KEY INFLUENCING FACTORS ON VOLUNTARY FEED INTAKE OF PIGLETS

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Introduction

The feed intake of swine is a deciding factor for both health and growth. Its relationship with growth is obvious; it is the nutrient supply above maintenance which sets the upper limit to growth of an animal. The impact of feed intake on health is underappreciated. Experiments with E. coli infections showed this nicely. These experiments aimed at screening feed additives against E. coli. However, each attempt to find effective additives, other than zinc oxide, failed. Combining the data from various experiments showed nicely why; the deciding factor if piglets succumbed to an E. coli infection was not the composition of the diet, but the intake of the diet. Pigs that had poor intake at the time of the infection became seriously ill, while piglets that ate well did not suffer from the infection. Most interestingly, this response was effectively binomial; either pigs ate poorly and became seriously sick, or they ate well and didn’t suffer from the infection. A middle ground didn’t exist. The objective of this presentation is, therefore, to discuss management of feed intake with a focus on health in piglets.

Lactation

Piglet mortality is highest in the first days after birth. One underlying reason for this mortality are genetic deficiencies and birth defects that prevent a normal functioning of the piglet. Another reason is starvation of the piglet leading to hypothermia and ultimately death. It has long been argued that the cause for this mortality is the lack of energy reserves of the piglets at birth. Although it is true that piglets are born with effectively no adipose energy reserves and only limited glycogen reserves, it is commonly found that glycogen reserves of mortality is not depleted.

An alternative explanation for this neonatal mortality is dystocia. Dystocia is an abnormally long and difficult birth. This extended birth process can reduce or even stop the blood supply to a piglet in utero resulting in asphyxiation (suffocation) of the piglet. Piglets with an extensive period of asphyxiation are born stillborn, while piglets born with intermediate asphyxiation are born 'out of breath'. These are the piglets that after birth remain lying behind the sow. While lying there they are highly susceptible to crushing and hypothermia. If they get up, they are typically disoriented and have difficulty finding the udder, and certainly at a disadvantage competing with healthy
litter mates for a good position at the udder. The consequence is a delay in feed intake and hypothermia, both of which can quickly become fatal to a newborn piglet.

The basis for this neonatal mortality is not the piglet, but the sow. Our sows are typically managed such that they get no or limited exercise. Hence, their stamina is limited. Given that parturition is a serious physical challenge, many sows don’t have the endurance to sustain this without an interruption, without running into dystocia. This problem is further compounded by ever increasing litter size and thus a prolonged partus.

The solution for this problem is to enhance the endurance of the sow. Although sports nutrition has taught us many tricks (e.g., glycogen loading), it remains very hard to practically implement this. Sports supplements aimed at accelerating birth have been equally unsuccessful as they were too cumbersome for farmers to implement routinely. Canadian research has shown that the consequences of dystocia on the piglet can be diminished by supplying oxygen, or by reheating the piglet using for example a modified microwave. Again, these techniques are hard to implement commercially.

One often ignored fact is that newborn piglets are born with a very low metabolic rate per kg metabolic body weight: approximately 60% of what textbooks state as normal. The reason for this is likely that internal organs focused on food digestion are not yet ‘turned on’. Gentz (1970) showed nicely that each time a newborn piglet consumed a meal of milk that its metabolic rate rises till it reaches the textbook target of 400 kJ/kg^0.75. Thus, in order to avoid hypothermia the milk uptake of a piglet should be stimulated (but only when the piglet has recovered enough from the birth process to accept feed).

Nutritional interventions targeted at the piglet should thus give the weak piglet an opportunity to first of all eat, and second, obtain the bio-active factors that it missed from not consuming enough colostrum. Sow’s milk is the ideal nutrient source, but when this is not adequate or hard to obtain then milk supplementation is a good alternative. In recent years, milk supplementation has evolved to where the milks work well in practice. Products now can provide bio-active substances like immunoglobulins and growth factors by incorporating colostrum, hyper-immunized egg, or plasma products. Products also are highly palatable and at the same time stable enough for commercial application.

The time of first distribution of these milk supplements has been one of much debate. Trials have shown that when starting administration on day 2-3 after birth that uptake is disappointing till day 5-7 after birth. Hence, many have concluded that supplementation should start around day 5-7. However, the question is when the best time is for teaching the piglet to consume this supplemental milk. Our own research has shown that this is immediately after birth. This results in a rapid development of milk (Yoghurt) intake. Coming back to the cause of most piglet mortality, dystocia, very early supplementation will also provide the best opportunity for reducing piglet mortality; supplemental milk can only reduce mortality if it is provided well in advance of when mortality occurs, and this is during the first 3 days of life. Especially disadvantaged piglets can benefit from milk supplementation, this since these animals have more difficulty competing at the udder. In practice, we see that some piglets rely solely on supplemental milk; these pigs perform just fine. Other pigs use it as ‘desert’; once they are done nursing they top off with supplemental milk. The benefits of supplemental milk are two-fold: better and more uniform growth of the piglets, and less weight loss of the sow, with possible implications for rebreeding.
The need for milk supplementation increases with increasing litter size. A recent study from Decaluwe (2014) showed that colostrum output was effectively independent of litter size. Hence, increasing litter size results in lower colostrum availability per piglet, and more piglets consuming less than the 160 g/d/kg body weight target. Not meeting this target means compromised growth, less immunoglobulins, and less disease resistance. In practice, this will translate itself into health problems and lack of uniformity. Milk supplementation with products designed for newborn piglets, thus high in bio-active factors like immunoglobulins, can somewhat compensate for an inadequate colostrum intake.

Effective milk supplementation requires not only a high quality milk, but also proper management of the milk supply. Ideally, the piglet is triggered to eat by frequent administration of fresh product, and that in a suitable (and hygienic) bowl. Providing a warm milk also stimulates intake and on top of that it further reduces the risk of hypothermia. For problem pigs it may even pay to administer a small amount of milk orally; this will increase their heat production and improve their chances for surviving.

Creep feed supplementation has two aims: increase the nutrient supply to the piglet, but above all, teach the piglet to eat solid feed in order to transition the piglet better through the weaning process. The importance of an increased nutrient supply increases with later weaning ages and larger litters, while the importance of an easy transition around weaning increases with earlier weaning age. Like for supplemental milk, presentation and palatability determine the intake and hence the success of creep feed.

Nursery

The second key stress period in the life of a pig is weaning. This typically occurs around 3 weeks of age under conditions where the piglet had limited experience consuming anything but sow’s milk. At weaning this piglet experiences a range of stressors: separation from its mother, relocation to a new facility, mixing with other piglets, and sometimes transport for an extensive period of time. On top of that a novel type and form of feed is presented to the piglet: a dry diet based predominantly on plant-based products.

In our research facility we have the unique ability to study the feed intake behavior of piglets after weaning through the use of computer-monitored feeding stations. This has taught us that piglets started visiting the feeders pretty much immediately after weaning. Our data also show that nearly all pigs sample the feed in the first hours post weaning. This is in the order of grams, though, and missed in most other research stations because of less accurate recordings. Subsequently, a small number of pigs, especially those already accustomed to consuming man-made feeds, continue to eat well. A large number, though, leaves the feed alone for an extended period of time, in extreme cases 2-3 days.

We can only speculate what the reason for this is, but neophobia is the most likely candidate: the piglets don’t recognize the feed as food, and they are simply afraid of this new stuff that is on their plate. In nature, animals have learned to carefully sample a novel food source before consuming large quantities. The reason for this is that toxins present in a food will typically show their effects within a day after consuming a food, and if there is a toxin in it one better not eat too much. Thus, by sampling they can check if this strange beige pellet is good or bad for them. It all takes time, though, and
during this time, as explained in the introduction, bacteria take the opportunity to make their host sick.

Another interesting finding was that the piglets only ate during day-time. Although this may sound logical, it really isn’t. During lactation the piglets nursed around the clock, and after weaning lights were on 24 h a day in the nursery, but nevertheless, the piglets immediately adapt a day-night rhythm. An interesting question is thus if waking up the pigs during night time can stimulate feed intake. Efforts to do this by playing tapes with grunting noises only lead to increases in water usage, suggesting that sow sounds stimulate the piglets to look for nipples (Torrey et al., 2004)

One calculation applied to the intake data was to assume that 10g of feed constituted a meal. This analysis showed that some pigs consumed their first meal (10g) quickly after weaning. However, for many pigs this took several hours. Interestingly, the time to the 2nd meal took another 50%. In other words, if piglets consume their first 10g of feed in 6 hours, they needed an additional 3 hours to consume the next 10g of feed. This rule worked nearly flawlessly across animals, but with one catch: during nighttime the pigs stopped eating. Thus, a piglet that consumed its first 10 g after mid-afternoon it failed to consume its second 10g within that 50% time window, this since it now had turned into night and during the night the piglet wouldn’t eat at all. Those pigs thus waited till the next morning to consume their second meal.

An interesting question that stems from this is what the optimum time of day is for weaning a piglet. If we wean a piglet midday, then it has limited time to initiate a regular eating pattern, this since he stops eating at night. If a piglet is weaned very early in the morning, it has the best chance of initiating regular feed intake before nighttime sets in. If a pig is weaned late in the evening, then it can possibly sample feed in the evening and initiate a regular eating pattern the next day as by that time he knows the feed is safe. Practical data on the optimum time of day to wean a piglet, from the piglet’s perspective, seem to be few. One publication from Kornegay suggests that weaning late in the evening yielded the best performance.

Water consumption of newly weaned piglets is a controversial topic. Quite some nutritionists feel that newly weaned piglets consume too little water, and this is hindering the consumption of solid (dry) feed. This controversy is further fueled by a lack of understanding of what the water requirement is of a piglet. For a grow-finish pig a water:feed ratio of 2:1 to 2.5:1 is used quite often. But what should we use for a newly-weaned piglet that barely eats? Recommendations of 0.5 to more than 1 L/day are common, but solid data on this are lacking. For infants, the water requirement has been set to 20 ml/kg BW, which translated to 120 ml for a 6 kg piglet. This figure is substantially lower than what most nutritionists recommend. When translating data from humans to piglets we do need to keep in mind that piglets don’t sweat, so there are limited evaporative water losses. Hence, if anything, the extrapolation from infants should be on the high side.

In practice, it is common to find 1.5L/day water disappearance for a piglet on the first full day after weaning. Relative to body weight this is roughly 25%! In silly student competitions who can drink the most water, intakes of 10-12L are reported. Intakes of this magnitude are life-threatening and responsible for deaths. This figure, though, is only half of what the average piglet consumes. Granted, the student did it in hours, and the piglet in a full day (likely day-time only). Nevertheless, excessive water intake may well be a reason for concern in commercial practice. Water intake at this level can
disturb gut health as the osmotic load causes enterocytes to lyse. The processing of this water by the body also can result in edema which in extreme cases can be fatal.

An interesting question is why the piglets are consuming such copious amounts of water. The answer to this remains speculation. One thought is that the piglets are used to consume food through the sow’s nipple. After weaning, we present them a metal nipple and a liquid comes from it. Cold and without nutrients, but it still fills the belly, at least short-term. Nursing behavior leading to water intake also fits with the observations from Torrey et al. (2004) whom showed that playing recordings of sow grunts in the nursery leads to more water intake. Consuming water is clearly not the most effective of stilling one’s appetite, which some pigs figure out quickly. Others, however, require an extensive period of time to figure out that the feed is where the nutrients are, not the water (e.g., Torrey, 2008). How much damage is done in the meantime by excessive water consumption? Better yet, why don’t we supply nutrients through the drinking water to a newly-weaned piglet? This strategy actually works very well for transitioning the piglet, but has as downside that the piglets still don’t learn to eat (cheaper) solid feed. This strategy would also require proper hygiene to function well, something that in commercial facilities is not always easy a guarantee.

In humans, excessive water consumption leads to edema. In newly weaned piglets, edema is not recognized. Interestingly, though, as an industry we are very proud of a feed efficiency in the first week post-weaning that is better than 1, that while the animals are eating at maintenance. If an animal is eating at maintenance, then where is the growth coming from? Edema is the likely answer, as shown by Mahan and confirmed by our own research. In fact, by replacing plain drinking water with a nutrient solution it is possible to obtain normal feed efficiencies: when animals eat at maintenance, they don’t grow. The challenge is that this physiologically normal performance is seen as problematic by our industry. No wonder we have so many health problems after weaning.

The solution is first of all to teach the piglets to eat before weaning; milk supplements and a high quality creep are great tools for this, provided they are managed well. Throwing a bag of feed in a hopper won’t do the piglet much good. Instead, the animal should be stimulated to eat by providing frequent meals, frequent arousals of its curiosity. Field trials, amongst others at EMBRAPA, have demonstrated both the short- and long-term benefits of this. Piglets grow better in lactation, but even more importantly, they transition better when weaned, starting the intake of solid feed earlier and with less fall-backs.

Post-weaning, liquid diets are technically the best option: pigs will consume those without interruption and gains of well over 500 g/d in the first week post-weaning are possible. More importantly, the uninterrupted nutrient supply also maximizes animal health. In practice, liquid diets are not always easy to implement, and they also require a weaning off of them later on if dry feed is the standard. In those cases, a transition with gruel is a good compromise, and if that is not possible, the most palatable prestarter.

Diets used should be formulated for optimal palatability as experienced by the piglet, not the sales man or farmer. Ingredients like plasma, milk products, and heat-processed rice are favored over raw cereals. On a nutrient basis, diets low in fiber and with a high glycemic index are preferred. The use of palatants is an interesting dilemma. Long-term, piglets prefer diets with strong palatants, but my experience is that short-term newly weaned pigs prefer unflavored feeds. Certainly, ingredients with a negative effect on palatability should be avoided: in the first days after weaning intake is the key factor,
not nutrient supply. After all, the piglet is not eating enough to grow. Similarly, many health-promoting ingredients require an effective dose that is only obtained several days after weaning. If these additives hurt intake in the first days after weaning then it is better to avoid them.

Diets should also be presented in the most palatable way. What that is remains controversial. Certainly 1.8 mm pellets look nice, but does the piglet agree? Some researchers claim that large pellets are easier to handle by piglets, but are they then treated as a toy or as feed? Likely, the mouth-feel of a pellet is much more important. Soft, meaty pellets actually work very well, but they are harder to manage from a farmer’s perspective.

Conclusion

Feed intake not only drives gain of an animal; during stress period it is a key determinant of the health of animal. These stress periods are strongest just after birth and after weaning. For those periods everything feasible should be done to improve the feed intake. Farrowing is a huge stress on both the sow and the piglets and when not proceeding smoothly, piglets can be suffocated resulting in stillbirths or piglets that are born too weak to fend for themselves. Supplementing milk to newborn piglets improves the chances of all animals receiving adequate nutrition, even those that suffered a difficult life start. Supplemental milk and creep feed are also tools for improving the homogeneity of litters and for facilitating the transition to solid feed after weaning. Upon weaning everything should be done to get piglets to eat as otherwise health problems surely will surface. Training the piglet to eat man-made diets before weaning is probably the most effective. Post-weaning the transition can be facilitated by high quality diets, ideally presented in wet or moist form.