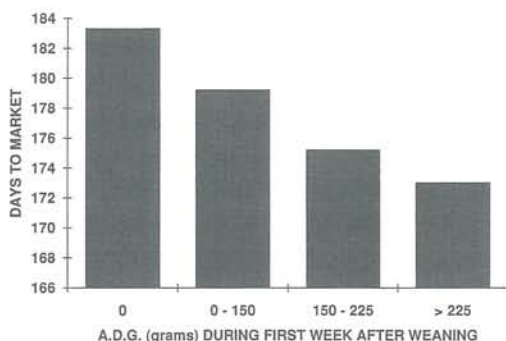


## 8. FEEDING THE WEANED PIG

The period immediately after weaning is an extremely important time in the life of the pig, one which has a significant impact on future performance. For example, on farrow-to-finish farms where age at market weight has been identified as a problem, one often finds the root cause in the nursery, rather than in the growout barn. Indeed, studies at the Prairie Swine Centre have demonstrated that about 30% of the variation in age to market can be attributed to the time it takes a pig to reach a body weight of 23 kg.

Healthy, vigorous pigs that are eating and growing well adjust more easily to weaning and suffer little or no effects of “post-weaning lag.” Poor-doing, lethargic pigs are slower-growing, do not adjust well to weaning and suffer the greatest drop in performance at weaning. Clearly, the key is to get pigs off to a good start to ensure ongoing success (Figure 8-1).



Adapted from Tokach et al. 1992. Proc. Kansas State Univ. Swine Day. Manhattan, KS. pp. 15-17.

Figure 8-1.

### Stresses at Weaning

At the time of weaning, the pig is exposed to a series of stressors that, if left unchecked, can lead to poor performance and increased mortality. For example, due to removal from the sow, the piglet is forced to change from an almost ideal liquid diet, based on lactose, fat and milk protein, to a dry diet based on different proteins, fats and carbohydrates. Sow's milk offers other advantages, containing 'non-nutritive' components that facilitate digestion and provide protection against disease.

In addition, it is almost impossible to prevent some decline in nutrient intake as the pig changes from sow's milk to a starter diet. This decline in intake results in a proportionate decline in metabolic body heat generation, making the pig more susceptible to chilling at the time of weaning. Control of the thermal environment is critical, and in some respects, will be related to diet composition (see “the pig's environment” later in this chapter).

It is self-evident that exposure to disease-causing organisms compromises the ability of the pig to adjust to weaning. However, management, as opposed to treatment of disease, has proven to be the most effective strategy. Attaining minimum disease status in a herd offers many overall advantages, particularly for the weanling pig. However, not all diseases can be eliminated from the herd. Depending on the diseases that are a concern in a given herd, segregated early weaning (SEW) offers advantages in terms of reducing pathogen transmission from the sow to her litter (Table 8-1). In the instance of other diseases, minimizing the age spread of piglets within the farrowing room and within the nursery is highly desirable.

In addition to the stresses of nutrition and disease, the impact of a sub-optimal environment and disturbances to the previous social order must not be underestimated. A holistic approach to managing the newly-weaned pig, particularly as the industry moves to weaning at an earlier age, becomes paramount. Modification of diet cannot overcome the effects of a poor environment, just as creating an ideal environment will not compensate for a poor diet. All the pieces of the puzzle must be in place and integrated.

However, the process of weaning, no matter how carefully managed, results in changes in the gut of the pig that make it more susceptible to digestive upset, diarrhea and impaired appetite. The objective, then, in developing diets for the weanling pig is to recognize these unique needs and facilitate a smooth transition to the piglet's new lifestyle,

resulting in rapid and efficient growth and limited health problems. This must all be accomplished with a keen eye to cost and economic efficiency.

**Table 8-1. Recommended Weaning Age for Disease Elimination.**

Infectious Agent	Age (days)
<i>Pasteurella multocida</i>	10
<i>Mycoplasma hyopneumonia</i>	10
<i>Actinobacillus pleuropneumonia</i>	21
T.G.E. virus	21
<i>Serpulina hyodysenteriae</i>	21
PRRS	21

NB. *Strep. suis*, *Haemophilus parasuis*, *Actinobacillus suis* are not easily eliminated.

Source: Sheridan, 1995.

### Performance Targets

Monitoring performance is essential for success; however, performance data is only useful if it is employed by management in a constructive way. One effective approach is to compare one's performance with that being achieved by other similar units, in order to determine where further improvements might be sought. If such information is not available from neighbouring farms, the targets illustrated in Figure 8-2 and Table 8-2 may be used. "Good" represents the level of performance expected in a reasonably good environment, while "better" illustrates what might be expected with a very high level of overall management. "Best" represents a level of performance which currently exceeds that achieved on most farms, but which should become more readily achieved as our understanding of weaning management grows and related technology improves.

**Table 8-2. Performance Targets for Pigs from 7 to 25 kg Body Weight.**

	Good	Better	Best
Average daily gain (kg)	460	520	585
Average daily feed (kg)	740	780	820
Feed conversion	1.6	1.5	1.4
Mortality, %	1.0	0.5	0.2

**Photo 8-1.**



**Water medicators are often used to mix nutritional supplements or medication into water supplies.**

Failure to achieve these performance targets could be due to diet composition, but could also include such factors as housing (all-in-all-out is essential), environment (warm, dry and draft-free), genetics and health.

### Maximizing Feed Intake

In most circumstances, weaning performance is limited by feed intake, and more precisely, by energy intake. Producers who achieve a high level of feed intake are able to realize the best overall performance in their nursery. A few key points appear to be crucial to such success.

Feed intake is heavily influenced by diet digestibility. Seemingly small reductions in digestibility can have a proportionately large impact by reducing voluntary feed intake.

Fresh water must be readily available. Piglets sometimes have difficulty finding nipple drinkers immediately after weaning, so attention to early water consumption is important. Dish-type drinkers offer advantages in terms of pigs accessing water soon after weaning, but difficulties in keeping them clean reduces their popularity.

Water containing high levels of minerals, especially sulphate, can contribute to diarrhea, but have surprisingly little impact on feed intake. Each situation where water is a concern needs to be evaluated closely.

Much is often said about the importance of fresh feed. While caked, stale or fouled feed is clearly



## Weanling Performance Targets

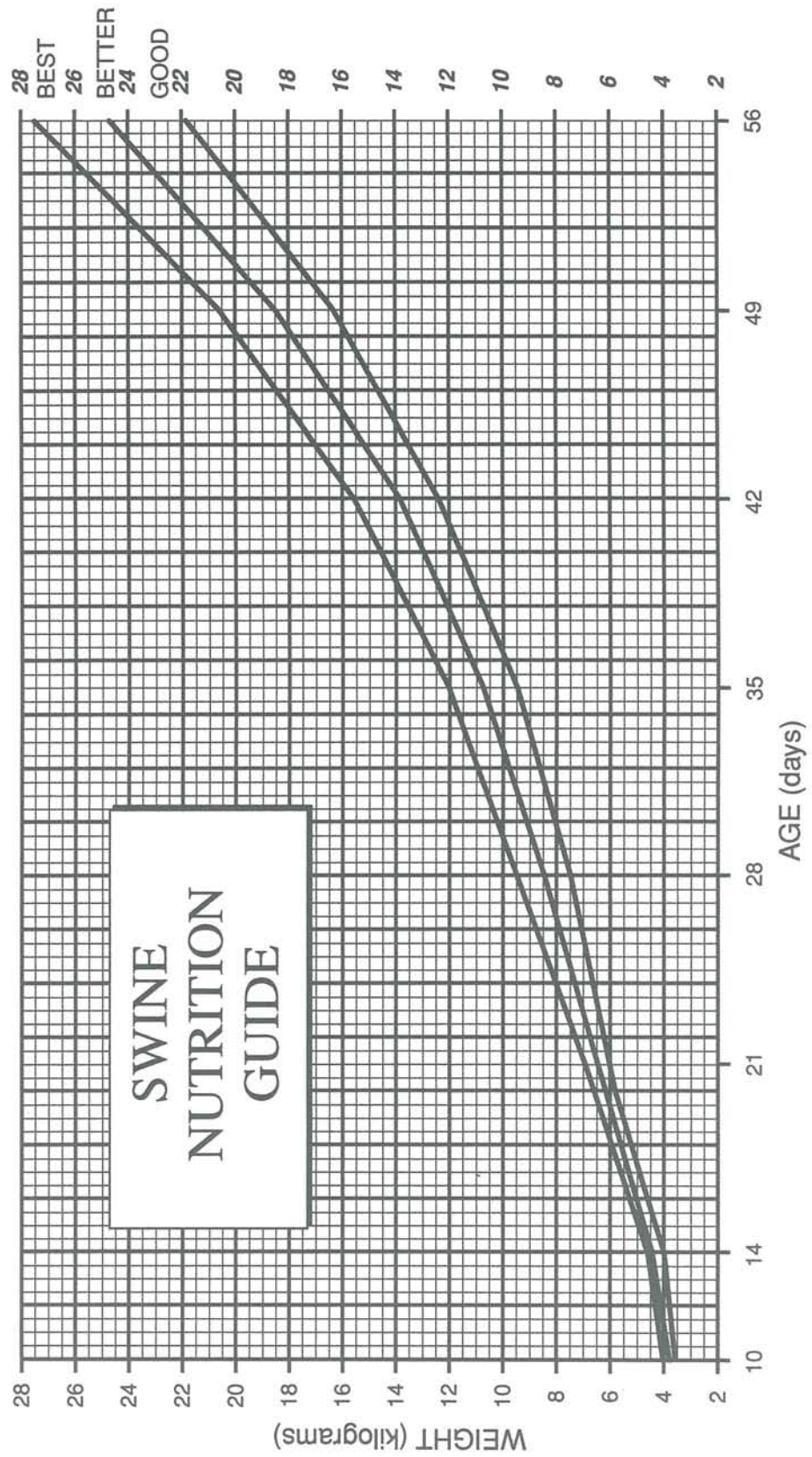


Figure 8-2. Growth Curves for Pigs Demonstrating Good, Better and Best Performance to 10 Weeks of Age.

undesirable, there is little data to suggest that feed needs to be added fresh daily. Indeed, limited research suggests barn odours have little effect on voluntary feed intake in weanling pigs. However, regularly adding new feed to the feeder appears to attract the pig's attention and thus may stimulate intake.

Under some circumstances, limiting daily feed intake in the newly-weaned pig might help to control diarrhea. While such a practice may be effective as a short-term solution, ultimately the underlying cause of the problem needs to be addressed, as the objective in the nursery is to get pigs onto full-feed as quickly as possible. Only then will growth rate be maximized. A full discussion of limit feeding appears later in this chapter.

Other important factors that determine feed intake are addressed later in this chapter. These include ambient temperature, floor space and feeder design.

### Managing the Early-Weaned Pig

Although feed composition is critical to success in early weaning (<21 days), proper animal and feed management is also essential. Pigs should be weaned in groups of 10 - 15 pigs per pen into an all-in-all-out nursery. At the time of weaning, the temperature should be approximately 32° C. Heat lamps should also be used for the first two or three days, especially for smaller pigs. If heat lamps are not available, the temperature should be increased by 2° C. The temperature can be reduced by 1° C every two to three days until the room temperature is 28° C. At this time, the temperature should be

**Table 8-3. Nutrient Requirements of the Weanling Pig.**

Nutrients	Weight Range, kg		
	Wean to 7 kg	7 to 12 kg	12 to 20 kg
<u>Energy</u> <sup>1</sup>			
D.E. kcal/kg	3450 - 3600	3450 - 3550	3350 - 3450
<u>Available amino acids</u> <sup>2</sup>			
Lysine, g/Mcal DE	3.60	3.10	2.90
Lysine, %	1.30	1.10	1.00
Methionine, %	0.36	0.31	0.28
T.S.A.A., %	0.72	0.61	0.56
Threonine, %	0.85	0.72	0.65
Tryptophan, %	0.22	0.19	0.18
Leucine, %	1.30	1.10	1.00
Isoleucine, %	0.78	0.66	0.60
Valine, %	0.88	0.75	0.68
Phenylalanine, %	0.74	0.63	0.57
Histidine, %	0.42	0.35	0.32
Arginine, %	0.55	0.46	0.42
<u>Minerals</u> <sup>3</sup>			
Calcium, %	0.90	0.80 (1.00)	0.70 (1.00)
Phosphorus, %	0.70	0.65 (0.80)	0.60 (0.80)
Sodium, %	0.12	0.12	0.12
Chloride, %	0.15	0.15	0.15

<sup>1</sup>Not a "requirement" per se, but a suggested D.E. level for pigs of this weight (age) range. Actual D.E. will depend on available ingredients and relative cost.

<sup>2</sup>All amino acid requirements expressed as "available" using ileal digestibility as the standard.

<sup>3</sup>Levels for animals destined for slaughter. Levels for animals intended for breeding stock are provided in parenthesis.



lowered by 1° C each week. These are estimates only, as conditions due to drafts, building insulation, flooring material, humidity, etc., will affect the exact needs of the pig. Pig behaviour is a good indicator of comfort. Lying in piles on their bellies is generally an indication of chilling. Panting is indicative of heat stress. Ideally, pigs should be lying on their sides, well separated from their neighbours. Remember, high temperatures suppress feed intake and may contribute to illness.

Initially, feed should be provided on pans placed in the centre of the pen. Heavy metal pans with 12 to 25 millimetre edges are desirable as they are easy to work with, difficult to tip, and help reduce wastage. Various feeding regimes are recommended, but we like offering 50 - 75 g per pig on the pan. It should be replenished three times a day. By the third day, pigs should be starting to use the self-feeder. By the third to fifth day, the feed pan can be removed.

Feeders should be adjusted to ensure ready access to feed while avoiding wastage. Plenty of feeder space is required, as pigs at this age are group eaters. Single space feeders are not recommended. To avoid fouling, the feeders should be at least 15 cm from a corner, since pigs like to defecate in corners. Finally, feeders should be designed with spacers in the trough to prevent pigs from sleeping in them.

While nipple drinkers are easiest to keep clean, dish drinkers are more conducive to water intake at the time of weaning. Most importantly, water must be readily available at all times.

**Photo 8-2.**



**Heat lamps should be used for the first few days after weaning, especially for smaller piglets.**

Some people recommend minimum lighting to reduce tail biting and other vices. This may actually have the opposite effect. Turning on the lights to check the pigs then creates a high level of activity that in some cases has led to increased vices. It is best to create a pleasant, warm, dry, draft-free, and uncrowded environment for the pigs. These conditions are the best way to avoid behavioural problems.

## **Nutrient Requirements of the Weaned Pig**

The nutrient requirements of the weaned pig, like other classes of swine, depend on many factors, including their genetic potential for lean and fat gain, the environment and health status. For the purposes of this chapter, when defining nutrient requirements and diet composition, we assume superior genetics, an optimum environment and a reasonably high health status. There are three reasons for taking this approach.

First, our understanding of the interrelationship among health status, the environment and nutrient requirements is not well understood at this time. Because of the importance of performance at this stage in production, one will typically err on the side of over- as opposed to under-formulation.

Second, the economic “risk” of over-feeding nutrients in the nursery is small compared to the potential benefit of improved performance. This is due to the fact that pigs in the nursery eat a relatively small amount of feed; indeed, less than 10 percent of the total feed required to carry the pig from weaning to market will be consumed during this period. In particular, during the early post-weaning stage, diet cost will be influenced more by selection of ingredients than levels of nutrients. This will be discussed in the next section.

Phase feeding programs help to address this problem as well, as they allow producers to meet the unique needs of the pig as it progresses from 2 or 3 weeks of age through to 8 to 10 weeks of age in the most economical fashion. The younger pig has much more stringent requirements, but in early-weaning systems (<10 days), less than 15% of the total starter intake occurs prior to 7 kg body weight

(Figure 8-3). In pigs weaned at 19 days of age, less than 5% of the total starter feed is consumed prior to 7 kg body weight.

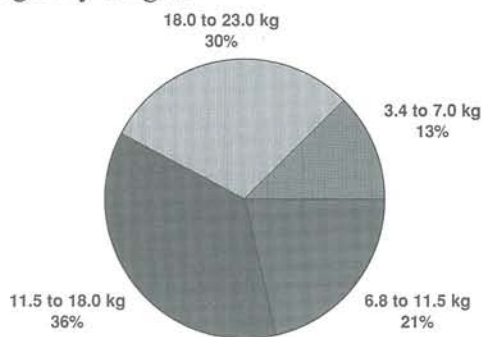


Figure 8-3a. Starter Feed Usage: two week weaning.

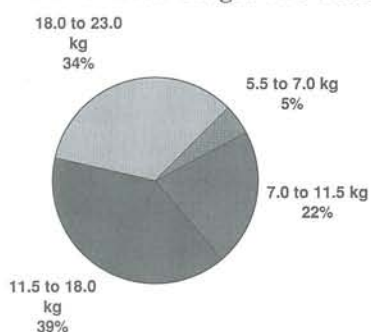


Figure 8-3b. Starter Feed Usage: three week weaning.

Third, during the weaning period, daily nutrient intake is generally the most critical factor limiting animal performance. While genetics, as well as the environment and health may influence feed intake, few pigs are fed diets that allow full expression of genetic potential because the nutrient density of the diet is limiting for both practical and economic reasons (Figure 8-4).

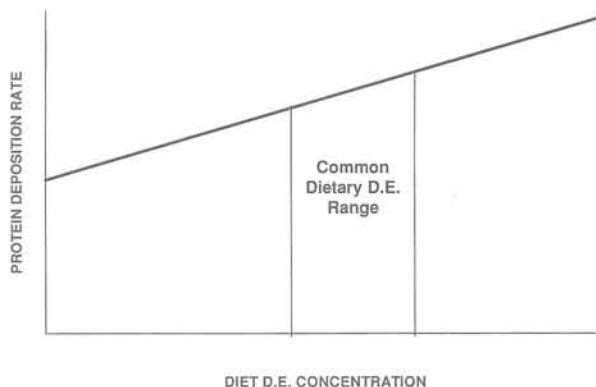


Figure 8-4. Relationship Between Dietary Energy Concentration and Body Protein Gain in Weanling Pigs. Adapted from Campbell and Dunkin, 1983.

Recommended nutrient requirements for the weanling pig are summarized in Table 8-3. The recommended energy levels are expressed as a range and are quite arbitrary. The exact levels will depend on the cost and availability of high energy basal feedstuffs. The ability to include moderate amounts of fat into diets based on wheat must also be considered. Lower energy values are possible in all cases, although growth rate will decline proportionately.

No lower limit for crude protein is provided. Diets are formulated to meet amino acid requirements. Under commercial conditions, if the requirements for essential amino acids are met, then it is assumed that the need for non-essential amino acids will also be addressed. The one exception that nutritionists might consider is glutamine.

There may, however, be an upper limit to crude protein in these diets, but that has not been firmly established. There are concerns that if crude protein levels are too high, scouring may be encouraged. In addition, the metabolic cost of eliminating excess nitrogen should be minimized, allowing available nutrients to be directed towards more productive purposes.

## Feeding Programs

For a variety of reasons, including a rapidly maturing gastrointestinal tract and the cost of providing an effective diet to the newly-weaned piglet, the optimum diet for weanling pigs changes almost weekly. Consequently, a phase feeding program is necessary to balance animal performance and feed costs. The nature of the program will depend on a variety of factors, the most important of which is the age at weaning.

## Transient Gastrointestinal Hypersensitivity

Research over the past two decades has revealed that early-weaned pigs experience a transient allergic reaction to certain dietary proteins. Certain vegetable proteins, such as those found in soybean meal, have been identified as contributing to transient allergic reactions. Young piglets, once exposed to soybean meal, produce antibodies specific to soy protein antigens; such exposure can



result from offering small amounts of creep feed containing soybean meal, or from piglets eating small quantities of the sow's feed. This allergic response results in damage to the intestinal villi, which in turn impairs digestive and absorptive capacity of the associated epithelial cells. Over time, pigs develop a tolerance.

The problem is less acute in pigs weaned at four weeks of age or later, due to the larger intake of creep feeds and the resulting tolerance to soybean proteins that develops. It is more acute in younger pigs because their consumption of creep diets will be less and tolerance will not yet be established.

A variety of products derived from soybean meal, such as soy protein isolates or concentrates, have been developed to overcome this problem. In addition, based on research from Kansas State University, various kinds of heat treatment, including moist extrusion, help to alleviate the problem.

### **Simple Versus Complex**

An age old topic of discussion in nursery diets revolves around the use of *complex* versus *simple* diets. Complex diets involve a number of different ingredients, including cereal grains, proteins from both animal and vegetable sources as well as fats and/or oils. Simple diets, in contrast, generally contain cereal grains, vegetable proteins and a small quantity of oil. In reality, a continuum exists from highly complex diets, with a dozen or more ingredients, to a very simple diet containing no more than 4 or 5 ingredients. Complex diets are more expensive to manufacture and require more skill in obtaining the large number of ingredients. They also tend to be more difficult to manufacture and often are difficult to pellet. However, one cannot dispute the much improved performance observed with early-weaned pigs fed such diets as compared to the more simple formulations.

The discussion arises from the relative economics of the two types of diets, and in particular, whether early improvements in performance are reflected in overall gains in productivity and profitability for the farm. The answer, as one might suspect, is not a simple one. Some proponents of simple diets suggest that compensatory gain later in the

production cycle make up for early losses in animal performance. The presence or absence of true compensatory gain in pork production remains controversial.

It is generally safe to conclude that in production systems requiring rapid animal throughput or in early weaning systems, complex diets are essential. It is difficult to envisage getting pigs to market in less than 150 days on simple starter diets, or weaning 12 to 17 day old pigs onto a cereal-based feed. Conversely, with older weaning and less emphasis on days to market, less expensive diets may suffice. To restate, phase feeding allows producers to optimize their feeding programs, using more complex diets at the time of weaning, followed by increasingly simple and less expensive diets later.

The solution, as in other controversies, remains the same: producers should monitor performance on their farm, consider all options and determine the best choice under their particular circumstances. The final decision will depend on economics and animal well-being. Without information specific to their farm, producers must depend on recommendations based on "typical" or "average" results.

### **Ad libitum Versus Restricted Feed Supply**

Diarrhea is an all-too-common problem in many nurseries. Diet change, environmental stress and reduced resistance to disease combine to increase the likelihood of illness, often related to the digestive system. Typically, at the time of weaning, a period of low feed intake is followed by gorging which overloads the intestinal tract, resulting in scouring.

One effective way to address this situation is to limit feed the pigs for the first 5 to 7 days after weaning to prevent this period of overconsumption. While the practice is effective, it is also labour intensive and requires careful management to ensure that feed intake is not restricted excessively, resulting in slower growth. Consequently, producers seek ways to provide diets ad libitum that avoid diarrhea and thus eliminate the need to restrict feed intake.

The solution is to provide a high quality physical environment which includes good control of temperature and embraces the all-in-all-out management system. These two factors, along with minimizing drafts and keeping piglets dry, will go a long way towards eliminating most of the major contributors to ill health.

The other solution is diet composition. The very high quality diets recommended for the newly-weaned pig are designed to be highly palatable and digestible thus avoiding the scenario that leads to gut overload. Such diets are costly, but support maximal performance. It is up to each producer to decide whether a lower cost diet, limit-fed for the first five to seven days after weaning, is preferable in their operation.

### **Diet Form**

There is not a great deal of published information on the relative merits of pellets, crumbles and mash in starter diets. Generally speaking, large pellets should be avoided in the very young pig as it does reduce feed intake. For creep feeds and early-phase starters, crumbles, small pellets or short-cut pellets are generally preferred. Further discussion on pelleting pig diets appears in chapter 10.

### **Phase Feeding Programs**

Whether one is considering the breeding herd, market hogs or weanling pigs, phase feeding programs are employed to closely match an animal's changing requirements with diet composition in the most economical manner. In the case of the weanling pig, these changes are rapid and profound. This is due not only to nutrient requirements changing, but also the ingredients most suited to the two to three week old piglet differ in a significant fashion from those necessary in the five week or eight week old pig.

The newly-weaned pig, especially those weaned at less than 4 weeks of age, have a unique requirement for a diet of high nutrient density, high digestibility and high palatability. Meeting these needs requires very expensive ingredients. However, as the pig ages, its needs become less stringent and a broader array of ingredients will support optimal performance.

## **Diet Composition**

While meeting the nutrient requirements of the weanling pig is essential in providing a balanced diet, the composition of the diet, in terms of ingredient content, is also very important. This is due to the fact that the gastrointestinal tract of the young pig is not fully matured and is influenced by the presence of anti-nutritive factors more so than in older animals. It is also assumed, at least, that palatability is more important at this stage of production.

The primary focus of composition of weanling diets is providing nutrients in a package that recognizes the unique needs of the immature gastrointestinal tract, avoids anti-nutritive factors and maximizes early feed intake. Cost is an important consideration, but needs to be addressed in the context of the total production system. Generally speaking, diets for the newly-weaned pig, especially those weaned at less than 4 weeks of age, represent a compromise between what is ideal, from the pig's perspective, and what is economically feasible, from the producer's perspective. The greatest success occurs when this compromise is managed most effectively.

While ingredients can be selected based on "typical" results, it is important to realize that quality standards are particularly important in weanling diets. Following are a few guidelines to consider.

### **Fats and Oils**

Young pigs, particularly those immediately after weaning are sensitive to the type of fats used. Short-chained fatty acids are more digestible than medium-chained fatty acids and long-chained fatty acids are the least digestible. The differences are greatest in the 3 week old piglet and decline almost weekly thereafter. As the pig ages, its ability to utilize the energy from fats increases. During the first 2 to 3 weeks after weaning, vegetable oils are clearly preferred over tallow and lard. However, as the pig ages, animal source fats are used with increasing effectiveness.



To maximize the utilization of energy from fats, excess calcium should be avoided to reduce the formation of poorly digested soaps. For this reason, calcium levels must be carefully controlled in starter diets.

### Blood Products

Only spray-dried blood products should be used in the diet of the young pig; flash and ring dried blood products are of lesser nutritive value and should generally be avoided in starter diets.

Spray-dried blood meal is collected from packing plants. The moisture is removed in a very controlled manner to prevent damage to the proteins. Spray-dried plasma proteins and spray-

dried blood cells are produced in a similar manner. The whole blood is treated with an anticoagulant to maintain it in liquid form. It is then centrifuged to separate the cells from the plasma. Once separated, the cells are spray-dried in a manner similar to that applied to whole blood. With increased interest in plasma proteins and blood cells, blood meal is becoming a less common ingredient.

The manufacture of these products has contributed greatly to the success of early-weaning programs. However, when formulating diets containing blood products, particular attention must be directed to methionine levels, as these tend to be quite low. For example, in whole blood, the ratio of methionine to lysine is about 0.12, less than half of what is required in the final pig diet.

**Table 8-4. Diet Composition Guidelines for the Weanling Pig.**

Ingredient	Body Weight Range, kg				
	Phase I			Phase II	Phase III
	Very early wean (<15 days) <sup>1</sup>	Early wean (<21 days) <sup>1</sup>	Late wean (21 to 28 days) <sup>1</sup>		
Soybean meal, max.	15%	20%	25%	25%	NUL
Porcine plasma protein, min.	6 to 10%	5 to 7%	0 to 3%	0 to 5%	nil
Spray-dried blood meal, max.	0 to 1.5%	1 to 2%	0 to 4%	0 to 5%	0 to 5%
Whey powder, min.	20 to 25%	20 to 25%	20 to 25%	0 to 15%	0 to 5%
Lactose, min.	20%	15%	9%	0%	0%
Growth promotant	Yes	Yes	Yes	Yes	Yes
Form	Crumble or small pellet			Crumble/short pellet	pellet or mash

<sup>1</sup> Feed until the pigs reach 7 kg bodyweight; for later weaning, feed for at least 7 days after weaning

NUL - no upper limit

NB. When ranges are provided, consideration can be given to economic conditions as well as the level of stress imposed on the animal by housing conditions.

### Whey and Skim Milk Powder

Whey powder is used extensively in weanling diets, especially immediately after weaning when lactose and milk proteins are preferred over starch and vegetable proteins. However, for greatest success, high quality whey powder must be used. For early-weaned pigs at least, spray-dried, edible-grade, high-lactose whey is preferred, even though it is more expensive.

Skim milk powder may also be used; however, it tends to be a much more expensive source of lactose and casein. If skim milk powder is priced competitively, it is a highly desirable product in starter diets.

### Dehulled Cereal Grains

Oat groats, when available, tend to be a highly palatable ingredient for use in starter diets. In regions where other cereal grains are more common

**Table 8-5. Sample Diets for Weanling Pigs.**

	Body Weight Range, kg									
	Phase I					Phase II		Phase III		
	Very early wean (<15 days)		Early wean (<21 days)		Later wean (21 to 28 days)		7 - 12 kg		12 - 20 kg	
<u>Ingredients</u>										
Wheat	-	37.55	-	39.39	-	40.73	-	51.68	-	69.37
Corn	36.69	-	39.01	-	41.37	-	52.52	-	66.38	-
Soybean meal - 47%	15.00	15.00	20.00	20.00	25.00	25.00	25.00	25.00	28.65	25.00
Spray dried whey	25.00	25.00	20.00	20.00	25.00	25.00	15.00	15.00	-	-
Lactose	5.00	5.00	5.00	5.00	-	-	-	-	-	-
Select menhaden fish meal	2.50	2.50	-	-	-	-	-	-	-	-
Spray-dried plasma proteins	6.00	6.00	5.00	5.00	2.50	2.50	-	-	-	-
Spray-dried blood meal	2.00	2.00	2.50	2.50	1.25	1.25	2.50	2.50	-	-
L-lysine HCl	0.21	0.15	0.11	0.03	0.10	0.04	0.08	-	0.12	0.13
L-threonine	0.14	0.11	0.11	0.08	0.13	0.10	0.08	0.04	0.10	0.10
DL-methionine	0.16	0.09	0.17	0.10	0.15	0.08	0.07	0.03	-	-
Fat/oil	3.80	3.60	4.10	3.90	1.00	1.80	1.00	2.00	0.50	1.15
Premix	3.50	3.50	4.00	4.00	3.50	3.50	3.75	3.75	4.25	4.25
Antibiotic	+	+	+	+	+	+	+	+	+	+
<u>Nutrients, minimum</u>										
D.E., kcal/kg	3600	3550	3600	3550	3450	3450	3450	3450	3400	3400
Crude protein, %	22.1	23.9	22.0	23.8	22.2	24.1	20.7	23.1	19.5	21.5
Lysine:D.E., g/Mcal	3.60	3.60	3.60	3.60	3.60	3.60	3.20	3.20	2.90	2.90
Dig. lysine, %	1.30	1.28	1.30	1.28	1.24	1.24	1.10	1.10	0.98	0.98
Dig. methionine, %	0.36	0.36	0.36	0.36	0.36	0.36	0.31	0.31	0.28	0.28
Dig. T.S.A.A., %	0.72	0.72	0.72	0.72	0.72	0.72	0.61	0.61	0.55	0.55
Dig. threonine, %	0.85	0.85	0.85	0.85	0.85	0.85	0.72	0.72	0.65	0.65
Dig. tryptophan, %	0.22	0.22	0.22	0.22	0.22	0.22	0.19	0.19	0.17	0.17
Calcium, %	0.90	0.90	0.90	0.90	0.90	0.90	0.80	0.80	0.70	0.70
Phosphorus, %	0.70	0.70	0.70	0.70	0.70	0.70	0.65	0.65	0.60	0.60

NB. These are **example** diets only and should not be employed without consulting a professional nutritionist. Exact formulations will require integration of the nutrient profiles of local ingredients, as well as completion of least cost procedures. Also, the technology associated with starter diet formulations is changing very rapidly.

The Phase II diet can be fed from a body weight of 7 to 12 kg. Under some circumstances, producers will find that such a diet will provide satisfactory performance for pigs weaned at 4 weeks of age, avoiding the need for the more expensive Phase I diet. Success will depend on such factors as quality of the nursery, health status of the pigs and overall management skills of the herdsman.

The Phase III diet is the simplest in design, requiring no expensive plasma proteins, whey powders, etc. Blood meal would only be used if economical. Whey powder could be used if problems are observed, but under reasonable conditions, whey powder will not be required if the previous feeding program has been adhered to.



**Table 8-6. Effect of Medication on the Performance of Weanling Pigs in a High Health Herd.**

	Control	Medicated
Average daily gain (kg)	0.37	0.47
Average daily feed (kg)	0.58	0.70
Feed conversion	1.56	1.48

NB. Four week trial, commencing immediately upon weaning

Source: Patience and Christison, 1988.

than corn, groating oats represents a method to enhance the digestible energy content of what might otherwise be lower energy feeds. Naked oats and dehulled barley represent another alternative to increase the energy content of the feed, but their value in starter diets has not been fully defined.

### Diet Formulations

Many alternatives are available in developing effective weanling feeding programs. Diets presented in this chapter are offered as examples only.

Producers are strongly encouraged to discuss their specific needs with a qualified nutritionist as the formulation of starter diets is a highly specialized science, one which is advancing at a rapid rate.

**Photo 8-3.**



**There is a move towards keeping pigs in the nursery longer, until they are 35 - 45 kg. Over-crowding must be avoided.**

The Phase I diet is designed to be fed from the time of weaning until the pig reaches 7 kg, or for at least one week, whichever is longer. It may also be used as a creep feed. A variety of Phase I diets are provided in Tables 8-4 and 8-5, depending on the age at weaning. In general, the younger the age at weaning, the lower the level of starch and vegetable proteins and the higher the desired levels of lactose and milk proteins. For pigs weaned at less than two weeks of age, lactose levels should be in the range of 20% or more. Spray-dried plasma proteins, spray-dried blood proteins and spray-dried red blood cells have all proven beneficial. The exact levels required will depend on conditions within the barn and will, of course, be influenced by economic considerations.

As the weaning age rises, the Phase I diet will become less expensive as a greater portion of the energy and protein can come from plant sources. If the pigs are weaned at 21 days of age or older, they should receive the appropriate diet in Table 8-4 for a period of at least one week, before switching gradually to the Phase II diet.

While such diets are expensive, they are consumed in relatively small quantities, so the cost per pig is quite small. For example, at the time of writing, feeding the "later wean" Phase I diet for one week after weaning would cost less than \$1.75 per pig. The final decision on the use of such diets rests with its impact on the overall profitability of the farm. The cost per tonne of feed tells only a part of the story.

### Feed Additives

#### Antibiotics

There is little doubt that antibiotics employed for growth purposes are economical in diets for pigs up to 25 kg body weight. Research at the Prairie Swine Centre, a high health herd, confirms this conclusion (Table 8-6). In this particular experiment, the medication increased net income by about one dollar per pig.

The practice has attracted some recent criticism, particularly related to environmental loading of zinc via the slurry. Such criticism can be tempered by only using zinc oxide when diarrhea is a problem and, even then, only for the necessary period of

time. Such guidelines also make economic sense. In addition, there are legal implications, as such high levels of zinc cannot be added to the feed without a veterinary prescription.

### **Zinc Oxide**

A number of years ago, research in Denmark revealed that adding zinc to the diet of newly-weaned pigs reduced the incidence of diarrhea, improved growth rate and reduced mortality. Not surprisingly, the use of zinc supplements has grown rapidly in the interim. Generally, the recommendation is to provide 2.5 to 4.0 kg of zinc oxide per tonne of feed for 10 to 20 days post-weaning.

### **Copper Sulphate**

Copper sulphate is a relatively common growth promotant added to many starter diets. It is relatively inexpensive, and for this reason, its use is almost automatic in many situations. However, concerns about the environment, recognition that the response to copper sulphate is not universal and the appearance of "sticky" droppings from treated pigs has tempered its use in recent years. If included in the diet, the exact amount will depend on local legislation, but is typically in the range of 125 ppm copper as copper sulphate.

### **Organic Acids**

High pH is conducive to the proliferation of pathogenic bacteria in the gut of the pig. For this reason, diets are formulated to help keep pH low and thus favour the growth of "good" bacteria. An upper gastrointestinal tract pH below four is preferred; with some kinds of diets, and under certain conditions that are not fully understood at this time, the pig finds it difficult to maintain a low gastrointestinal pH. To assist the pig in this regard, organic acids may be added at 0.5 to 3.0% of the diet. In all cases, manufacturers recommendations must be followed.

The observation that organic acids are not always beneficial may be due to the fact that pH is not always excessively high. Some research has suggested that mixtures of acids will be more beneficial than single additions. The response to organic acids will generally be greater in simpler as

compared to complex formulations. As with all feed additives, selecting the right conditions for their use is critical to their success.

## **The Pig's Environment**

### **Temperature**

The weanling pig presents a unique set of circumstances in terms of establishing an ideal thermal environment. In particular, low post-weaning feed intake elevates the pig's thermal requirements; for example doubling the newly-weaned pig's feed intake reduces its lower critical temperature from 32°C to 26°C! This is due to the body heat generated by normal digestion and metabolism. Consequently, room temperature must be linked to the piglet's feed intake.

Various components of the nursery facilities may contribute to the overall thermal environment. While the effect of moisture and draughts on pig comfort are well known, the impact of cold walls, floors and ceilings, in fact, any cold surface, which increase radiant heat losses from the pig, lower the effective ambient temperature relative to measured temperature. Clearly then, in addition to warm air temperatures, well-insulated walls and ceilings are critical to piglet comfort.

As a rule, newly-weaned pigs should be maintained initially at about 30 to 32°C, due to poor feed intake, lowering the temperature by about 1°C every 2 to 3 days during the first week and by 1 to 2°C each week thereafter. The most important consideration, however, is to watch the activities of the piglets. If they shiver and huddle, they are too cold and the temperature should be raised; however, remember that weanlings are highly motivated by social interaction, so lying in close proximity to other pigs should not be interpreted as huddling! The objective is to keep the temperature warm enough to prevent huddling, but no warmer.

Temperature variation is also a particular concern in the nursery. Twenty-four hour fluctuations in excess of 2°C have been shown to reduce both growth rate and feed conversion efficiency. It should be noted that so-called high-low thermometers may underestimate the extent of temperature



**Table 8-7. Recommended Floor Space Allowances for Weanling Pigs.**

Body weight, kg	Fully-slatted $0.035 \times BW^{0.667}$	Partially-slatted $0.039 \times BW^{0.667}$	Solid, bedded $0.045 \times BW^{0.667}$
10	0.16	0.18	0.21
20	0.26	0.29	0.33
30	0.34	0.38	0.44

Adapted from Recommended Code of Practice for the Care and Handling of Farm Animals:Pigs, Ag. Canada, 1993.

fluctuation in the nursery, because they do not record rapid changes very effectively. For example, in mercury thermometers, the response to temperature change is quite slow and may underestimate fluctuation by 50% or more.

While too low a temperature is undesirable, failure to lower room temperature as the pig's thermal needs change will suppress appetite and lower overall animal performance. Managing room temperature in the nursery is not a simple task, because the consequences of error are severe.

### Floor Space

Overcrowding is a particular concern with the weanling pig. Because it is a social animal and often chooses its behaviour based on that of its penmates, space to express such behavioural patterns is important. Table 8-7, extracted from the Recommended Code of Practice for the Care and Handling of Farm Animals:Pigs, provides a useful guideline on this subject.

### Feeder Design

Feeder design is often overlooked, in part because there are few objective guidelines. It is clearly understood that weanling pigs tend to eat in groups, so multiple-space feeders are preferred over single-space feeders. If feeders are too large, however, pigs will tend to dung in one or both ends of the feeder. As a general rule, 7.5 to 10.0 cm of feeder space should be allowed per pig. Other than that, the design should allow easy access to the feed while concurrently minimizing waste and spill.

### Additional Reading and References

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