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Michigan State University
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Authors:
James R. Jones, North Carolina State University
John C. Rea, University of Missouri
M. Terry Coffey, North Carolina State University
Reviewers:
Leland Tribble, Texas Technological University
Kofi Boeteng, College of the Virgin Islands
Dale Forsyth, Purdue University
William Hugh, University of Hawaii

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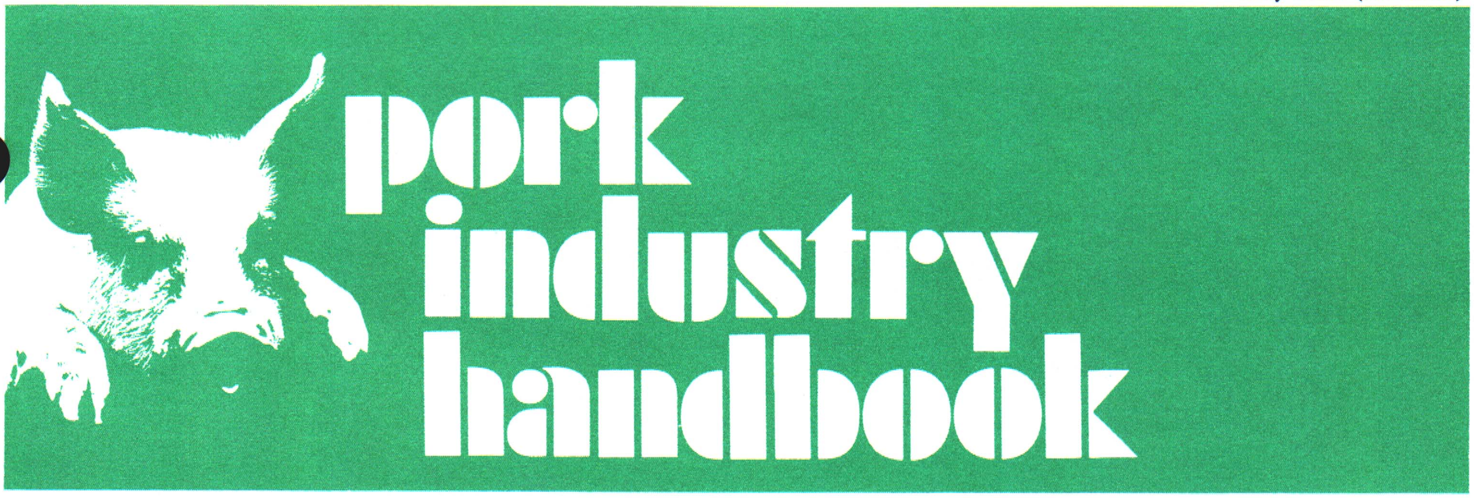


Cooperative Extension Service • Michigan State University

# Principles of Balancing Swine Rations

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A balanced swine ration contains the necessary nutrients in the correct proportions to nourish the animal properly. Required nutrients are energy, amino acids, minerals, and vitamins. Fat is also required to supply essential fatty acids but is usually adequate in practical rations. Water is an important nutrient and normally is provided with free access so it is not considered for ration formulation purposes. A palatable and economical energy source like corn or grain sorghum can be transformed into a nutritionally balanced ration if nutrient deficiencies are corrected.

Practical ration formulation must be sufficiently flexible to accommodate price and feedstuffs available while retaining the necessary nutritive balance and adequacy. When protein supplements are extremely expensive, it might be more economical to feed slightly less protein than recommended, even with a somewhat decreased rate of growth. Likewise, when protein supplements are cheap relative to grain, it is sometimes economical to supply a greater percentage of protein than is normally recommended.

Swine rations are usually formulated around cereal grains because they are low in fiber and high in energy. Corn is the most commonly fed grain; but, other grains such as sorghum grain, wheat or barley may be used. All grains are deficient in protein quantity and quality as well as minerals and vitamins. Corn is an excellent energy source, and soybean meal is an excellent amino acid source. Soybean meal can be fed as the only supplemental protein source for swine.

The nutrient content of grains is affected by factors such as type or cultivar, stage of maturity at harvest, soil and climatic conditions, location grown, and time in storage. Nutrient requirements of animals vary due to age, weight, sex, and function. Requirements may vary even in animals of the same weight. Therefore, rations are usually over-fortified as insurance against variations in feeds and requirements.

Usually high-energy, low-fiber rations are fed to swine, thus energy level is not a particular problem for growing-finishing animals. However, for gilt developer and gestation rations, lower energy and higher fiber levels can be used to control weight gains.

## Logical Steps in Formulating a Ration

1. *Identify animals to be fed by age, weight, function and specific conditions under which they are fed.* Penning and feeding in uniform lots allows a producer to more accurately meet the pigs' requirement.

2. *Select a set of nutrient requirements or allowances most appropriate for the animals being fed.* An authoritative source of information is *Nutrient Requirements of Swine* published by the National Academy of Sciences. Adaptations from this publication, mostly revised upwards, are presented in Table 1 and are called nutrient allowances. Nutrient allowances may differ from requirements and may reflect special areas, regional needs, and even opinions. Table 2 gives some conversion factors that are very useful in ration calculations.

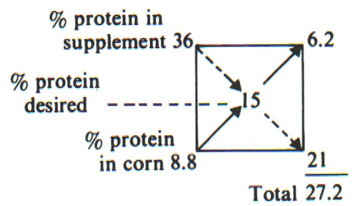
3. *Select suitable ingredients to help ensure that the ration is nutritionally balanced, palatable, safe, and economical.* Some guidelines for utilizing different feeds are given in Table 3. Various feeding guides and example rations are helpful in selecting feed ingredients. Average analyses of selected ingredients are presented in Table 4.

4. *Determine the necessary fixed amount of certain ingredients (minerals and vitamins) and then mix grain(s) relative to protein supplement to provide the desired protein level.* Rations can be formulated on either a cwt. basis or on a ton basis, depending on personal preference. The advantage of cwt. basis is that percentage figures for ration nutrients are the same as pound figures for ration nutrients. However, formulating rations on a ton basis can reduce calculations and time required, particularly where cost per ton of ration ingredients is to be determined. The

quantity of any particular ingredient may be determined by using feeding guides and personal experience. Precision in balancing a ration can be obtained with simultaneous equations or algebraic equations. However, the "Square Method" is most used in balancing rations because it is easy to use in blending two feeds or combinations of feed ingredients into a mixture containing a definite percentage of some nutritive factor.

## Using the "Square Method" To Balance Rations

Example 1: Combine a supplement containing 36% protein and corn containing 8.8% protein to make a 15% ration.




| Cwt. or % basis | Ton basis |
|---|---|
| $\frac{6.2}{27.2} \times 100 = 22.79\% \times 20 =$ | 456 lb. supplement |
| $\frac{21}{27.2} \times 100 = 77.21\% \times 20 =$ | 1544 lb. corn |
| | 2000 lb. total |

Subtract on the diagonal the smaller number from the larger to obtain relative amounts of corn (36 - 15 = 21) and supplement (15 - 8.8 = 6.2). A 15% ration would be derived from 6.2 parts of 36% supplement and 21 parts of 8.8% corn. To put on a percentage basis, divide 21 by 27.2 and multiply by 100 to get 77.21% corn in the diet, and divide 6.2 by 27.2 and multiply by 100 to get 22.79% supplement in the diet. Each of these percentage figures can be multiplied by 20 to put on a ton basis. The protein content of other grains, supplements, or mixtures can be substituted in the above formula to mix a ration of a desired protein content.

Example 2: A 15% protein ration is needed. It is to contain 35% barley and an appropriate amount of corn and 40% supplement. Barley has 11.7% protein content and corn has 8.8%. Since 35% of the ration is 11.7% protein, the remaining 65% of the ration must be considerably higher in protein to give a 15% protein ration.

$(35 \times 11.7) + 65X = 100 \times 15$

$65X = 1090.5$

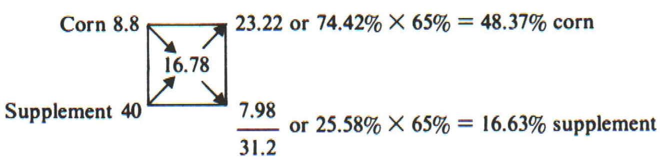
$X = 16.78$

or

$35 \times .117 = 4.095\%$ protein (from barley)

$15 - 4.095 = 10.905\%$ protein

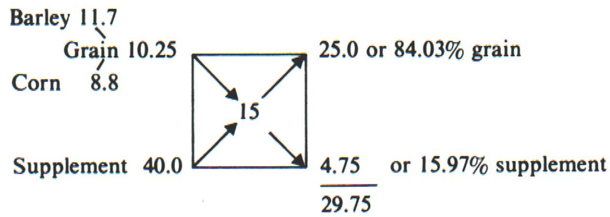
$\frac{10.905}{.65\%} = 16.78\%$ protein (from 65% of ration which goes in the center of the square)




| Ingredient | Pounds | Percent protein | Total protein |
|---|---|---|---|
| Barley | 35.0 | 11.7 | 4.10 |
| Corn | 48.4 | 8.8 | 4.26 |
| Supplement | 16.6 | 40.0 | 6.64 |
| | 100.0 | | 15.00 or 15% |

The above method may be used for any predetermined amount of any ingredient such as 5% fish meal, 10% alfalfa meal, 5% whey, etc.

Example 3: A 15% ration is to contain equal parts of corn and barley balanced with a 40% protein supplement. Corn has 8.8% protein and barley has 11.7%, which gives a 10.25% average for the two grains.

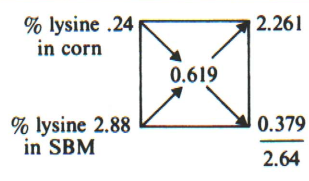



| Ingredient | Pounds | Percent protein | Total protein |
|---|---|---|---|
| Barley | 42.0 | 11.7 | 4.91 |
| Corn | 42.0 | 8.8 | 3.70 |
| Supplement | 16.0 | 40.0 | 6.4 |
| Total | 100.0 | | 15.01 or 15% |

## Balancing Rations for Amino Acids

Rations can be balanced on an amino acid basis rather than on a crude protein basis. This can provide a more precise indication of ration adequacy. Lysine is the amino acid recognized as most limiting in swine rations.

Example: A corn-soybean meal ration providing 0.60% lysine is needed for finishing hogs. Assume that 3% of the ration formula will be needed to provide minerals, vitamins, and additives. Corn contains about 0.24% lysine, and 44% soybean meal contains about 2.88% lysine. Since only 97% of the ration contains lysine, that portion must contain 0.619% lysine (0.60 ÷ .97 = 0.619).




$\frac{2.261}{2.64} \times 100 = 85.64 \times .97 = 83.07\% \times 20 = 1{,}661.5$ lb. corn

$\frac{0.379}{2.64} \times 100 = 14.36 \times .97 = 13.93\% \times 20 = 278.5$ lb. SBM

$3.0\% \times 20 = 60$ lb. added

$100.0\%$ — 2,000 lb. total

A mixture of 1,661.5 lb. corn, 278.5 lb. soybean meal, and 60 lb. of minerals, vitamins, and additives results in 1 ton of ration with a lysine level of 0.60%. Rations using grains other than corn are best balanced on a lysine basis. Sorghum grain can be substituted for corn on pound for pound basis since they are similar in lysine content.

## Balancing Rations for Minerals

The following procedure is suggested for supplementing rations with minerals.

1. Use iodized salt and trace mineral mix or swine trace mineral salt in rations to meet sodium, chlorine, and trace mineral needs.

2. Use calcium (Ca) and phosphorus (P) sources to meet allowances as shown in Table 1.

Example 1: Meet the requirements for a finishing pig of 0.65% Ca and 0.50% P in the ration from the previous example.

Step 1. Using ingredient composition from Table 4, calculate the Ca and P supplied from corn and soybean meal.

| | | Ca | | P | |
|---|---|---|---|---|---|
| **Ingredient** | **lb.** | **%** | **lb.** | **%** | **lb.** |
| Corn | 83.07 | .01 | .008 | .25 | .208 |
| SBM | 13.93 | .25 | .035 | .60 | .084 |
| Total | | | .043 | | .292 |

Step 2. Subtract the Ca and P supplied by corn and soybean meal from the requirement. Calcium is still short by 0.607 and P is short by 0.208%.

| | Percent | |
|---|---|---|
| | **Ca** | **P** |
| Requirement | .650 | .50 |
| Corn and SBM | .043 | .292 |
| Shortage | .607 | .208 |

Steps 3 and 4. Meet the P requirement first since most P sources also contain some Ca (P sources are also more expensive than Ca sources). To determine the amount of P source to add, divide the amount required by the P content of the P source. Dicalcium phosphate contains 18.5% P and 22% Ca; therefore, .208 ÷ .185 = 1.1% or 22 lb. per ton (1.1% x 20 = 22 lbs./ton). Adding 1.1% dicalcium phosphate would meet the P requirement and provide .242% Ca (1.1 x .22 = .242%). This would leave a Ca shortage of .365% (.607% - .242% = .365%).

| **Dicalcium** | Ca | | P | |
|---|---|---|---|---|
| **phosphate** | **%** | **lb.** | **%** | **lb.** |
| 1.1 | 22 | .242 | 18.5 | .208 |

Ca: short 0.365 (.607 - .242)
P: need is met

Step 5. Provide enough ground limestone to meet the Ca shortage. Do not add excess limestone just because it is cheap. To determine the amount of ground limestone, divide the amount of Ca required by the Ca content of limestone. Limestone contains 38% Ca; therefore, 0.365 ÷ .38 = .96% or 19.2 lb. per ton (.96 × 20 = 19.2 lb./ton).

| | Ca | |
|---|---|---|
| **Limestone, %** | **%** | **lb.** |
| 0.96 | 38 | 0.365 |

The complete formulation for the ration balanced for lysine, calcium, and phosphorus is:

| Item | % | lb./ton |
|---|---|---|
| Corn | 83.07 | 1,661.5 |
| Soybean meal | 13.93 | 278.5 |
| Dicalcium phosphate | 1.1 | 22.0 |
| Ground limestone | 0.96 | 19.2 |
| Premix* | .94 | 18.8 |
| Total | 100.0 | 2,000.0 |

*Premix to contain salt, vitamins and trace minerals.

This same system can be used with other feed ingredients. Calcium and phosphorus levels in each ingredient can be obtained from Table 4.

Example 2: Calculate the mineral adequacy of a ration, using a commercial protein-mineral-vitamin supplement and grain. Assume that the supplement contains 35% protein, 4.3% Ca, and 2.0% P according to the label. It is being fed in a combination of 1,700 lb. corn and 300 lb. of 36% supplement. Assume a desired level of 0.65% Ca and 0.50% phosphorus in the ration. Calculate the expected levels of Ca and P:

| Item | Ca | P | Ca/ton | P/ton |
|---|---|---|---|---|
| | Percent | | Pounds | |
| 1,700 lb. ground corn | .01 | 0.25 | 0.17 | 4.25 |
| 300 lb. supplement | 4.3 | 2.0 | 12.9 | 6.0 |
| Total | | | 13.07 | 10.25 |
| Desired levels in 1 ton | | | 13.0 | 10.0 |

Calculations suggest the above combination of feedstuffs is fully adequate in both Ca and P. Most commercial supplements will provide adequate mineral and vitamin fortification when fed at levels recommended by the manufacturer.

## Balancing Rations for Vitamins

A premix is usually used to provide supplemental vitamins. Check to see if the recommended levels are met. This can be done rather simply by filling in Worksheet 1, using the units per pound of premix and the recommended pounds of premix per ton of ration.

## Computer Ration Formulation

Computer formulation is available in most areas at a reasonable cost. This method often provides additional alternatives of ingredient substitution and reduces time and chances of error in hand calculation.

Many swine producers have access to computers to aid decision making. Computers can handle the calculations of diet formulation efficiently, allowing you to examine rations in more detail and evaluate alternatives. The computer will not replace the nutritionist or farm manager. However, it is a tool that will be increasingly used, and if used properly, can add power to the thinking side of farming.

The computer can rapidly select combinations of feeds that will meet nutrient requirements; and, when cost data are provided, it will select those that meet the requirements at the lowest cost. Also, a computer can be used to analyze your current feeding program by checking rations against accepted nutrient allowances.

To properly use computers, several requirements must be met:

1. Knowledge of diet specifications and requirements including minimum and maximum allowances on nutrients and ingredients,
2. Up-to-date ingredient information such as nutrient analysis and accurate onfarm prices,
3. Procedures for converting analysis, results, and feed tag information to a format that can be properly handled by the computer,
4. An organized system for updating information such as prices, results of analyses, and ingredient availability,
5. Access to a suitable program, and
6. Proper mixing procedures.

Since feed cost represents a large portion of total swine production cost, a small savings can significantly reduce total cost. As swine producers become more knowledgeable and take advantage of the computer, consistency will improve in swine ration composition.

The role of a computer is to calculate balanced rations at the least cost and to check rations against requirements. Information on ingredient availability, nutrient content, and nutrient requirements is supplied by the user. Therefore, the accuracy of the results depends upon the detail and accuracy of the information supplied.

## Summary

Most rations are formulated in one of three ways:

1. Combining corn and/or other grains with a complete protein supplement (Table 5 gives varying protein levels using corn and supplement), or
2. Combining corn and/or other grains with soybean meal and a complete vitamin-mineral premix (Table 6 shows some example rations using this method), or
3. Combining corn and/or other grains with soybean meal, a vitamin-premix, trace minerals, salt, calcium, and phosphorus (examples of this are shown in Table 7).

Further examples are given in Pork Industry Handbook fact sheet 23 *Swine Rations.*

**Worksheet 1. Calculating vitamins supplied by a premix.**

| Vitamin | Units per lb. premix | × | Pounds premix per ton | = | Total units per ton | vs. | Units required per ton |
|---|---|---|---|---|---|---|---|
| Vitamin A, IU | ________ | | ________ | | ________ | | ________ |
| Vitamin D, IU | ________ | | ________ | | ________ | | ________ |
| Vitamin E, IU | ________ | | ________ | | ________ | | ________ |
| Vitamin K, mg. | ________ | | ________ | | ________ | | ________ |
| Riboflavin, mg. | ________ | | ________ | | ________ | | ________ |
| Niacin, mg. | ________ | | ________ | | ________ | | ________ |
| Pantothenic acid, mg. | ________ | | ________ | | ________ | | ________ |
| Choline, mg. | ________ | | ________ | | ________ | | ________ |
| Vitamin $B_{12}$, mcg. | ________ | | ________ | | ________ | | ________ |

**Table 1. Nutrient allowances for swine, percentage or amount per pound of diet.***

| Nutrient | Weight class, lb. 10-25 | 25-45 | 45-125 | 125-market | Breeding herd |
|---|---|---|---|---|---|
| | | | Percent | | |
| Protein | 20 | 18 | 16 | 13 | 14 |
| Lysine | 1.15 | .95 | .70 | .60 | .60 |
| Calcium | .85 | .75 | .65 | .65 | .90 |
| Phosphorus | .72 | .65 | .55 | .50 | .70 |
| Salt | .35 | .35 | .35 | .35 | .50 |
| | | | Parts per million | | |
| Iron | 100 | 100 | 100 | 100 | 100 |
| Copper | 10 | 10 | 10 | 10 | 10 |
| Manganese | 10 | 10 | 10 | 10 | 20 |
| Zinc | 100 | 100 | 100 | 100 | 100 |
| Iodine | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Selenium | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| | | | International units | | |
| Vitamin A | 2,000 | 2,000 | 1,200 | 1,200 | 2,000 |
| Vitamin D | 200 | 200 | 120 | 120 | 200 |
| Vitamin E | 7.5 | 7.5 | 4.5 | 4.5 | 7.5 |
| | | | Milligrams | | |
| Vitamin K | 1.65 | 1.65 | 1 | 1 | 1.65 |
| Riboflavin | 2.5 | 2.5 | 1.5 | 1.5 | 2.5 |
| Niacin | 17.5 | 17.5 | 10.5 | 10.5 | 17.5 |
| Pantothenic acid | 11.25 | 11.25 | 6.75 | 6.75 | 11.25 |
| Choline | 50 | 50 | — | — | 150 |
| | | | Micrograms | | |
| Vitamin $B_{12}$ | 12.5 | 12.5 | 7.5 | 7.5 | 12.5 |

*Source: *Pork Industry Handbook* fact sheets PIH-2, PIH-5, and PIH-52.

**Table 2. Metric system—mass conversions.**

**Equivalents**

1 pound (lb) = 454 grams (g)
1 kilogram (kg) = 2.2 lb = 1000 g
1 g = 1000 milligrams (mg)
1 mg = 1000 micrograms (mcg)
1 mg/kg = 1 part/million (ppm)
1 mcg/lb = 2 mg/ton
1 mg/lb = 2 g/ton
1 mg/lb = 2.2 ppm
1 mcg/g = 1 ppm

**To convert**

mg/g to mg/lb—multiply by 454
mcg/g to mg/g—divide by 1000
mcg/lb to mg/lb—divide by 1000
mg/lb to mcg/g—divide by 0.454
mg/lb to ppm—multiply by 2.2
g/lb to %—divide by 4.54
% to g/lb—multiply by 4.54

**Conversion table**

| % | | ppm | | g/ton | | mg/lb |
|---|---|---|---|---|---|---|
| 0.0001 | = | 1.0 | = | 0.9 | = | 0.45 |
| 0.00011 | = | 1.1 | = | 1.0 | = | 0.5 |
| 0.001 | = | 10.0 | = | 9.1 | = | 4.55 |
| 0.0011 | = | 11.0 | = | 10.0 | = | 5.0 |
| 0.01 | = | 100.0 | = | 90.8 | = | 45.4 |
| 0.011 | = | 110.0 | = | 100.0 | = | 50.0 |
| 0.1 | = | 1000.0 | = | 908.0 | = | 454.0 |
| 0.11 | = | 1100.0 | = | 1000.0 | = | 500.0 |

**Table 3. Maximum amount of different feedstuffs for various diets.**

| | % complete diet Gestation | Lactation | Starter | Grower | Finisher |
|---|---|---|---|---|---|
| Alfalfa meal | 90 | 10 | 0 | 5 | 5 |
| Barley | 80 | 80 | 25 | 80 | 90 |
| Blood meal | 3 | 3 | 0 | 3 | 3 |
| Corn | 85 | 85 | 70 | 80 | 90 |
| Corn and cobmeal | 70 | 10 | 0 | 0 | 0 |
| Cottonseed meal | 5 | 5 | 0 | 5 | 5 |
| Distillers dried solubles, corn | 5 | 5 | 5 | 5 | 5 |
| Fish meal | 10 | 10 | 5 | 10 | 5 |
| Linseed meal | 5 | 5 | 5 | 5 | 5 |
| Meat and bone meal | 10 | 10 | 5 | 5 | 5 |
| Grain sorghum | 85 | 85 | 60 | 80 | 90 |
| Molasses | 5 | 5 | 5 | 5 | 5 |
| Oats | 70 | 15 | 0 | 20 | 20 |
| Skim milk, dried | 0 | 0 | 40 | 0 | 0 |
| Soybean meal | 20 | 20 | 30 | 25 | 20 |
| Tankage | 10 | 5 | 0 | 5 | 5 |
| Wheat | 85 | 85 | 60 | 80 | 90 |
| Whey (dried) | 5 | 5 | 20 | 10 | 10 |

**Table 4. Average nutrient content of common feedstuffs.[1]**

| Ingredient | Nutrient[2] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | CF | ME | Ca | P | CP | Lys | Try | Thr | Met | Cys |
| | % | kcal./lb. | Percent | | | | | | | |
| Alfalfa hay, suncured | 29.0 | 890 | 1.20 | 0.16 | 14.2 | 0.55 | 0.35 | 0.60 | 0.20 | 0.15 |
| Alfalfa meal, dehydrated, 17% | 25.0 | 1,050 | 1.30 | 0.23 | 17.0 | 0.80 | 0.36 | 0.75 | 0.29 | 0.29 |
| Barley | 7.0 | 1,275 | 0.06 | 0.36 | 11.7 | 0.36 | 0.16 | 0.36 | 0.18 | 0.19 |
| Corn, yellow | 2.5 | 1,500 | 0.01 | 0.25 | 8.8 | 0.24 | 0.09 | 0.32 | 0.19 | 0.20 |
| Cottonseed meal (solvent) | 12.5 | 1,150 | 0.15 | 0.95 | 41.0 | 1.65 | 0.48 | 1.35 | 0.49 | 0.65 |
| Fat[3] | — | 3,550 | — | — | — | — | — | — | — | — |
| Fish meal, menhaden | 1.0 | 1,290 | 5.20 | 2.90 | 60.0 | 4.60 | 0.71 | 2.67 | 1.88 | 0.62 |
| Meat and bonemeal, 50% | 2.8 | 1,100 | 8.10 | 4.10 | 50.0 | 2.50 | 0.29 | 1.81 | 0.65 | 0.62 |
| Milk, dried skim | — | 1,520 | 1.25 | 1.00 | 33.3 | 2.50 | 0.45 | 1.75 | 0.90 | 0.40 |
| Oats | 12.0 | 1,220 | 0.08 | 0.33 | 12.0 | 0.34 | 0.13 | 0.31 | 0.18 | 0.15 |
| Oat groats | 3.0 | 1,500 | 0.07 | 0.40 | 16.0 | 0.45 | 0.18 | 0.47 | 0.20 | 0.26 |
| Sorghum, grain | 2.7 | 1,425 | 0.02 | 0.27 | 9.0 | 0.22 | 0.09 | 0.29 | 0.17 | 0.14 |
| Soybeans, full-fat (cooked)[4] | 5.0 | 1,609 | 0.25 | 0.58 | 38.0 | 2.40 | 0.52 | 1.50 | 0.50 | 0.60 |
| Soybean meal, 44% | 6.5 | 1,475 | 0.25 | 0.60 | 44.0 | 2.88 | 0.55 | 1.87 | 0.56 | 0.66 |
| Soybean meal, 48.5% | 3.0 | 1,520 | 0.20 | 0.65 | 48.5 | 3.14 | 0.63 | 2.00 | 0.73 | 0.82 |
| Sunflower meal, 32% | 23.7 | 1,040 | 0.38 | 0.97 | 32.0 | 1.66 | 0.59 | 1.40 | 1.57 | 0.69 |
| Sunflower meal, 41% | 13.3 | 1,340 | 0.43 | 1.04 | 41.0 | 2.00 | 0.60 | 1.52 | 1.60 | 0.71 |
| Sugar | — | 1,383 | — | — | — | — | — | — | — | — |
| Tankage, 60% | 2.0 | 980 | 4.60 | 2.50 | 60.0 | 3.89 | 0.58 | 2.48 | 0.75 | 0.52 |
| Wheat, hard winter | 2.4 | 1,500 | 0.05 | 0.35 | 12.2 | 0.38 | 0.15 | 0.37 | 0.20 | 0.16 |
| Wheat, soft winter | 2.4 | 1,500 | 0.05 | 0.35 | 10.2 | 0.31 | 0.12 | 0.32 | 0.20 | 0.20 |
| Wheat, hard red spring | 2.4 | 1,515 | 0.04 | 0.39 | 13.5 | 0.34 | 0.18 | 0.37 | 0.19 | 0.26 |
| Wheat, Durum | 2.5 | 1,505 | 0.10 | 0.40 | 12.7 | 0.39 | 0.16 | 0.43 | 0.19 | 0.26 |
| Wheat bran | 11.0 | 890 | 0.08 | 1.15 | 15.0 | 0.56 | 0.29 | 0.38 | 0.09 | 0.29 |
| Wheat middlings | 7.5 | 1,300 | 0.05 | 0.80 | 16.0 | 0.64 | 0.18 | 0.54 | 0.16 | 0.18 |
| Whey, dried | — | 1,455 | 0.90 | 0.70 | 12.0 | 0.80 | 0.13 | 1.03 | 0.16 | 0.24 |
| Calcium carbonate (limestone) | — | — | 38.00 | — | — | — | — | — | — | — |
| Dicalcium phosphate | — | — | 22.00 | 18.50 | — | — | — | — | — | — |
| Defluorinated phosphate | — | — | 32.00 | 18.00 | — | — | — | — | — | — |
| Steamed bonemeal | — | — | 24.00 | 12.00 | — | — | — | — | — | — |

Source: PIH-23, Table 1.

[1] All values are on a 90% dry matter basis.

[2] Nutrient abbreviations are for crude fiber, metabolizable energy, calcium, phosphorus, crude protein, lysine, tryptophan, threonine, methionine, and cystine, respectively.

[3] Different sources may contain different ME values.

[4] Soybeans should be cooked or roasted to a temperature of 220-250°F to destroy the trypsin inhibitor. The values reported are for heat treated soybeans.

**Table 5. Varying protein of feed using corn and supplement.***

| Ingredient | Protein percent | | | | |
|---|---|---|---|---|---|
| | 18 | 16 | 15 | 14 | 13 |
| | Pounds per ton | | | | |
| Ground corn | 1,446 | 1,566 | 1,627 | 1,687 | 1,747 |
| 42% supplement | 554 | 434 | 373 | 313 | 253 |
| Ground corn | 1,410 | 1,538 | 1,603 | 1,667 | 1,731 |
| 40% supplement | 590 | 462 | 397 | 333 | 269 |
| Ground corn | 1,370 | 1,507 | 1,575 | 1,644 | 1,712 |
| 38% supplement | 630 | 493 | 425 | 356 | 288 |
| Ground corn | 1,324 | 1,471 | 1,544 | 1,618 | 1,691 |
| 36% supplement | 676 | 529 | 456 | 382 | 309 |
| Ground corn | 1,270 | 1,429 | 1,508 | 1,587 | 1,667 |
| 34% supplement | 730 | 571 | 492 | 413 | 333 |
| Ground corn | 1,207 | 1,379 | 1,466 | 1,552 | 1,638 |
| 32% supplement | 793 | 621 | 534 | 448 | 362 |
| Ground corn | 1,132 | 1,320 | 1,415 | 1,509 | 1,604 |
| 30% supplement | 868 | 680 | 585 | 491 | 396 |

*Corn figured at 8.8% protein.

**Table 6. Examples of diets using a mineral-vitamin premix.**

| Item | Gestation | Lactation | 25-45 lb. | 45-125 lb. | 125 lb.-market |
|---|---|---|---|---|---|
| | | | Pounds* | | |
| Ground corn (8.8%) | 1,598 | 1,611 | 1,384 | 1,516 | 1,636 |
| Soybean meal (44%) | 317 | 314 | 541 | 424 | 309 |
| Mineral-vitamin premix | 85 | 75 | 75 | 60 | 55 |
| Total | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| | | | Kcal/pound | | |
| Metabolizable energy | 1,432 | 1,440 | 1,437 | 1,450 | 1,455 |
| | | | Percent | | |
| Protein | 14.0 | 14.0 | 18.0 | 16.0 | 14.0 |
| Lysine | .65 | .65 | .95 | .79 | .64 |
| Calcium | .90 | .75 | .75 | .65 | .65 |
| Phosphorus | .70 | .60 | .65 | .55 | .50 |

*In prepared premixes, actual weights can vary with ingredient sources and carriers.

**Table 7. Examples of complete swine diets.**

| Item | Gestation | Lactation | 25-45 lb. | 45-125 lb. | 125 lb.-market |
|---|---|---|---|---|---|
| | | | Pounds | | |
| Ground corn (8.8%) | 1,597.6 | 1,613.0 | 1,394.2 | 1,514.6 | 1,629.3 |
| Soybean meal (44%) | 316.8 | 313.8 | 539.4 | 424.4 | 310.7 |
| Dicalcium phosphate | 44.6 | 33.8 | 30.2 | 26.0 | 22.0 |
| Ground limestone | 19.0 | 17.4 | 17.2 | 16.0 | 19.0 |
| Vitamin premix | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Trace mineral premix | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Salt | 10.0 | 10.0 | 7.0 | 7.0 | 7.0 |
| Total | 2,000.0 | 2,000.0 | 2,000.0 | 2,000.0 | 2,000.0 |
| | | | Kcal/pound | | |
| Metabolizable energy | 1,432 | 1,441 | 1,443 | 1,449 | 1,451 |
| | | | Percent | | |
| Protein | 14.0 | 14.0 | 18.0 | 16.0 | 14.0 |
| Lysine | .65 | .65 | .94 | .79 | .64 |
| Calcium | .90 | .75 | .75 | .65 | .65 |
| Phosphorus | .70 | .60 | .65 | .55 | .50 |

See *Pork Industry Handbook* fact sheet PIH-23 for further example rations.

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