THE INFLUENCE OF NUTRITION ON NON-PRODUCTIVE DAYS IN THE SOW

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SUMMARY

Non-productive days (NPD) are an important economic indicator in commercial pig production. Inadequate nutrition can influence several of the reproduction parameters which contribute to NPD. The onset of puberty in gilts may be delayed by the reduction of growth rate through nutrient restriction, particularly protein restriction. There is no benefit in encouraging gilts to deposit any more body fat than is normally achieved under a liberal feeding strategy with protein-adequate diets. Weaning to oestrus interval can also be an important component of NPD in many commercial herds. Nutrient restriction during the first lactation and excessive fat deposition during pregnancy may prolong the interval between weaning and mating. The optimum feeding strategy to ensure minimum NPD should result in carefully controlled and limited weight gain during pregnancy, followed by maximum conservation of body tissues during lactation.

INTRODUCTION

The ability of pig producers to influence productivity of the sow herd is somewhat limited by biology and management. Gestation length is relatively constant and lactation length is commonly dictated by available facilities and husbandry standards. The major factor that the producer can influence is the days that the sow or gilt is not neither pregnant nor lactating i.e. non-productive days (NPD). From a financial perspective, NPD signifies those days that an inventoried sow or gilt is incurring expenses without generating income.

The major components that will influence the NPD in commercial pig herds are:

* The time lost between weaning and mating
* The time between mating and any repeat mating
* The time between mating and culling for non-pregnant females or sows culled because they are sick or injured.
* The time between a gilts entry in the gilt pool and her first mating must be counted.

There have been major changes in the management of the gilt and sow during the last 10-20 years. Weaning age has been reduced, sows are more intensively housed, and gilts are mated younger and at lighter body weights. Most commercial sows have originated from breeding programs where selection has been directed against backfat. Selected animals are likely to start reproducing when they have lower total body fat. In addition, selection programs directed mainly against backfat may have resulted in a sow population of larger mature body size and/or individuals with lower voluntary feed intake.

Because of her large body reserves, the young sow of over twenty years ago, was extremely resilient to nutrient stress. Sows possessed enormous capacity to cope with any deficit in nutrient supply. However, present-day sows are much more prone to nutritional stress.- Inadequate nutrition can influence several of the reproduction parameters which contribute to non-productive days (NPD). The components of NPD most likely influenced by nutrition and body condition of sows are:
Age of gilt at first mating  
Weaning to oestrus interval  
Longevity  

AGE AT FIRST MATING  

Economic pressures to mate gilts as early as possible have often led to the modern gilt beginning its reproductive life at less than 200 days of age. The attainment of puberty in commercial gilts may range from 150 to over 200 days of age. Thus onset of puberty may be a major factor limiting the early mating of gilts. To ensure that age at first mating is a minor contributor to NPD, early attainment of puberty is essential.  

Nutrition during the rearing period and the consequences of live weight and body composition may influence the attainment of puberty. The onset of puberty in gilts may be delayed by the reduction of growth rate through food restriction. Results from recent studies indicate that provided lifetime growth rates for modern commercial gilts are in excess of about 550g/day, age at puberty is unlikely to be compromised by nutritional management (Figure 1). If boar stimulation is to begin at about 165 days of age, gilts should weigh in excess of 90 kg live weight.  

The decreased body fat content of breeding gilts that has resulted from genetic programs has led to interest in the effects of body composition on attainment of puberty. Threshold limits of body fatness have been suggested as critical for early attainment of puberty. However, where body fat content has been increased, independent of body weight, by nutritional manipulation during the growing phase, attainment of puberty has been delayed. (Table 1). This evidence supports the hypothesis that lower or diminished body protein reserves have an adverse effect on the fertility of young sows. There is no benefit in encouraging gilts to deposit any more body fat than is normally achieved under a liberal feeding strategy with protein-adequate diets.
Table 1  Effect of live weight and body composition at boar introduction (165 days of age) on subsequent performance of gilts

<table>
<thead>
<tr>
<th>Treatment*</th>
<th>LL</th>
<th>LF</th>
<th>HL</th>
<th>HF</th>
<th>SED</th>
<th>Significance of differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>At boar introduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>live weight (kg)</td>
<td>70.6</td>
<td>71.5</td>
<td>101.3</td>
<td>100.0</td>
<td>1.6</td>
<td>*** NS</td>
</tr>
<tr>
<td>backfat (mm)</td>
<td>11.3</td>
<td>20.9</td>
<td>21.7</td>
<td>27.0</td>
<td>1.2</td>
<td>*** ***</td>
</tr>
<tr>
<td>Age at puberty (d)</td>
<td>193.4</td>
<td>203.3</td>
<td>179.1</td>
<td>187.1</td>
<td>8.9</td>
<td>** P&lt;0.10</td>
</tr>
<tr>
<td>Ovulation rate at puberty</td>
<td>9.4</td>
<td>9.7</td>
<td>11.0</td>
<td>11.0</td>
<td>0.8-1.0</td>
<td></td>
</tr>
</tbody>
</table>

King (1989)

* LL = Light, lean; LF = Light, fat; HL = heavy, lean; HF = heavy fat.

WEANING TO OESTRUS INTERVAL

Weaning to oestrus interval can be an important component of NPD in many commercial herds. The weaning to oestrus interval may be prolonged in sows weaned from their first litter. Often, 50% of first-litter sows fail to exhibit oestrus within one week of weaning whereas over 80% of older sows are mated within this period. Apart from the importance of environmental (both social and climatic) factors, nutritional management plays a key role in influencing the incidence of post-weaning anoestrus.

Nutrition during lactation

The feeding strategy during lactation should be designed to cater adequately for milk production and to prevent excessive weight and condition loss while suckling. Factors such as milk yield, sow weight, litter size and length of lactation all influence nutrient requirements.

The amount of milk produced is the major contributor to the requirements for nutrients. It is now well accepted that sows produce much greater amounts of milk than previously thought (King et al. 1989). Sows capable of producing 10 kg milk each day, would need to consume at least 7 kg feed/day to meet the dietary requirements for milk production.

The voluntary feed intake of sows is quite variable, both within farms and between farms. Average daily feed intake may be below 4.5 kg particularly in the case of first-litter sows and sows lactating during the hotter summer months. In addition, the feed intake pattern during lactation can vary considerably among farms. Both the amount of nutrient intake and pattern of nutrient intake will influence the incidence of post-weaning anoestrus.

If feed intake is limited either by appetite or by constraints of management, sows will attempt to maintain milk supply by mobilizing body reserves. If the undersupply of nutrients is extreme, the young sow is unable to supply sufficient nutrients from body tissues to support milk production with the result that both milk production and subsequent reproductive efficiency will decline (Table 2).
Table 2: Effect of food intake during lactation on the performance of first-litter sows and their litters

<table>
<thead>
<tr>
<th>Daily Feed Intake (kg)</th>
<th>1.5</th>
<th>2.2</th>
<th>2.9</th>
<th>3.6</th>
<th>4.2</th>
<th>4.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation body weight loss lb.</td>
<td>44</td>
<td>31</td>
<td>27</td>
<td>19</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Piglet 28-d weaning weight (kg)</td>
<td>6.0</td>
<td>6.2</td>
<td>6.6</td>
<td>7.0</td>
<td>7.0</td>
<td>6.7</td>
</tr>
<tr>
<td>No. sows exhibiting oestrus within eight days of weaning</td>
<td>1/12</td>
<td>4/12</td>
<td>6/12</td>
<td>7/12</td>
<td>7/12</td>
<td>10/12</td>
</tr>
</tbody>
</table>

King and Dunkin (1986,a)

Recent research has implicated nutrient intake during lactation and the availability of body tissue reserves as major factors which influence the incidence of post-weaning anoestrus amongst first-litter sows. The results of initial experiments suggested that low energy intake during lactation was involved in post-weaning anoestrus. However, protein intake during the first lactation has also been implicated (Table 3).

Daily intakes of at least 50 MJ DE, 700 g crude protein and 35 g lysine are required during lactation to maximize litter performance and minimize post-weaning anoestrus among first-litter sows King (1987); higher intakes are desirable. These dietary intakes can be achieved if grower or even starter diets are offered to sows during their first lactation. The mechanisms by which nutrient intake during lactation influences subsequent weaning to oestrus interval are poorly understood. There are several plasma substrates (eg. glucose, fatty acids, amino acids) and plasma metabolic hormones (eg. insulin, growth hormone, insulin-like growth factor, thyroid hormones) that reflect the catabolic state of lactating sows. These metabolites and hormones may provide signals to the reproductive hormones, particularly luteinizing hormone (LH).

Table 3: Effect of protein and energy intake during lactation on the performance of first-litter sows and their litters

<table>
<thead>
<tr>
<th>Daily intake</th>
<th>Digestible energy (MJ)</th>
<th>45.2</th>
<th>45.2</th>
<th>61.1</th>
<th>64.4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude protein (g)</td>
<td>510</td>
<td>705</td>
<td>510</td>
<td>851</td>
</tr>
<tr>
<td>Lactation body weight loss (kg)</td>
<td>22</td>
<td>21</td>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Piglet 28-d weaning weight (kg)</td>
<td>6.3</td>
<td>7.0</td>
<td>6.7</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>No. sows exhibiting oestrus within 8 days of weaning</td>
<td>5/22</td>
<td>12/22</td>
<td>9/22</td>
<td>13/22</td>
<td></td>
</tr>
</tbody>
</table>

King and Dunkin (1986,b)

The results-of several studies suggest that the resumption of ovarian activity in sows after weaning may be associated with the establishment of a pattern of LH secretion during the preceding lactation (King 1990, Mullan and Close 1989). Although the sow does not secrete much LH during lactation, because of inhibition by the nursing piglets massaging the udder, she does secrete some and the amount seems to be pivotal. In fact, sows destined to return to oestrus promptly after weaning secrete more LH as early as day 14 of lactation than do sows that will have a prolonged interval from weaning to
oestrus (Tokach et al. 1991, King 1990). In addition, Tokach et al. (1991) showed that a high insulin level in the lactating sow’s blood was associated with a (relatively) high level of LH secretion. Insulin may be a key signal that tells the sow’s reproductive system she is in good enough condition to begin another reproductive cycle.

**Nutrition between weaning and oestrus**

It appears that the events in lactation have already determined whether and when the sow will exhibit oestrus after weaning. Experiments examining the effects of post-weaning feed intake have usually failed to influence the weaning to oestrus interval particularly when the interval is short (Brooks et al. 1975). Withdrawal of feed and/or water for 24 hours following weaning, may in fact extend the weaning to oestrus interval (Shearer and Adam 1973).

**Nutrition during pregnancy**

Feeding strategies imposed during pregnancy may affect weaning to oestrus interval after the subsequent lactation. These effects on weaning to oestrus interval may be mediated by the effects of feeding on body weight, body composition and voluntary feed intake during lactation. Body composition at farrowing may be manipulated by genotype and nutrition during the pregnancy. It is well known that sows which receive high intakes during pregnancy (greater than 2.3 kg/day) have reduced feed intake in the subsequent lactation (Baker et al. 1969). Furthermore, once body fat exceeds about one third of body weight (equivalent to about 28 mm backfat at P2) then voluntary feed intake will decrease (Williams and Mullan 1989).

The aim of the feeding strategy during pregnancy will be to control weight gain such that the sow should gain minimum weight commensurate with productivity. Usually maternal body weight gains of 25-35 kg (corresponding to 45-55 kg total gain) are sufficient during pregnancy. The nutrient requirements are now well understood and accepted for sows during pregnancy (ARC 1981).

**LONGEVITY**

The savings obtained by decreasing NPD from selection to mating has encouraged producers to mate replacement gilts at a younger age when they are less physically developed. The modern lean gilt is able to conceive at a very young age and produce an acceptable litter of piglets at first farrowing.

However, there has been concern as to whether these gilts have adequate body reserves to reproduce at their maximum potential for extended periods and remain in the herd for at least 4-5 parities. There is very little quantitative information on the level of fatness that gilts should achieve either at mating or at parturition to ensure that they have sufficient reserves for a long and productive life. Different genotypes may have quite different threshold levels of body reserves.

Field studies have often revealed that gilts which are mated at an older age, are heavier and have greater fat reserves, have less NPD and are retained in the herd for longer periods (King et al. 1984). On the other hand there is evidence that excess body weight and fatness of gilts may adversely affect long-term reproductive performance (Den Hartog and Van Kempen 1980). Young et al. (1990) reported increased probability of culling of sows that were at the extremes of body condition i.e. thin or fat but the probability of culling was greater for thin (less than 12mm P2 backfat) sows which agrees with the observations of Yang et al. (1989).
The results of controlled experiments at research institutes have usually shown no effects of gilt age, body weight or body composition at first breeding on longevity or reproductive performance over 3 or more parities (Rozeboom et al. 1991). In these experimental studies, the management and husbandry of animals would have been much more strictly controlled than in field studies. In the less controlled and often harsher environment of commercial pig production, body weight and composition of gilts at first breeding may become more important.

The apparent inconsistencies in the effects of age, body weights and body composition of gilts at first breeding on longevity and long-term reproductive performance highlight the importance of the management required to optimize the reproduction efficiency of the modern lean gilt.

Feeding strategies for modern sows should be designed to maintain the body condition of sows. The ability to monitor such condition changes has been helped in practice by the use of scales and ultrasonic machines. The optimum feeding strategy should result in carefully controlled and limited weight gain during pregnancy, followed by maximum conservation of body tissues during lactation. Management procedures should be adopted to increase voluntary food intake during lactation.

REFERENCES


