feeding systems and attempt to have fresh feed available to the sow at all times.

Sow wt, lb.	385	385	385	385	385	385
Pig growth, lb/day	.33	.44	.55	.33	.44	.55
Sow wt loss, lb	0	0	0	22	22	22
Feed/day lb.	9.5	11.8	14.0	7.8	10.1	12.5
ME intake, Mcal/day*	14.1	17.5	20.9	11.6	15.1	18.5
Protein, %	16.3	17.5	18.4	17.2	18.5	19.2
Protein, lb/day	1.55	2.06	2.59	1.35	1.94	2.39
Lysine, %	0.82	0.91	0.97	0.89	0.97	1.03
Lysine, g/day	35.3	48.6	61.9	31.6	44.9	58.2

Table 2: Energy and Nutrient Requirements of Lactating Sows Nursing 10 Piglets per Litter. NRC (1998) Diet contains 1.49 Mcal metabolizable energy (ME) per lb

Simple as this may sound, it is obvious from the survey data on sow lactation feed intake that many sows, especially parity 1 and 2 sows, do not consume enough feed during lactation to meet their energy and nutrient needs for maintenance and milk production. The consequence is that these sows mobilize their own body tissues to meet their energy and nutrient needs. It has been shown that excessive weight loss during lactation will compromise subsequent reproductive performance (Hughes 1993, Tantasuparuk et al 2001). The mechanism by which inadequate feed intake and excessive weight loss impairs subsequent reproduction is still not certain. Several experiments have shown that if first and second parity sows mobilize more than 12% of their protein mass during lactation, subsequent reproductive efficiency will suffer and litter weaning weight will be reduced (Clowes et al 2003 a,b). Because there is a high negative correlation between fat mass and protein mass, we can use backfat measurement as a rough estimate of a sow's protein status. Therefore, it is recommended that all sows have 0.7-0.8in. of backfat at time of farrowing (backfat is measured 2.5in. from the midline of the sow's back at the 10th rib). If backfat loss during lactation can be kept to 0.1-0.15in. then sows with 0.7 or 0.8in. of backfat at farrowing will still have 0.55-0.7in. backfat at time of weaning. Data from several studies have shown that backfat levels of less then 0.55in. at weaning may delay return to estrus (Tantasuparuk et al 2001).

Pattern of Feeding

Accepting that the average daily feed intake of lactating sows in the USA is about 11.5lb, the weekly intake throughout lactation is likely to be: Wk 1, 8.5lb, Wk 2, 12.4lb, Wk 3, 13.8lb (these three numbers do not average 11.5). For a 385lb. sow losing 22lb of body weight and weaning 10 pigs with average daily growth rates of 0.55lb/day, a feed intake of 11.5lb/day is about one pound of feed less than the 12.5lb recommended by NRC 1998, (Table 2) or 20lb. per 20 day lactation period. This sow would lose about 9lbs (20/2.2=9) more weight than the 22lb weight loss predicted by NRC (1998). Therefore total weight loss would be 31lb (for each 2.2lb deficit in feed requirement the sow will lose one pound of body weight). Depending on the parity of the sow, this weight loss could consist of 40-60% fat. Thus, the sow would lose 12-18lb of fat. This could result in backfat loss of 0.16 to 0.24in. and sows with 0.7in. of backfat or less at farrowing would have 0.55in. of backfat or less at weaning and be in a catabolic condition at time of weaning. These sows are likely to have prolonged weaning to estrus intervals and poorer subsequent reproductive performance.

Appetite

The appetite of a lactating sow is lower in early lactation compared to late lactation. Feed intake increases gradually up to the third week. But in spite of this, many farms adopt a feeding program that gradually increases feed allowance of the sow over the first 5-7 days of lactation. This feeding system will further reduce sow feed intake by up to 15% in the first week of lactation compared to a more aggressive feeding system. This restricted feeding system is practiced because of the commonly held opinion that 'overfeeding' sows in early lactation may cause udder congestion, reduced milk production, piglet scours, sow constipation and may lead to sows 'going-off' feed in mid-to-late lactation. Survey data has shown that 10-30% of sows show a marked dip in feed intake for 2-3 days in the second week of lactation (Kotetsu et al 1996a). These dips in feed intake are associated with longer weaning-to-estrus intervals, reduced farrowing rates, and smaller subsequent litter size. Deen (2005) reported that even one day in which a lactating sow eats 4lb. feed will increase the odds of removal of this sow from the herd by 50%. The cause of this reduced feed intake is still speculative (poor water intake and quality, high barn temperature, gut stasis, etc.). However, many sows, even with aggressive feeding systems in early lactation, show no such dips in feed intake. Restricting feed intake in any week of lactation, whether due to a poor appetite or imposed by a very conservative feeding program, will increase sow weight loss and may decrease reproductive efficiency after weaning (Kotetsu et al 1996 a,b.). These researchers reported that for each

additional pound of feed consumed in lactation an additional 0.5 pigs were born at the subsequent farrowing. This is consistent with the observation that it takes 19 days for follicles to reach ovulatory size, and that restricted feeding in any week of lactation can reduce subsequent litter size (Zak et al 1997). Litter weaning weights are lower and weaning-to-estrus intervals are longer and more variable on farms using a gradual increase feeding program in early lactation than those of farms that employ a rapid increase in early lactation feed intake. This highlights the importance of maximizing feed intake during each week of lactation in order to optimize piglet growth rate, limit sow weight loss and optimize subsequent reproductive performance.

Factors Affecting Sow Feed Intake

Familiarity with some of the more important factors affecting sow lactation feed intake is necessary to achieve high levels of feed intake. Among the more important of these are: parity, barn temperature, backfat at farrowing, and feeding systems.

Parity

Lactation feed intake generally increases from the first to the sixth parity, with the major increase from first to second parity (15-20%). The problem of lower feed intake with first parity sows is accentuated because they are still growing and may have low body stores of fat, protein and minerals. First parity sows may constitute 15-35% of litters born and can significantly influence overall herd output of weaned pigs. Limiting litter size of first parity sows to a maximum of 10 pigs, and parity segregation to allow use of different diets and feeding systems for these sows may help to overcome these second parity problems, and program is becoming increasingly popular.

Barn Temperature

Whenever possible, farrowing room temperature should be kept between 66-72°F. High barn temperature will decrease feed intake of all lactating sows, but first parity sows are the most sensitive. As a rule of thumb, average daily feed intake will decrease by 0.2lb per °F when temperatures rise above 66°F. (Genest and D'Allaire, 1995, Kotetsu et al., 1996 b)

Use of properly managed drip coolers will increase sow feed intake by 20-25% during hot weather. Wetting sow feed at feeding time, especially during hot weather, will also increase feed intake by about 2lb/sow/day, but it is a very time consuming chore (Genest and D'Allaire ,1995).

If feed is available to them, lactating sows will consume 20-25% of their daily intake in late evening and during the night. (Quinios and Noblet, 1999) Therefore, it is particularly important to have feed available to sows during the cooler period of the day during hot weather .

Backfat at farrowing

Many studies have shown that high backfat (>0.85 in) at farrowing will decrease feed intake in lactation, and the decrease may be as much as 0.3 lb per day per 0.04in. backfat above 0.75in. (Dourmad, 1991, Revell et al 1998, Young et al 2004). Therefore., it is important to avoid overfeeding the sow during gestation to ensure she does not gain too much weight and condition prior to farrowing.

Calculating Sow Feed Intake

General guidelines to formulate lactating sow diets are presented by NRC (1998). However, to formulate herd-specific diets, it is necessary to know sow feed intake and sow performance. Average feed intake values for the herd can best be calculated from feed deliveries over a period of one to three months. If feed wastage is not excessive, then feed disappearance should approximate feed intake. Feed disappearance can be calculated as:

Assume a 3 month period.
Lb.feed/sow/3 months = (Total lactation feed delivered) ÷ (# of lactations in the 3 mo.)
Correct for gestation sow days spent in the farrowing barn and divide by the number of days per lactation.

This equation will not work for systems using once or three times a week weaning. For such units an estimate of daily sow feed intake can be calculated as:

Total feed delivered ÷ (Lactation length x number of litters weaned)

The average of these two values should give a good approximation of lactation feed intake per day, unless gestating sows are in the farrowing room for long periods before farrowing.

(14lb + 11.9lb) ÷ 2 = 12.94lb

This is a little lower than the value calculated by method one. (13.75lb) Some producers calculate feed intake from daily recordings of the amount of feed that is added to each sow's feeder. Recording feed in this manner is also helpful in tracking the pattern of sow feed intake during the course of lactation.

Method 1 Example: 1,250 sow unit, 20-day lactation, 3-month period, 7 farrowing rooms of 28 crates (196), twice/week weaning.

Calculate "crate cycle" days:
7 days/week x (No. farrowing rooms ÷ weaning frequency/week)
Crate cycle = 7 x (7 ÷2) = 24.5 days.

Calculating gestating sows days in farrowing barn:
Washing (1) + Moving (1) + Lactation (20) = Total 22 days
Gestation days = 24.5 - 22 = 2.5

Calculate feed fed to gestating sows:
2.5 days at 5.5 lb/day = 13.75 lb.

Feed intake per lactation:

Feed delivered	106 tons
No. litters weaned	756 (63/week)
Feed use/litter	106T ÷756 = 0.14T or 280 lb/litter

Feed intake/day, lb (280-13.75) ÷ 20 = 13.3 lb.

Method 2 Example uses same data as Method 1:

Sow feed intake:
106 tons ÷ (20 x 756) = 212,000lb ÷ 15,120 = 14lb

Total feed delivered:
212,000lb. ÷ (# crates x # days/period)
crates x # days/period 196 x 91.0 = 17,836
212,000lb ÷ 17,836 = 11.9lb.

Calculating Sow Energy and Nutrient Requirements

Having estimated average daily feed intake, it is now necessary to calculate the actual feed, energy and nutrient intake levels needed to meet the sow's need for maintenance and milk production.

Feed requirements

The daily feed requirement of a lactating sow can be calculated from average herd litter weight gain. We can assume average pig birth weight to be 3.1-3.3lb, but we need to measure average weaning weight. The following example will show how this data can be used to calculate energy and nutrient requirements of the sow.

Sow weight, at farrowing	385 lb.
Average piglet birth weight	3.1 lb.
Average 20-day pig weaning weight	14.6 lb.
Average pig weight gain	11.5 lb.
9.7 pigs weaned/litter	
Total litter gain	111.6 lb. (9.7 x 11.5 lb)
Litter gain per day	5.58 lb (111.6 ÷20)

Allowing a margin of safety we can assume a requirement of 3.6 Mcal of digestible energy (DE) per lb of litter weight gain.

Total daily energy requirements for litter gain would be: 3.6 x 5.58 = 20 Mcal DE/day. This can be supplied by 13.1lb of a diet containing 1.53 Mcal DE/lb.

The 1.53 Mcal DE/lb is typical of the energy level in a corn-soybean diet and is adequate for lactating sows. For diets based on wheat, barley and sorghum, the addition of fat or oil would be required to achieve this energy level. Also, there is some value to added fat levels to increase or maintain energy intake of lactating sows during periods of hot weather.

Having calculated the energy requirement for milk production (litter gain), we must now meet the energy requirement for sow maintenance. This can be met by an allowance of one percent of the sow's weight or 3.85lb/day for the 385lb sow used in our example. Therefore, the total daily feed requirement for this sow and litter would be 16.95lb (13.1 + 3.85). If the actual average daily feed intake of this sow was 13.3lb/day (as previously calculated), she would be short 3.65lb/day. This feed shortage would result in a sow weight

loss of 32.6lb throughout the 20 day lactation (assuming a contribution of 3.36 Mcal DE/lb sow weight loss).

The old recommendation of 4.0lb feed per sow and 1.0lb per pig in the litter on day 2 of lactation gives a rough estimate of the sow's minimum daily feed requirement. If the number weaned is 9.7 in our example, we can assume 10.5 pigs in the litter at day 2 of lactation. For this litter of 10.5 pigs the estimated daily feed requirement would be (10.5 x 1.0) + 4 =14.5, which is 15% lower than the amount calculated previously, (16.95). Therefore, a better guide of the sow's daily feed requirement might be: 4lb for the sow and 1.25lb per pig.

Similarly the daily lysine requirement (total basis)of the sow can be calculated as: 11.8 g lysine per lb of litter gain.(NRC, 1998) Thus, the sow's daily lysine requirement would be: *5.58 x 11.8 = 66g lysine/day*.

Add 2g lysine/day for sow maintenance and the total lysine requirement would be: 68 g/day or 0.15lb. If average sow feed intake is 13.1lb/day the percentage lysine in the diet to supply the daily lysine requirement should be: *% lysine in diet = (0.15lb lysine ÷ 13.1lb feed/day) x 100 = 1.15%*

The protein requirement can be met by an allowance of 0.4lb protein for the sow and 0.4lb. protein per lb of litter gain.

Daily protein need would be: *5.58lb litter gain/day x 0.4lb protein = 2.23lb plus 0.4lb for the sow = 2.63lb.*

% protein in diet = (2.63lb protein ÷ 13.3lb feed/day) x 100 = 19.8 %

For this feeding program, the diet should have a nutrient and energy content similar to that shown in Table 3. These suggested nutrient levels are based on NRC (1998) recommendations.

A suggested amino acid pattern relative to lysine to provide an ideal amino acid balance is shown in Table 4.

Nutrient	unit
ME, Mcal/lb	1.50
Total Lysine, %	1.15
Digestible lysine, %	0.96
Crude Protein, %	19.80
Fat, %	3.50
Calcium, %	0.95
Phosphorus, %	0.80
Av. Phosphorus, %	0.43
Salt, %	0.50
Zinc, ppm	150
Iron, ppm	100
Manganese, ppm	30
Copper, ppm	20
Iodine, ppm	0.35
Selenium ppm	0.3
Vitamin A IU/lb	5000
Vitamin D IU/lb	800
Vitamin E IU/lb	30
Vitamin K mg/lb	2.0
Choline mg/lb	300
Niacin mg/lb	20
Riboflavin mg/lb	4.5
d-panothenate mg/lb	15
Vitamin B12 mcg/lb	17
Folic acid mcg/lb	600
d-biotin mcg/lb	150
Thiamine mg/lb	1.0
Pyridoxine mg/lb	1.5

Table 3: Recommended Nutrient allowances for lactating sows

Feeding methods

Complete all cross fostering by Day 2. Set target feeding level to gradually reach an intake of 4.0lb for the sow and 1.25lb per pig in the litter by day 8 of lactation. On the day of farrowing, feed 3-5lb of feed, on Days 1 and 2 feed 5-7lb of feed, and then based on the sow's appetite, increase feed intake daily to reach the target intake as quickly as possible. Having achieved target feed intake levels by day 8, this level of feeding is held from day 8-12 to help avoid dips in feed intake by some sows. From day 13 to weaning increase feed intake to the sow's appetite level. There is some evidence that an increasing daily feed intake pattern in late lactation has a stimulatory effect (flushing) on the sow's endocrine system and may decrease weaning-to-estrus interval and increase subsequent litter size. Many herds can manage true *ad libitum* feeding systems without experiencing problems with sows going-off feed. Other systems hand feed sows based on the amount of feed eaten at the previous 2-3 meals using records on sow feed cards. Lactating sows should be fed a minimum of twice and preferably three times per day to ensure that feed is available at all times.

Amino acid	Ratio relative to lysine
Lysine	100
Methionine + cystine	50
Threonine	70
Tryptophan	20
Valine	85
Isoleucine	55

Table 4: Suggested amino acid pattern based on total or true ileal amino acid ratios

The feeding system that that most easily and effectively allows barn staff to maximize the feed intake of all lactating sows should be the system of choice.

Diet Form

Recent research by Baudon et al (2003) has shown no improvement in litter weight gain, sow feed intake, or sow weight loss by feeding pelleted compared to mash diets. This has certainly been verified on farms using wet/dry feeders. It has also been demonstrated that sows will consume 10-15% more of a wet feed than they will of a dry feed (Genest and D'Allaire ,1995) which has increased the use of wet/ dry feeders for lactating sows.

An average particle size of grain in sow diets of 700 microns is recommended to support optimum sow performance, feed processing efficiency and feed flowability in bins and feeders. (Wondra et al 1995).

Water

It is important that water supply to the sow not be restricted, whether due to location of the water supply or inadequate flow rates. A water flow rate of 1.5-2 pints per minute should be adequate.

Summary

The objective of the farrowing barn staff must be to maximize sow feed intake. Whether sows are fed manually or by automatic feeding systems, they should be fed a minimum of twice daily, preferable three or more times per day, and have fresh feed available to them at all times. A feed allowance of 4.0lb (approximately 1.0% of the sows weight for the sow) plus 1.25lb for each pig in the litter is a good guide to the minimum levels lactating sows should be fed. Formulation of herd specific diets can be accomplished by estimating sow feed intake and litter weight gain.

References

1. Aherne F. Feeding and management of the lactating sow. *International Pigletter.* 2000; Vol 20. No. .
2. Baudon EC, Hancock JD Pelleted diets for lactating sows. Kansas State University, Swine Day Report. 2003; Pp 33-35.
3. Clowes EJ, Aherne FX, Schaefer AL, Foxcroft GR, Barocos VE. Selective protein loss in lactating sows is associated with reduced litter growth and ovarian function. *J. Anim. Sci.* 2003a; 81:753-764.
4. Clowes EJ, Aherne FX, Schaefer AL, Foxcroft GR, Baracos VE. Parturition body size and body protein loss during lactation influence performance during lactation and ovarian function at weaning in first-parity sows. *J. Animal. Sci.* 2003b; 81:1517-1528.
5. Deen, J. Off-feed sows in lactation. *International Pigletter.* 2005: Vol 24. No. 11.
6. Deen J. The challenge of benchmarking. *International Pigletter.* 2003; Vol. 23. No. 60.
7. Dourmad JY. Effect of feeding level of the gilt during pregnancy on voluntary feed intake during lactation and changes in body composition during gestation and lactation. *Prod. Sci.* 1991; 27:309-319.
8. Genest, M., and S.D'Allaire. 1995. Feeding strategies during the lactation period for first parity sows. *Can. J. An. Sci.* 75: 461-467.
9. Hughes PE. The effects of food level during lacation and early gestation on the reproductive performance of mature sows. *Anim. Prod.* 1993; 75:437-445.
10. Kotetsu Y, Dial GD, Pettigrew JE, King VL. Feed intake pattern during lactation and subsequent reproductive performance of sows. *J. Anim. Sci.* 1996a; 74:2875-2884.
11. Kotetsu V, Dial GD, Pettigrew JE, Marsh WE, King VL. Characterization of feed intake patterns during lactation in commercial swine herds. *J. Animal Sci.* 1996b; 74:1202-1210.
12. NRC. 1998, Nutrient requirement of swine, 10th edition. National Academy Press, Washington, DC.
13. Quiniou N, Noblet J. Influence of high ambient temperature on the performance of multiparous lactating sows. *J. Anim. Sc.* 1999; 77:2124-2134.
14. Revell DK, Williams I.H, Mullan BD, Ranford JL, Smits RJ. Body composition at farrowing and nutrition during lactation affect the performance of primiparous sows 1. voluntary feed intake, weight loss and plasma metabolites. *J. Anim. Sci.* 1998; 76:1729-1737.
15. Tantasuparuk W., Lundeheim N, Dalen AM, Kunaongkrit A, Einarsson S. Weaning-to-service interval in primiparous sows and its relationship with longevity and piglet production. *Livest. Prod. Sci.* 2001; 69:155-162.
16. Wondra KJ, Hancock JD, Kennedy GA, Hines RH, Behnke KC. Reducing particle size of corn in lactation diets from 1200 to 400 micrometers improves sow and litter performance. *J. Animal Sci.* 1995; 73:421-426.
17. Young MG, Tokach MD, Aherne FX, Main RG, Dritz SS, Goodband RD, Nelssen JL. Comparison of three methods of feeding sows in gestation and the subsequent effects on lactation performance. *J.Anim. Sci.* 2004; 82:3058-3070.
18. Zak LJ, Xu X, Hardin RT, Foxcroft GR. Impact of different patterns of feed intake during lactation in the primiparous sow on follicular development and oocyte maturation. *J. Reprod. Fertil.* 1997; 110:99-126.

Information developed for the Pork Information Gateway, a project of the U.S. Pork Center of Excellence supported fully by USDA/Agricultural Research Service, USDA/Cooperative State Research, Education, and Extension Service, Pork Checkoff, NPPC, state pork associations from Iowa, Kentucky, Missouri, Mississippi, Tennessee, Pennsylvania, and Utah, and the Extension Services from several cooperating Land-Grant Institutions including Iowa State University, North Carolina State University, University of Minnesota, University of Illinois, University of Missouri, University of Nebraska, Purdue University, The Ohio State University, South Dakota State University, Kansas State University, Michigan State University, University of Wisconsin, Texas A & M University, Virginia Tech University, University of Tennessee, North Dakota State University, University of Georgia, University of Arkansas, and Colorado State University.