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Feeding the high performing sow herd

Steven J. Kitt, PhD
Progressive Swine Technologies, Columbus, Nebraska

Feeding the modern sow and her litter is vastly different than sows 10-20 years ago primarily due to increased litter size, increased litter growth rate, and associated metabolic demands. It is imperative that nutritionists consider and understand on-farm feeding rates and practices in order to optimize performance. A nutritionist's role does not stop upon generation of a diet; it cannot be understated that the herdsperson can have a greater impact on sow and litter performance as compared to a nutritionist's efforts in formulation; however, it is important that key production staff understand the goals outlined by the nutritionist. Therefore, a nutritionist's role should be to complement, support, and train the production staff in an attempt to achieve greater pigs weaned per farrowed sow. This paper will outline some nutritional concepts and cited research used in estimating nutritional requirements, ideas for future research to address pertinent questions, and discuss processes that have been used to achieve success.

Sound gilt development and supporting nutrition

The impact of sound gilt development on herd performance cannot be understated. We often see good performing gilts become highly prolific sows; conversely, poorly performing gilts in the developer are not prolific and observational data will be shared (Jakubowski, unpublished). Therefore, many management factors of gilt development (e.g., health, stocking density, ventilation, etc) including nutrition are key to long-term success of the sow herd. A concise and effective review by Williams et al (2005) summarized the "non-negotiables" to successful gilt development with the primary targets at first mating of: a) body composition target – which may be different across genotypes (likely 300 lb +/- 30 lb), b) physiological target – bred on ≥ 2nd estrus. These targets may be different with differing genotypes (Johnson et al, 2010) and farm specific growth, but conceptually are consistent guidelines providing good results with modern genotypes. With these objectives and mindful of existing facilities, one can formulate nutritional strategies: 1) to obtain identified pubertal estrus on + 90% of gilts by ~ 30 weeks of age - which often requires growth near genetic potential 2) to feed for longevity – which is debatable on how to achieve and to what extent nutrition has an impact. Nutritional theories that may impact longevity through different mechanisms include: reduced amino acid intake (thereby reducing lean:fat ratio; O'Down et al, 1997), supply of chelated trace minerals, heightened dietary trace minerals and vitamins, etc but limited scientific data exists. A likely objective is maximizing bone density and a series of studies (Fent, 2005) have aided in decision making regarding dietary phosphorus. Much is yet to be learned on optimally feeding developing gilts, particularly as it relates to longevity and lifetime prolificacy.

Breeding/gestation

The objective of gestation feeding depends upon the stage of gestation. Most would agree on the following objectives:

Immediately post-farrow, it is logical that sows should be offered feed ad libitum in order to recover energy, amino acids, and mineral depletion during the lactation period. Again, clear science eludes the practice; however, Wellen

Table 1: Conceptual goal and feeding rate during gestation.

Gestation period	Metabolic goal	Energy intake relative to maintenance
Wean to breed	+++ energy balance	2.25
Breed to end of 1st trimester	+ energy balance	1.15
1st trimester to 21 d prior to parturition	static energy balance	1
Last 21 d of gestation	static energy balance	1.4

Production

et al (2007) have produced data suggesting improvement in embryo number due to metabolic recovery. At some point soon after breeding, sows can be fed "maintenance plus". Risk of overfeeding modern sows is a reality and will contribute towards inadequate lactation feed intake. Therefore, from the start of the 2nd trimester to farrowing is a time of regular assessment of body-condition scoring and modification of feed allocation. True maintenance energy requirements of modern sows may not be all that far off of that suggest by NRC (1998); however, imprecise feeding equipment and herdperson paradigms often hurt our ability to best feed the modern sow. The need of increased feed allocation in the last 14-21 days of gestation is often debated. Scant scientific evidence is available, but the data that does exist (Cromwell et al., 1989; Miller et al., 2000) suggests merit for either the sow or litter. The use of fiber has long been discussed and was reviewed by Reese (1997); updated research studying energy utilization by sows is needed. More research is needed on amino acid requirements of gestating high litter rate gilts and sows but available data (Srichana et al., 2006) suggests greater requirements than previously estimated (NRC, 1998).

Lactation

The objective in lactation is to: a) deliver antibodies via colostrum, b) limit or eliminate sow body weight and tissue loss so as to limit subsequent reproductive issues, c) maximize litter growth rate (via milk output) and these objectives are driven through maximal feed intake. Definition of a productive herd might be characterized by upper ten percentile of peers; Pig Champ (2010) database shows total born = 14.07; born live = 12.46; weaned pigs/sow weaned = 10.86. Using these data as a reference to estimate (Pettigrew, 1993) lysine requirements are shown in Table 2.

Although long-term studies have not been conducted, it is feasible that Ca and P requirements have increased as milk output has increased. Factorial calculations to estimate Ca and P requirements suggest they might be higher than current "typical" dietary concentrations. Dietary formulation cannot greatly modify energy intake. Increasing supplemental fat in lactation much above 3% isn't recommended. Therefore, the ownership to drive lactation energy intake resides not on the nutritionists shoulders but rather the herdsperson's. A simple energy model (Table 3) mostly comprised of factorial calculations based on published data (NRC 1998) shows the impact of increasing litter size coupled with sub-maximal feed intake. This clearly illustrates the need for management processes and innovation to maximize lactation intake as diet formulation alone cannot negate this magnitude bodyweight loss. Moreover, this table illustrates an area of focus on high performing sow farms.

Therefore, a nutritionist's role in driving lactation ADFI should be on assessment (of feeder type, improvement of SOP, sow comfort, ambient temperature, etc), innovation, and building belief that greater lactation ADFI is possible and in the sow's, piglet's, owner's, and herdperson's best interest. For example, often observant, well-intended herdspersons will focus on the minority of sows with concern for sows that ADFI "crashes" 5-10 days post-farrow if stepped up on feed too aggressively. Well designed research (Table 4; Ratliff et al., unpublished) trials can direct decision making, change belief, and therefore modify behavior of encouraging staff to feed modern sows to ad libitum.

A note on DDGS

This cannot be a US swine nutrition presentation without some discussion on by-products. The application of distillers dried grains with solubles (DDGS) appear ubiquitous in our industry. There is growing scientific data on the use of DDGS in sows and a recent large trial (Roux et al., 2010) that included 1,021 sows suggests equal reproductive performance given the nutrient composition and mycotoxin concentration are measured and understood.

Summary

Our industry has made great strides on litter size improvement. The metabolic demand placed on the modern sow

Table 2: Comparative lysine requirements based on herd productivity

	2010 pig champ avg	2010 pig champ upper 10% tile	30 PSY
Pigs/litter	10.10	10.90	12.25
Wean wt, lb	13.24	13.94	13.94
Litter growth, lb	103.42	119.25	134.02
Lactation length,d	20	20	20
Litter ADG, g	2346	2704	3039
Total lysine, g/d	55	64	73

Table 3: Comparative lactation ME intake necessary to negate body weight loss

	Number pigs/litter					
	9	10	11	12	13	14
Birth wt, lb	3	3	3	3	3	3
Current ADFI	12.5	12.5	12.5	12.5	12.5	12.5
Avg wean wt, lb	13	13	13	13	13	13
Piglet ADG, g	238.7368	238.7368	238.7368	238.7368	238.7368	238.7368
Lactation length, days	19	19	19	19	19	19
Avg sow weight, lb	450	450	450	450	450	450
ME required for milk production, kcal/day	13,550	15,056	16,561	18,067	19,572	21,078
ME required for maintenance, kcal/day	5,724	5,724	5,724	5,724	5,724	5,724
Total ME required/sow, kcal/day	19,275	20,780	22,286	23,791	25,297	26,802
Dietary ME, kcal/lb	1,540	1,540	1,540	1,540	1,540	1,540
ADFI necessary to negate body fat loss	12.52	13.49	14.47	15.45	16.43	17.40
ME balance, kcal/day	-25	-1,530	-3,036	-4,541	-6,047	-7,552
ME balance, kcal/lactation	-467	-29,073	-57,679	-86,285	-114,891	-143,497
Body fat loss, lb (negative = fat gain)	0.1	8.1	16.1	24.0	32.0	39.9
Subsequent TB loss[a]	0.00	-0.24	-0.48	-0.72	-0.96	-1.20

[a] Assumes fat loss solely contributes to reproductive performance loss as described by Thaker & Bilkei (2005)

Table 4: Lactation feeding rate on sow and litter performance

Treatment/description	Limit fed day 0-5 4/6/8/10/12 lb/day	Full feed	Pooled SEM	Level of significance
Entry wt, lbs	462.49	464.34	5.531	0.044
Lactation wt. loss, lbs[6]	11.77	4.47	3.088	0.035
Overall FI, lbs	216.36	240.5	4.921	0.001
Overall ADFI, lbs	11.59	12.94	0.23	0.001
Standardized litter size	11.52	11.52	0.1	0.985
Standardized litter start wt., lbs	36.29	35.77	0.662	0.693
Wean litter size	10.41	10.98	0.156	0.011
Litter wean wt., lbs	131.16	141.2	2.614	0.002
Litter wean wt., lb/pig	12.45	12.89	0.192	0.012
Mortality, %	9.57	5.21	0.01	0.012

continues to increase. Therefore, the nutritional requirements continue change. Research that is relevant for the future will focus on nutrient requirement relationships with litter size, longevity, and novel ways for precision feeding during gestation.

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