GROWER-FINISHER PIG MANAGEMENT

INTRODUCTION

1. General Goals

A. “Time” - Produce the maximum amount of pork with the least time possible!
B. “Inputs” - Spend minimum dollars possible on feed to achieve the first goal! (Doesn’t necessarily mean the cheapest feed though!)
C. “Quality” - Maximize the quality of final products in any way possible!

2. Numerical Goals (See a box)

ENVIRONMENT FOR GROWER-FINISHER PIGS

1. Temperature (1° concern!)

A. Critical temperatures:

1) Lower critical temperature (LCT) - Heat loss is minimal, and below this point, pigs must heat production to maintain body temperature. (“Cool zone” - Pigs huddle & also blood flow.)
2) Thermoneutral zone - Heat production can offset heat loss, and may promote maximum performance. (“Warm zone” - Pigs stretch out & blood flow.)
3) Upper critical temperature (UCT) - Up to this temperature, pigs can maintain a "normal" body temperature, but above this point, pigs are heat stressed!

“LCT and UCT” are affected by pig weight, drafts, type & condition of floors, use of bedding, and other factors!

B. Effect of temperatures on pig performance:

1) An example of the effect of temperatures on pig performance: (See a box)
   a) The main effect of temperatures is the regulation of feed intake!
   b) Cold - Eat more to heat production.
   c) Hot - Eat less to heat production.

2) Recommendation - 60 to 70°F for G-F pigs:
2. Other Environmental Concerns

A. Hydrogen sulfide:

1) Has an odor of a “rotten egg.”
2) A toxic gas associated with manure decomposition, and deadly during agitation and pumping of stored manure! (Death can occur at 600 ppm or above!)
3) Maximum levels? 5 for humans & 10 ppm for pigs.

B. Ammonia:

1) Has a sharp pungent odor, and released from manure and urine.
2) > 50 ppm can reduce the performance and health of pigs, and possible to have > 50 ppm in the confinement - e.g., solid floor with manure & urine build-up and(or) low ventilation rate (especially during the winter time).
3) Recommended maximum level for humans? 7 to 10 ppm.

C. Carbon monoxide:

1) A colorless & odorless gas produced by incomplete combustion of fuels.
2) Above 50 ppm can have adverse effects, and unborn fetus is more susceptible (both pigs & humans!)
3) Maximum levels? 50 for humans & 100 ppm for pigs.

D. Dust and particulate matters:

1) Possible carriers of microorganisms (M.O.) & gases into the respiratory system - e.g., feed dust, dander, hair, dried feces, etc.
2) Can cause allergic reactions & respiratory disorders.
3) Standards are set at 5 and 10 mg/m³ for respirable and total dust, respectively. (These values are established for humans in other industries!)

Be aware of these potentially hazards, and some important considerations include: 1) Provide adequate ventilation, 2) Keep floors dry and clean, 3) Take precautionary measures when agitating “stored” manure, 4) Should not use un-vented heaters, and 5) Use of fats/lipids in diets to reduce dust, ammonia and M.O. concentrations?

HOUSING FOR GROWER-FINISHER PIGS

1. Generally, Four Types

A. Totally enclosed or environmentally controlled (EC; MWPS, 1982):

1) Ventilation systems - Mechanical.
2) Floors - Totally or partly slotted.  
3) Manure handling - Pit, scraped gutter, flushed gutter, etc.

B. Modified open front (MOF; PIH-11):

1) Roof - Gable style (ridge opening at the top) or single slope.
2) Ventilation system - Natural (adjustable doors on both sides - often, translucent panels on the front, but the use of “curtains” has increased in recent years).
3) Manure handling - Pit, scraped gutter, flushed gutter, etc.

C. Open ront with outside apron (OF-OA; PIH-11):

1) Ventilation system - Natural.
2) Sleeping area (floors with ≈ 1.2” slope/foot) - Gable style or single slope roof with adjustable ventilation doors on the back.
3) Apron or lot:
   a) Sloped (≈ ⅜” per foot), and waterers (& feeders?) are located in this area.
   b) Often has large gates on the outside for “mechanical” cleaning of the pen.
   c) May have a gutter for the entire length of buildings - A narrow one for handling “liquids” only, or a wider one for handling both liquids & solids.

D. Unpaved dirt lot (Bodman, 1991):

1) No “vegetative” covers.
2) No standard recommendations for the design, but some general considerations:
   a) Feeders should be capable of being filled from the outside, and feeder & shelter should be located at the upper end.
   c) Provide ≥ 10' between the feeder & shelter for air movement.
   d) Feeders on the concrete pad - Extend aprons ≥ 8' in all directions from the feeders.

* The same arrangements can be used for sows & replacement gilts!

2. Comparison of Three Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Initial costs</th>
<th>Summer performance</th>
<th>Winter performance</th>
<th>Oper. costs</th>
<th>Labor requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC</td>
<td>Higher</td>
<td>Same</td>
<td>Higher</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>MOF</td>
<td>Medium</td>
<td>Same</td>
<td>Higher</td>
<td>Lower</td>
<td>Lower</td>
</tr>
<tr>
<td>OF-OA</td>
<td>Lower</td>
<td>Same</td>
<td>Lower</td>
<td>Lower</td>
<td>Higher</td>
</tr>
</tbody>
</table>

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A. Selection of G-F units based on “compromise” among: 1) Performance of pigs, 2) Labor management, and 3) Economics.
B. Regardless of the type, the level of success is a function of the “management!”
C. Advantages of using natural ventilation?

1) Lower initial & operating costs.
2) Lower noise - May reduce stress?
3) With a proper design, may improve odor & humidity control.
4) A brighter buildings - More pleasant to work & possibly safer?
5) A higher ventilation rate during summer? - More rapid air change with breeze.
6) Often, better performance?
7) Ventilation despite a “power failure!”

3. Floor Space

A. Effect of space allowances (See an example) - Crowding can depress the performance of grower-finisher pigs!

B. Recommendations:

1) Environmentally regulated and modified open front:
   6 ft²/grower pig (75-150 lb), 8 ft²/finisher pig (150-200 lb),
   and 9 ft²/finisher pig (hot weather and > 200 lb).
2) Open-front with outside lot: 5-6 ft² for indoors & 12-15 ft²/pig for outdoors.
3) Dirt lot:
   a) Shelter - 6 (winter) & 8 ft²/pig (summer).
   b) Lot - ≥ 150 to 200 ft²/pig (depends on the soil type, rainfall and slope), and
      width:length, 1:3 preferred & should have a slope of 2 to 5%.

4. No. of Pigs/Pen or Lot

A. Partly or totally slotted floors - A maximum of 20 to 25 pigs/pen.
B. Dirt lot - 35 to 50 pigs/pen.

5. Feeder/Waterer Space

A. Feeding space & pig performance - See an example!
B. Feeder - One feeder space for every 4 to 5 pigs.
C. Waterer - One for every 10 to 15 pigs with a minimum of two waterers per pen.

6. Floor Surfaces

A. At least 30 to 40% of pen floor should be slotted (vs 2/3 for smaller pigs).
B. For concrete slats, use 5-8" wide slats with 1" slot.
C. Place slats parallel to “natural traffic flow” so that pigs are walking down slats rather than across slats - might be beneficial for pigs.
D. Flooring materials & training pigs for partly slotted floors.
COOLING SYSTEMS FOR GROWER-FINISHER PIGS

1. General

A. Not only for G-F pigs, but for other classes of swine as well!
B. Larger pigs are more susceptible to heat-stress, i.e., begin to feel the effect of heat at \( \approx 70^\circ F \), and if temperatures remain above \( 85^\circ F \), can reduce performance!
C. Pigs lose little moisture through their skin because they: (1) are unable to sweat, and (2) have thick fat-layers.

2. Heat Loss

A. Radiation - Net loss of heat from body the surface when surroundings are cooler than the skin. (Account for \( \approx 20\% \) of heat loss during the summer?)
B. Conduction - Loss of heat through direct contact with a cooler surface. (\( \approx 5-10\% \))
C. Convection - Loss of heat through air movement over the body surface. (\( \approx 30\% \))
D. Evaporation - Evaporation of water requires heat, thus lose heat. (At \( 80^\circ F \), panting account for \( \approx 40\% \))

3. Methods of Cooling

A. Shades are effective in pastures and outside lots.
B. Insulation of "roof/ceiling" is important to minimize solar heat buildup.
C. Ventilation:
   1) Ventilation rates (confinement) [cubic feet per minute (cfm)/head]: (PIH-87)

<table>
<thead>
<tr>
<th></th>
<th>Cold</th>
<th>Mild</th>
<th>Hot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sow &amp; litter</td>
<td>20</td>
<td>80</td>
<td>500</td>
</tr>
<tr>
<td>Pre-nursery (12-30 lb)</td>
<td>2</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Nursery (30-75 lb)</td>
<td>3</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>Growing (75-150 lb)</td>
<td>7</td>
<td>24</td>
<td>75</td>
</tr>
<tr>
<td>Finishing (150-220 lb)</td>
<td>10</td>
<td>35</td>
<td>120</td>
</tr>
<tr>
<td>Gestating sow (325 lb)</td>
<td>12</td>
<td>40</td>
<td>150*</td>
</tr>
<tr>
<td>Boar (400 lb)</td>
<td>14</td>
<td>50</td>
<td>180*</td>
</tr>
</tbody>
</table>

* Use 300 cfm/sow or boar in breeding facility due to low animal density & susceptibility to poor performance at high temperatures.

   a) In the Northern areas, \( 1/2 \) of hot weather rates might be sufficient.
   b) In the Southeast, may require twice the rates indicated.

   2) Cools swine by:

   a) Removing a humid, respired air away from animals & replacing with a cooler air.
   b) Increasing the air velocity around animals, i.e., a wind-chill effect.
   c) Evaporate \( H_2O \) from the surface, i.e., an evaporative cooling effect.

D. Water cooling:

   1) Drinking - Must drink a lot of water for evaporative heat loss during the hot weather:

   a) A rule of thumb for the water requirement/water intake is 2 to 2.5:1 (water:dry feed), which may increase to 5:1 during the hot weather.
b) Important to provide “cool” drinking water.

c) Should be clean & TDS (total dissolved solids) content of ≤ 3,000 ppm.

d) Grower pigs need ≈ 3 gal/day, whereas finisher pigs need ≈ 5 gal/day.

2) Wet-skin cooling - Cooling pigs by evaporation of moisture, and air movement facilitates this process.

a) “Wallow” - Effective in pastures/outside lots & more effective with a “shade.” [See an example of “sanitary” wallow (Krider et al., 1982).]

b) “Sprinkler or fogger” for outdoors/indoors:

(1) A fogger cools air first and then the air cools pigs, whereas a sprinkler cools pigs directly, thus might be better!? 

(2) The best system? Wet the animal then allow it to dry, and thermostat- & timer-controlled sprinkler system might be better!? 

c) Wet pigs using a hose every hour or so - Labor intensive & use more water, but can be beneficial/necessary during the hot weather!

E. Evaporative cooling system: [See an example (PIH-87)]

1) With this system: a) The air is drawn into the building via fiber pads, and b) Fiber pads are kept wet via the water distribution system with a pump & pipes.

2) How does it work? Uses “heat” from the air to vaporize water - ↑ relative humidity but ↓ the air temperature!

F. Air conditioning systems are too expensive (both initial & operation costs), and usually not used for swine buildings!

G. Earth tempering of ventilation air - Can be used for for “zone” cooling & heating! [((See an example (PIH-102))]

1) Earth-tube heat exchanger:

a) Tubing (≈ 12’ plastic pipes) - Several layouts are possible, but a wagon wheel/radial or lateral layout is common.

b) Air inlets - Pipes should extend 3-4 feet above the soil surface to form “air inlet,” and the top should be screened.

c) Pipes are sloped to collection duct & connected to a “fan house,” the air to the distribution duct.

2) Ground/soil temperatures:

(1) Variations in annual averages - ≈ 67°F in SC, GA, AL, MS, LA & TX, and ↓ to ≈ 42°F in MN, ND, etc. (72-77°F in FL & southern TX.)

(2) Soil temperatures vary throughout the year, but much less variation in soil temperatures vs surface.
3) “Thermal lag” between the soil surface and e.g., 10-12’ deep is = 3 mo, and the variation ↓ with ↓ depth.

- Depends on installation costs & geographical locations, but “tubings” are commonly buried in a depth of 7-12 feet.

3) Does it work? [Performance during summer & winter at IL (PIH-102)]

- Can be an effective way to modify the temperature of swine buildings!

**GROWER-FINISHER PIG NUTRITION**

1. **Nutrient Requirements**

   A. NRC (1998)

<table>
<thead>
<tr>
<th>Item</th>
<th>Grower (20-50 kg)</th>
<th>Finisher 1 (50-80 kg)</th>
<th>Finisher 2 (80-120 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein, %</td>
<td>18.0</td>
<td>15.5</td>
<td>13.2</td>
</tr>
<tr>
<td>Lysine, %</td>
<td>0.95</td>
<td>0.75</td>
<td>0.60</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.60</td>
<td>0.50</td>
<td>0.45</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.50</td>
<td>0.45</td>
<td>0.40</td>
</tr>
<tr>
<td>ME, kcal/kg</td>
<td>3,265</td>
<td>3,265</td>
<td>3,265</td>
</tr>
</tbody>
</table>

B. Some examples: (NE-SD Swine Nutrition Guide, 1995)

*Table 21. Example diets for 45 to 100 lb growing pigs*

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Grower 1 (45 to 80 lb)</th>
<th>Grower 2 (80 to 100 lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caseinoso</td>
<td>1401</td>
<td>1300</td>
</tr>
<tr>
<td>Lysine, %</td>
<td>0.95</td>
<td>0.75</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.60</td>
<td>0.50</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.50</td>
<td>0.45</td>
</tr>
<tr>
<td>Total</td>
<td>1358</td>
<td>1250</td>
</tr>
</tbody>
</table>

*Table 22. Example diets for 130 to 230 lb finishing pigs*

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Finisher 1 (130 to 190 lb)</th>
<th>Finisher 2 (190 to 250 lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caseinoso</td>
<td>1401</td>
<td>1300</td>
</tr>
<tr>
<td>Lysine, %</td>
<td>0.95</td>
<td>0.75</td>
</tr>
<tr>
<td>Calcium, %</td>
<td>0.60</td>
<td>0.50</td>
</tr>
<tr>
<td>Phosphorus, %</td>
<td>0.50</td>
<td>0.45</td>
</tr>
<tr>
<td>Total</td>
<td>1358</td>
<td>1250</td>
</tr>
</tbody>
</table>

*Assumes a mixture of medium lean grain hampers and hogs. All diets are full-fed under thermoneutral conditions.*

*See Table 1 for nutrient levels. Amount added / % of feed will depend on the carriers.*

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2. **Alternative Energy Sources**

A. **Relative feeding value of energy sources:** (NE Swine Diet Suggestion, 1992)

<table>
<thead>
<tr>
<th>Feeding Source</th>
<th>Feeding Value</th>
<th>Starter</th>
<th>G-F</th>
<th>Gestation</th>
<th>Lactation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa, dehy</td>
<td>75-85</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td>10</td>
<td>Low energy, high in B vitamins</td>
</tr>
<tr>
<td>Alfalfa hay, early bloom</td>
<td>75-85</td>
<td>10</td>
<td>10</td>
<td>66</td>
<td>10</td>
<td>Low energy, high in B vitamins</td>
</tr>
<tr>
<td>Bakery waste, dehy</td>
<td>95-100</td>
<td>20</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>High energy, about 13% fat</td>
</tr>
<tr>
<td>Barley (48 lb/bu)</td>
<td>90-100</td>
<td>25</td>
<td>85</td>
<td>90</td>
<td>80</td>
<td>Low energy</td>
</tr>
<tr>
<td>Beet pulp</td>
<td>70-80</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>Bulky, high fiber, laxative</td>
</tr>
<tr>
<td>Corn &amp; cob meal</td>
<td>80-90</td>
<td>0</td>
<td>0</td>
<td>70</td>
<td>10</td>
<td>Bulky, low energy</td>
</tr>
<tr>
<td>Corn distiller grains, dehy</td>
<td>115-130</td>
<td>5</td>
<td>15</td>
<td>40</td>
<td>10</td>
<td>B vitamin source, low lysine</td>
</tr>
<tr>
<td>Corn gluten feed</td>
<td>75-85</td>
<td>5</td>
<td>10</td>
<td>90</td>
<td>10</td>
<td>Dry pelleted source preferred</td>
</tr>
<tr>
<td>High lysine corn</td>
<td>100-105</td>
<td>60</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>Test lysine level</td>
</tr>
<tr>
<td>Corn silage (20-30% DM)</td>
<td>20-30</td>
<td>0</td>
<td>0</td>
<td>90</td>
<td>0</td>
<td>Bulky, low energy, for sows only</td>
</tr>
<tr>
<td>Fat (stabilized)</td>
<td>185-210</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>High energy, reduces dust</td>
</tr>
<tr>
<td>Hominy feed</td>
<td>100-105</td>
<td>0</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>Subject to rancidity</td>
</tr>
<tr>
<td>Millet, proso</td>
<td>90-95</td>
<td>40</td>
<td>75</td>
<td>90</td>
<td>40</td>
<td>Low lysine</td>
</tr>
<tr>
<td>Milo</td>
<td>95-97</td>
<td>60</td>
<td>85</td>
<td>90</td>
<td>80</td>
<td>Low lysine</td>
</tr>
<tr>
<td>Molasses (77% DM)</td>
<td>55-65</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>Energy source, used in pelleting</td>
</tr>
<tr>
<td>Oats (36 lb/bu)</td>
<td>85-95</td>
<td>15</td>
<td>20</td>
<td>70</td>
<td>10</td>
<td>May cause gut edema &amp; nutritional scours</td>
</tr>
<tr>
<td>High protein oats</td>
<td>90-100</td>
<td>20</td>
<td>50</td>
<td>70</td>
<td>10</td>
<td>May cause gut edema &amp; nutritional scours</td>
</tr>
<tr>
<td>Oat groats</td>
<td>110-115</td>
<td>20</td>
<td>85</td>
<td>90</td>
<td>90</td>
<td>Palatable, but expensive</td>
</tr>
<tr>
<td>Potatoes (22% DM)</td>
<td>20-25</td>
<td>0</td>
<td>25</td>
<td>80</td>
<td>0</td>
<td>Should be cooked, low protein</td>
</tr>
<tr>
<td>Rye</td>
<td>85-90</td>
<td>0</td>
<td>25</td>
<td>20</td>
<td>20</td>
<td>Watch for ergot toxicity</td>
</tr>
<tr>
<td>Triticale</td>
<td>90-95</td>
<td>20</td>
<td>75</td>
<td>90</td>
<td>40</td>
<td>Watch for ergot toxicity</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>60-65</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>10</td>
<td>Bulky, High fiber, Laxative</td>
</tr>
<tr>
<td>Wheat, hard</td>
<td>100-105</td>
<td>35</td>
<td>85</td>
<td>40</td>
<td>40</td>
<td>Avoid fine grinding</td>
</tr>
<tr>
<td>Wheat middlings</td>
<td>110-125</td>
<td>5</td>
<td>15</td>
<td>30</td>
<td>10</td>
<td>Partial grain substitute</td>
</tr>
</tbody>
</table>

a. Value apply when ingredients fed at no more than the maximum recommended % of complete diet; ranges presented to compensate for quality variation.
b. Higher levels may be fed, but the performance may decrease.

e.g., Milo - “Feeding value” is 95% of corn, thus, economically replace corn when the price of milo is less than 95% of corn.

B. How to use alternative sources?

1) Substitute on the “pound-for-pound” basis within the limit. (Exceptions? Using ingredients low in the amino acids such as fat, corn silage, corn-corn cob meal, etc.)
2) Reformulate the diet on the “lysine basis” - Can effectively utilize wheat, barley & others that are relatively high in Lys, thus can ↓ protein supplements.

3. **Alternative Amino Acid Sources**

A. Some by-products of oil extractions:

1) Peanut meal - Low in lysine (1.4-1.7%), and contains 5-7% fat, may cause rancidity problems?
2) Rapeseed meal - Low in lysine (2.1-2.3%), and the quality is influenced by glucosinolate content (goitrogenic).
3) Canola (Canada Oil-Low Acid) meal is produced from rapeseed low in undesirable substances (erucic acid in the oil & glucosinolate in the meal), and its protein value is 75-85% of SBM (lb-for-lb basis).

4) Sunflower meal is high in the fiber content (= 12%) & low in lysine (= 1.7%), thus should not replace more than 20-30% of SBM, and also should be used only for pigs > 75-100 lb.


<table>
<thead>
<tr>
<th>Source</th>
<th>% of complete diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Starter</td>
</tr>
<tr>
<td>Alfalfa, dehy</td>
<td>0-5</td>
</tr>
<tr>
<td>Alfalfa hay</td>
<td>0-5</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>0-2</td>
</tr>
<tr>
<td>Fish solubles, dr.</td>
<td>0-3</td>
</tr>
<tr>
<td>Meat &amp; bone meal</td>
<td>0-5</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>0-25</td>
</tr>
<tr>
<td>Tankage</td>
<td>0-5</td>
</tr>
<tr>
<td>Whey, dried</td>
<td>0-20</td>
</tr>
<tr>
<td>Yeast, brewers dr.</td>
<td>0-3</td>
</tr>
</tbody>
</table>


| Source                  | Protein, % | Lysine, % | % | Pounds
|-------------------------|------------|-----------|---|--------
| Soybean meal            | 44         | 2.86      | 100| 100    |
| Soybean meal            | 47.5       | 3.18      | 111| 90     |
| Alfalfa meal            | 41         | 1.51      | 53 | 187    |
| Cottonseed meal         | 41         | 1.51      | 53 | 187    |
| Wheat bran              | 15         | 0.59      | 21 | 476    |
| Wheat middlings         | 16         | 0.69      | 24 | 417    |
| Yeast, brewers dried    | 45         | 3.23      | 112| 89     |
| Fish meal               | 60         | 5.44      | 190| 53     |
| Fish soluble, dried     | 54         | 1.73      | 60 | 167    |
| Meat & bone meal        | 50         | 2.60      | 91 | 110    |
| Skim milk, dried        | 33         | 2.40      | 84 | 119    |
| Tankage                 | 60         | 3.00      | 105| 95     |
| Whey, dried             | 12         | 0.97      | 34 | 294    |

$^a$Pounds required to replace 100 lb of 44% SBM.

$^b$e.g., Te relative value of 47.5% CP SBM is 111% of 44% SBM. If 44% SBM is $200/ton, then the value of 47.5% SBM is $222/ton. Thus, if the price of 47.5% SBM is < $222, better to use 47.5% SBM!

### 4. Other Feed Ingredients

#### A. High lysine corn:

1) Higher in most indispensable amino acids vs normal corn (e.g., Lys content is $\approx.38\%$ for high lysine corn vs. $\approx.25\%$ for normal corn).

2) No differences in performance if diets are formulated based on lysine, thus can save protein supplements, however, when using high lysine corn:
a) Analysis is important because of the variation in the lysine content!
b) Should be ground coarsely because it become powdery easily during grinding!

B. High moisture grains:

1) Can save drying costs and ↓ harvest-loss.
2) Similar feeding value to dry grain on the dry matter basis, but because of the moisture content, the quantity of grains in the diet must be increased accordingly:

Conversion factors (NE Swine Diet Suggestion, 1992):

<table>
<thead>
<tr>
<th>Moisture (%)</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>21%</td>
<td>23%</td>
</tr>
<tr>
<td>27%</td>
<td>25%</td>
</tr>
</tbody>
</table>

3) Feeding to pigs less than 40 lb is not recommended.
4) Prepare diets frequently to prevent spoilage, i.e., every one or two days?

C. Fats or lipids:


   a) May or may not improve weight gain, but consistently improve feed efficiency.
   b) Generally, can expect 2% improvement with 1% ↓ in dietary fat. (Lipids are utilized more efficiently during the summer vs winter!)
   c) Generally, no adverse effects on the carcass quality, but may ↓ carcass fat with > 5% dietary fat.

2) Effects of dietary fat on the environment:

   a) Dust:

      (1) Can be nuisance.
      (2) Has adverse effects on buildings, ventilation ducts, motors, thermostats, timer, etc.
      (3) Has adverse effects on humans (& pigs) - e.g., eye irritation, headache, coughing, chest tightness, stuffy nose, shortness of breath, etc.
      (4) (aerial particles) Can be a possible carrier of M.O. & harmful gases (particles > 5 μ are especially dangerous because can penetrate into a deeper portion of the respiratory tract!).

   b) Effects of dietary fat on aerial dust, NH₃ & M.O. concentrations: (Chiba et al., 1985. JAS 61:763 & Chiba et al., 1987. Trans. ASAE 30:464)
Dietary fat can improve environment for both humans & pigs!

3) Additional benefits of dietary fat?
   a) ↓ wear on mixing/handling machineries by its lubricating action.
   b) Facilitate “pelleting” process - ↓ power requirement.
   c) ↓ palatability of feed.
   d) ↓ feed wastage during handling/feeding process.
   e) ↓ feed or particle separation, thus all pigs can receive a “uniform” diet.

Fats/oils should be stabilized with an antioxidant(s)!

D. Whole soybeans:

1) Depending on the price of soybean/oil and soybean meal, the use of whole soybeans can be economical from time to time.
2) Contain 32-37% protein and 18-19% fat, thus whole soybeans can be a good source of both amino acids & lipids!
3) The results of many studies indicate that the processed whole soybeans can be used as a replacement for SBM!

E. Crystalline amino acids:

1) At present, feed grade Lys, Thr & Trp (& Met has been available for a long time) are commercially available.
2) Economical? - “Yes & No,” depending on the price of grains and supplemental protein sources. (See a table.)

Lys is often economical to use, but Trp & Thr are rather expensive at this time, and probably not!

3) Commonly used methods:

a) For 44% SBM - 3 lb of L-Lys HCl (78% Lys) plus 97 lb of corn to replace 100 lb of SBM.
   b) For 48% SBM - 3.2 lb of Lys + 96.8 lb of corn to replace 100 lb of SBM.

Value of using synthetic lysine: (NHF, 1990)

<table>
<thead>
<tr>
<th>Corn, $/bu</th>
<th>160</th>
<th>165</th>
<th>170</th>
<th>175</th>
<th>180</th>
<th>185</th>
<th>190</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>1.40</td>
<td>1.60</td>
<td>1.85</td>
<td>1.93</td>
<td>2.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.10</td>
<td>1.45</td>
<td>1.64</td>
<td>1.89</td>
<td>1.97</td>
<td>2.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.20</td>
<td>1.40</td>
<td>1.65</td>
<td>1.90</td>
<td>1.98</td>
<td>2.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.30</td>
<td>1.45</td>
<td>1.67</td>
<td>1.92</td>
<td>2.00</td>
<td>2.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.40</td>
<td>1.40</td>
<td>1.68</td>
<td>1.94</td>
<td>2.02</td>
<td>2.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.50</td>
<td>1.35</td>
<td>1.60</td>
<td>1.89</td>
<td>2.03</td>
<td>2.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.60</td>
<td>1.30</td>
<td>1.55</td>
<td>1.84</td>
<td>2.00</td>
<td>2.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.70</td>
<td>1.25</td>
<td>1.50</td>
<td>1.79</td>
<td>1.95</td>
<td>2.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.80</td>
<td>1.20</td>
<td>1.45</td>
<td>1.74</td>
<td>1.90</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.90</td>
<td>1.15</td>
<td>1.40</td>
<td>1.69</td>
<td>1.85</td>
<td>1.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.00</td>
<td>1.10</td>
<td>1.35</td>
<td>1.64</td>
<td>1.80</td>
<td>1.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* e.g., At $2.20/bu corn & $165/ton SBM, can ↓ the cost of diets if the price of Lys is < $1.48/lb.
4) Amino acids to replace protein supplements? (Lewis, 1989. NE Swine Rep.)

<table>
<thead>
<tr>
<th></th>
<th>Corn-SBM (+) control</th>
<th>Corn (-) control</th>
<th>Corn+ Lys &amp; Trp</th>
<th>Corn+Lys, Trp &amp; Thr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial wt, lb</td>
<td>133</td>
<td>132</td>
<td>132</td>
<td>132</td>
</tr>
<tr>
<td>Final wt, lb</td>
<td>247</td>
<td>213</td>
<td>239</td>
<td>237</td>
</tr>
<tr>
<td>Feed intake, lb/d</td>
<td>6.60</td>
<td>4.73</td>
<td>5.91</td>
<td>5.55</td>
</tr>
<tr>
<td>Weight gain, lb/d</td>
<td>1.75</td>
<td>.70</td>
<td>1.19</td>
<td>1.30</td>
</tr>
<tr>
<td>Feed/gain</td>
<td>3.77</td>
<td>6.79</td>
<td>4.98</td>
<td>4.28</td>
</tr>
<tr>
<td>Dressing %</td>
<td>75.5</td>
<td>74.0</td>
<td>74.7</td>
<td>74.9</td>
</tr>
<tr>
<td>Backfat, in</td>
<td>1.22</td>
<td>1.38</td>
<td>1.34</td>
<td>1.29</td>
</tr>
<tr>
<td>Lean, %</td>
<td>54.9</td>
<td>53.0</td>
<td>53.4</td>
<td>54.1</td>
</tr>
</tbody>
</table>

- May have the potential, but need more research on this area!

5. Economical Dietary Protein?

A. Both “overfeeding” or “underfeeding” protein can ↓ total production costs!

1) Underfeeding - ↓ growth performance & carcass quality.
2) Overfeeding - ↓ feed cost without affecting the performance.

B. The most economical level? (Bitney & Reese, 1988. NE Swine Rep.)

![Graph 1](image1.png)

![Graph 2](image2.png)

1) Point “A” - 16% CP diet is the most economical!
2) Point “B,” the boundary line, has alternatives: a) Feed higher protein - May reach market weights sooner with the same cost, b) Feed higher protein for a lower weight range & lower protein for a higher weight range, c) Feed an average of the two, and d) No problem with facility, feed lower protein.

6. Grower and Finisher Feeders


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1. **Introduction**

A. Because of consumer demands for lean meats, need to improve leanness of pigs.

B. "High-lean" pigs can be beneficial for both producers (a higher base carcass value + premiums) and packers (a higher value for pork cuts). [See a box - NHF 38(7):17 (1993)]

C. Excess consumption of energy? Finisher pigs have a propensity to consume energy in excess of their needs for "optimum" protein accretion, resulting in "excess" fat accretion! See Figure 1 (Just, 1984. JAS 58:740).

2. **Improve Leanness?**

A. A proper nutritional management (mostly, amino acid and energy contents):

1) Provide adequate protein or amino acids:

   a) According to some, in addition to satisfying the energy needs, pigs may eat to satisfy the Lys requirements.

   b) If the Lys content is too low, they may over-consume energy.

2) A proper balance of protein/amino acid & energy - e.g., Pigs eat less high-energy diet, thus may not consume enough amino acids for protein accretion if the amino acid-energy proportion is not appropriate.

B. Reducing energy intake of pigs:

1) Limit feeding:

   a) Extensively used in Europe, Australia & other countries to improve the efficiency of feed utilization and carcass leanness!


   c) Useful?

   (+) Can ↓ leanness / ↓ fat content of carcass.

   (-) ↓ weight gain, ↓ the feeding period.

   (-) A practical feeding method (i.e., feeding *per se* & ensuring daily allowances for each pig) can be a problem.

With a greater financial incentive(s) to produce lean pork in the future, benefits may offset disadvantages!?
2) Use of fibrous ingredients:

a) Pig’s ingestive capacity is limited, ∴ it is possible to reduce energy intake by increasing dietary bulk (e.g., by using oats, alfalfa, etc.).

b) Dietary fibers often improve leanness, but also reduce weight gain.

c) Some concerns/questions on the use of fibers?

(1) Possible adverse effects on digestibility of other nutrients, especially amino acids.

(2) Variations among various fibers as a source of energy.

C. Repartitioning agents:

1) Effective in improving growth performance and carcass characteristics! See a box!

2) Partitions nutrients away from fat deposition, ∴ more nutrients are used for lean muscle production.

3) Examples of repartitioning agents:

   a) GH or pST (porcine somatotropin) - Increases muscle production & reduces fat deposition.

   b) Beta adrenergic agonists - Similar to catecholamine (epinephrine, norepinephrine & dopamine) and examples include ractopamine, cimaterol, clenbuterol, and isoproterenol, which may or may not increase muscle production but reduce fat deposition.

4) Questions/problems:

   a) Effectiveness may be depending on the type of pigs (genotypes, sex . . .).

   b) Effectiveness may be depending on diets (probably higher amino acid requirements for pigs treated with pST & β-agonists . . . but how much higher?).

   c) Cost-effectiveness?

   d) pST must be injected or implanted (daily, weekly or whatever).

   “Consumer perception” - Consumers have negative perceptions on the use of hormones or feed additives for animal production!

**FEEDING HEAVY HOGS?**

1. **Introduction**

   • Not many years ago, pigs had to weigh under 200 lb to be eligible for a top price.

   • Today, packers are pushing for heavier pigs - e.g., IBP Inc., 230-260 lb; Monfort, 220-290 lb; John Morrell, 220-250 lb.

2. **Producer's View Point**

   A. Heavier pigs are usually fatter & contrary to the current trend for lean pigs!

   B. Costs more to produce heavier pigs - ↓ gain & efficiency after ≈ 230-240 lb.

   C. Heavy pigs add to pork tonnage & ↓ market price.
3. **Packer's View Point**

A. Major costs are based on a "per-head" basis rather than on a per-pound basis, thus can spread fixed costs over more pounds.

B. Heavier pigs provide larger cuts?

4. **Must Consider Three Factors?**

A. “Genetic capacity” of pigs:

1) Pigs must have the ability to go to heavy weights without depositing excess fat, i.e., stay relatively lean regardless of the weight.

2) There would be no benefit if pigs turn most of feed they consumed into fat accretion after reaching a certain weight, which would simply increase the costs & may result in the quality discount.

B. “Packer’ incentives” - e.g., IBP [Pork'93 13(4):22]:

<table>
<thead>
<tr>
<th>Live wt, lb</th>
<th>Carcass wt, lb</th>
<th>BF, in</th>
<th>Supreme lean</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>210-230</td>
<td>157-171</td>
<td>Premium, $/cwt</td>
<td>&lt;0.60</td>
<td>0.61-0.80</td>
<td>0.81-1.00</td>
<td>1.01-1.20</td>
</tr>
<tr>
<td>230-260</td>
<td>172-194</td>
<td>Premium, $/cwt</td>
<td>&lt;0.60</td>
<td>0.61-0.80</td>
<td>0.81-1.00</td>
<td>1.01-1.20</td>
</tr>
<tr>
<td>261-280</td>
<td>195-209</td>
<td>Premium, $/cwt</td>
<td>&lt;0.80</td>
<td>0.81-1.00</td>
<td>1.01-1.20</td>
<td>1.21-1.40</td>
</tr>
<tr>
<td>&gt;281</td>
<td>&gt;210</td>
<td>Premium, $/cwt</td>
<td>1.00</td>
<td>1.01-1.10</td>
<td>1.21-1.40</td>
<td>1.41-1.60</td>
</tr>
</tbody>
</table>

C. “Additional costs?”

1) Must consider the cost for extra feed & overhead, and also quality discounts.

2) “Formula” to estimate changes in the market price required to cover costs of feeding pigs to heavier weights: See a box [1993. NHF 37(5):30].

3) Example - See the data on “Costs/returns of feeding pigs to heavier weights [1993. HFM 37(5):30].”

\[
\frac{(AW \times AC) - (AW \times HP) + (FW \times D)}{FW}
\]

where \(AW\) = additional wt (lb), \(AC\) = cost of additional wt ($/lb), \(HP\) = current live pig price ($/lb), \(FW\) = final wt (lb), and \(D\) = weight and(or) quality discount ($/lb).

---

“Costs/returns of feeding pigs to heavier weights:” [1993. HFM 37(5):30]:

<table>
<thead>
<tr>
<th>Item</th>
<th>No disc &amp; avg perf</th>
<th>Poor perf</th>
<th>Higher input costs</th>
<th>Adding more wt</th>
<th>Greater disc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price, $/cwt</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Feed, $/lb</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Overhead, $/lb</td>
<td>0.06</td>
<td>0.10</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Gain, lb/d</td>
<td>1.8</td>
<td>1.5</td>
<td>1.8</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Feed:gain</td>
<td>4.0</td>
<td>4.5</td>
<td>4.0</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Additional wt, lb</td>
<td>0.27</td>
<td>0.31</td>
<td>0.42</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Cost of added wt, $/lb</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>Final wt, lb</td>
<td>260</td>
<td>260</td>
<td>260</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>Discount, $/lb</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>To cover costs, $/cwt</td>
<td>39.00</td>
<td>40.31</td>
<td>41.15</td>
<td>41.22</td>
<td>42.22</td>
</tr>
</tbody>
</table>

“Disc” = discount; “Perf” = performance.
HEALTH MANAGEMENT OF GROWER-FINISHER PIGS

1. **Mycoplasmal Diseases**

   A. Introduction:

   1) 99% of hogs in the U.S. have some forms of pneumonic lesions, and 30 to 70% of U.S. hogs are affected by *Mycoplasma hyopneumoniae*.

   2) Mycoplasmal pneumonia alone may reduce growth rate by 13-16% & may increase feed:gain by 14% based on the Australian data, and economical losses can be $1.50-2.50/pig marketed in the US!

   B. General:

   1) Mycoplasmal pneumonia, which is the main problem, is a chronic disease caused by *Mycoplasma hyopneumoniae*, and usually it doesn't kill pigs:

      a) Can affect pigs of all ages but often > 6-10 week-old pigs, and it is a wide spread cause of reduced weight gain and efficiency.

      b) Dominant sign is a sporadic, dry or nonproductive cough, and usually, “mixed-infections” with Haemophilus, Streptococcus, etc.

   2) Also, there are mycoplasmal polyserositis-arthritis and mycoplasmal arthritis.

   3) A poor air quality can contributes to and(or) aggravates infections.

   B. Prevention/treatment:

   1) Prevention by a proper nutrition, providing a warm, dry, dust- and draft-free environment, using “all-in, all-out” system, etc. - Also, these are important for minimizing adverse effects of infections!

   2) Tetracycline may be effective in prevention & Lincomycin may be effective in controlling infections, whereas some questions on the effectiveness of vaccines.

2. **Haemophilus or Actinobacillus**

   A. Caused by *Actinobacillus pleuropneumoniae* (bacteria) & at least 12 different serotypes have been identified.

   B. Cause pneumonia and death in an acute form, and a chronic form can result in pleuritis (inflammation of tissues around lungs), lung adhesions & abscesses, labored breathing or abdominal breathing, and other signs include fever, depression, and inactivity.

   C. Prevention/treatment:

   1) Prevention by good management practices (all-in/all-out, adequate space, proper No. of pigs/pen, adverse environmental factors, etc.).

   2) Treatment? - Penicillin/tetracycline injections may be effective in an acute outbreak.

   3) Vaccination - Must contain proper serotype(s) to be effective, but even then do not completely block the infection, thus prevention is more important!!

3. **Atrophic Rhinitis (AR):** (See PIH-50)

   A. Introduction:
1) 25-75% of all slaughter pigs have signs of AR & it may increase to 40-90% on the herd basis, and estimated production loss is 5-10% from ↓ gain and feed efficiency.
2) Aggravated by mycoplasmal pneumonia and(or) parasite (ascaris) infestation.

B. What is it?

1) Inflammation of mucous membranes that line the pig's nose, and partial or almost complete atrophy of turbinate, a reduction in the nasal cavity, and distortion of the nasal septum.
2) Loss of the ability to warm, moisten & filter the inhaled air & the consequence being the direct entry of dust, gases & others into the respiratory system!

C. Cause(s):

1) A bacterium, *Bordetella bronchiseptica* (considered as the 1° agent), may or may not be a cause of AR because: a) there is an inverse relationship between Bordetella and snout lesions & 2) pigs negative for Bordetella showed typical rhinitis lesions.
2) *Pasteurella* (thought to be a secondary invader) may be a major cause of AR!

D. Prevention/treatment:

1) Prevention - Aain, sound management practices!
2) Tetracycline and tylosin may be effective in controlling AR, and vaccination may be useful in controlling AR (pgs at 7 & 28 days of age & sows at 4-5 and 2-3 weeks before farrowing).

4. Pseudorabies

A. An acute & frequently fetal disease, and can affect most species of domestic and wild animals.
B. Caused by various strains of herpesvirus, and affects “nervous and respiratory” systems.
C. Death loss generally ↓ as pigs get older, i.e., < 2-week old, 100% loss; 3-week old, 50% loss; 5-month old, less than 5% loss, but depends on a strain of virus!
D. No medication to treat pigs infected with pseudorabies, and also there is no drug to eliminate herpesvirus!
E. Vaccines? A very inconsistent response - Do not prevent infections but may ↓ death losses & prevent spreading further!?
F. Once infected, the premise should be quarantined & there should be a very strict control of movement of people, animals, vehicles & others.
G. Prevention by a strict control of movement of people, animals and objects into the swine premises.
H. National 10-Year Eradication Program - 46 states had taken the first step & projected costs are: producers, $68.7 million; states, $57 million; USDA, $57 million. *Worth it?*

5. Swine Dysentery

A. Affects pigs of all ages, but often 8-14 week-old pigs.
B. Loose stools containing blood (via damaged intestinal wall) and mucus.
C. Caused by a bacterium, *Treponema hyodysenteriae*.
D. Prevention? The effort should be made to prevent “introduction,” i.e., isolation of the herd (people, trucks, farm implements, etc.), control rodents/birds & obtain new stocks from reliable source(s), etc.
E. Treatment? Medication of feed is not effective, and should use water medication (BMD, Gentamicin, Lincomycin, Tiamulin & Tylosin) or injection (Tylosin).

6. **Trichinosis** (See PIH-103)
   A. Caused by a parasitic worm, *Trichinella spiralis*, that can encyst in the skeletal muscle, and this has been a stigma to consumption of pork for many years but the number of human cases has declined steadily in the U.S. during the last 40 years.
   B. Pigs with the natural infection do not show clinical effects, and there is no available routine treatment for infected swine.
   C. Prevention/control measures include: 1) feed only well-cooked garbage, 2) strict rodent control, 3) ensure proper handling of dead pigs (burial or incineration), and 4) provide effective barriers between pigs and wild animals.
   D. Meat should be heated to at least 137°F! To be safe, 160°F is recommended!

7. **Slaughter Checks** (See PIH-93)
   A. Purpose is to look for abnormal tissues on the regular basis so that: 1) subclinical problems (may not be detected for an extended period of time) can be identified, and 2) the effectiveness of herd health management programs can be monitored.
   B. Reveals information on the prevalence of diseases and severity of lesions, and possibly, cause(s) of the problem. Pneumonia, AR and parasites are three major disease problems often investigated during a slaughter check.
   C. Procedures?
      1) Make arrangements with the packing plant & veterinarian. (Important to maintain a good relationship with a packer!)
      2) How often? Commercial producers, at least two times/year, whereas seedstock producers, more often & possibly quarterly?.
      3) What time of the year?
         a) Pneumonia problems peak in the late fall with a small peak in late spring, fall-winter & spring-summer might be useful for a commercial producer.
         b) Quarterly checks in January, April, July and October might be useful for a seedstock producer.
      4) How many?
         a) Depends on the size of the herd and incidence of specific disease problems.
         b) Generally, 30 pigs representative of the herd should be adequate.

*To get a “true” picture of the herd health, fast-growing pigs as well as tail-enders should be checked!*