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EC74-210 Swine Diet Suggestions

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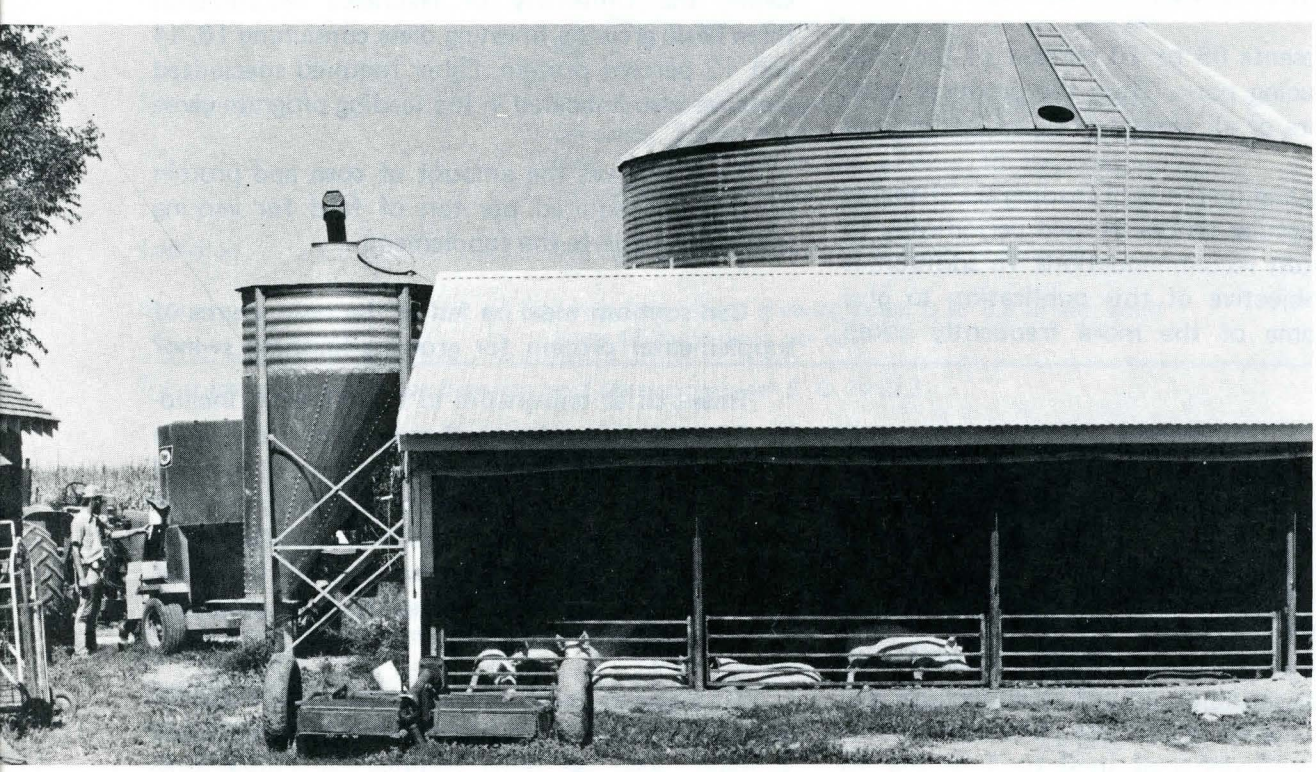
swine diet suggestions



EXTENSION WORK IN "AGRICULTURE, HOME ECONOMICS AND SUBJECTS RELATING THERETO,"
THE COOPERATIVE EXTENSION SERVICE, INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES,
UNIVERSITY OF NEBRASKA-LINCOLN, COOPERATING WITH THE COUNTIES AND THE U. S. DEPARTMENT OF AGRICULTURE
J. L. ADAMS, DIRECTOR

University of Nebraska
Swine Diet Suggestions

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Feed represents 65 to 70 percent of the total costs of producing pork. Thus, the producer must be keenly aware of all aspects of swine feeding and nutrition.

Since diets and methods of feeding are changing rapidly, this circular will be revised periodically to provide the latest recommendations. In addition, it will be the objective of this publication to give answers to some of the more frequently asked questions.

Protein

What is the relationship between amino acids and protein?

Protein is composed of small units called amino acids. There are 22 known amino acids which occur naturally in protein, 8-10 of which are essential in swine diets for optimum growth, maintenance and reproduction. Cereal grains are relatively low in total protein and deficient in 3 to 4 of the 10 essential amino acids—lysine, tryptophan, methionine and possibly threonine. Soybean meal and commercial protein supplements each increase the level of protein and generally correct amino acid deficiencies and imbalances present in cereal grains.

Amino acid balance and its relationship to protein quality.

A diet that is "balanced" with respect to amino acids would contain the proper level and ratio of the 8-10 essential amino acids required by the pig during a given stage of its life cycle. Quality refers to the amino acid balance and level in relation to a pig's need at a particular stage of growth. The protein of corn and other cereal grains is of a poor quality while protein from soybean meal is of a high quality.

What is the recommended level of protein in the diet for all classes of swine?

A general recommendation is found in Table 1. To simplify the nutritional program required for swine, the University of Nebraska recommends three basic growing-finishing diets containing 16, 14 and 12 percent protein. Other required specialized diets are also indicated in the feeding program given in Table 1.

Table 2 gives the amount of corn and protein supplement required per ton of feed for varying levels of protein in the supplement.

Can soybean meal be fed as the only source of supplemental protein for growing-finishing swine?

Research at universities in the midwest, including Nebraska, has shown that soybean meal is an excellent protein supplement for swine. It is equal to any other source of protein or combination of proteins for swine when properly fortified with vitamins and minerals. Soybean meal by itself contains an adequate balance of amino acids to meet the needs of all classes of swine.

If soybean meal alone contains an adequate balance of amino acids (the building blocks of body protein), why do most commercial supplements contain a variety of protein sources?

There are three major reasons. 1. When a feed manufacturer registers his feed, he lists feedstuffs that he may want to include in it. Then, depending on the price and limits of good nutrition, he substitutes lower for higher priced protein sources; thus, the feed manufacturer is able to pass these economic advantages on to the consumer. 2. Since soybean is highly palatable to swine, the feed

Table 1. General feeding program for all classes of swine.

Diet	*Source*	*Age or size of pig*	*Level of Protein %*
Pre-starter	Commercial	Early weaned or orphan pigs	22
Starter	Commercial	Two weeks of age to 30 lb body weight	18-20
Starter-grower or growing-finishing	Commercial or farm mixed	30-60 lb body weight	16
Growing-finishing	Commercial or farm mixed	60-130 lb or market weight	14
Growing-finishing	Commercial or farm mixed	130 lb to market weight	12
Pre-gestation and gestation[a/]	Limit feed gilts and sows about 4 lb per head per day. In extreme cold weather and/or for females in poor condition a level of 5 to 6 lb is suggested. Flush gilts by full feeding or hand feeding 6 to 8 lb per day two weeks prior to breeding. Two to three weeks prior to farrowing, feeding level should be increased 1 lb per head per day.		14
Farrowing	Reduce feed intake slightly 4 to 5 days before and after farrowing. Laxative rations, those containing 10-15% beet pulp, should be fed starting 10 days before farrowing and during the first week of lactation.		14-16
Lactation	Self-feed during lactation or hand-feed to appetite.		14-16
Boars	Limit feed young growing boars 5 to 5.5 lb and adult boars 4.5 lb per head per day.		14

[a/] *For more information on Breeding Herd Management, see E. C. 74-212*

Table 2. Corn and protein supplement per ton of feed with varying levels of protein.

Percent protein in supplement	*Percent protein ration*		
	16%	*14%*	*12%*
36 Corn or Milo[a/]	1,471 lb	1,618 lb	1,765
Supplement	529	382	235
Lb of grain/lb sup.	2.8	4.2	7.5
40 Corn or Milo[a/]	1,538	1,667	1,795
Supplement	462	333	205
Lb of grain/lb sup.	3.3	5.0	8.8
44 Corn or Milo[a/]	1,591	1,705	1,818
Supplement	409	295	182
Lb of grain/lb sup.	3.9	5.8	10.0

[a/] *Where protein content of milo is 9% or greater (see page 9 for explanation)*

manufacturer usually adds less palatable ingredients, such as alfalfa meal, to help control supplement consumption for producers who feed supplement free choice with grain. 3. Habit! Animal proteins were once considered to be better than plant proteins.

Is it practical to supplement swine diets with amino acids?

Sometimes yes, sometimes no. Under certain economic conditions, it is practical to supplement lysine directly. We recommend that not over 100 lb of 44% soybean meal be replaced per ton of diet. A rule of thumb is that 2.75 lb of actual lysine (100% pure) and 97.25 lb of corn can replace 100 lb of 44% soybean meal per ton of diet. A common source of lysine is L-lysine monohydrochloride which is 78% lysine. At present it is not economically feasible to supplement practical swine diets with tryptophan and threonine. Recent evidence indicates that supplementing practical swine diets with methionine does not improve performance and in some instances depresses performance.

If the price of meat and bone meal and/or tankage is the same as soybean meal on a protein basis, can meat and bone meal and/or tankage be fed as the only source of protein?

Research at the University of Nebraska indicates that high levels of meat and bone scraps in the diet reduce growth rate for finishing swine. Our general recommendation is that meat and bone meal and/or tankage should not exceed 5% of the diet or 25% of the protein supplement. Obviously, economics will play a major role in the level of these protein sources to be fed. Potential problems with some sources of animal protein are the possible presence of disease organisms such as salmonella and variation in quality and analysis from batch to batch.

Is there a difference in uniformity of product between protein sources?

Animal proteins vary more in composition and quality than do plant proteins. Meat and bone meal and tankage are by-products of the meat packing industry. Thus, composition of these two products depends upon the classes of animals slaughtered. Methods of processing also influence the quality of animal proteins. Plant proteins, on the other hand, are more uniform because they are made from only one product. Too, methods of processing plant proteins have been standardized and the same kind of product can be produced year in and year out. However, improper processing can, and sometimes does, occur in the production of plant proteins. Such instances are exceptions rather than the rule.

Does protein poisoning occur?

No. Extremely high protein levels may cause looseness in pigs, but these protein levels are not usually associated with a sick or poisoned condition.

How can I determine the most economical protein level to feed growing-finishing pigs when corn and soybean meal prices vary?

Figures 1, 2, and 3[1/] can be used to determine the most economical protein levels to feed growing-finishing pigs based on corn and soybean meal prices. For example, in Figure 1, if corn is $3 a bushel, and soybean meal is $200 per ton, we arrive at point (a) via the dotted lines. This point is in the 16% area of the chart. Thus, at these corn and soybean meal prices, a 16% ration would take these pigs from 40 to 100 pounds at a lower cost than would a 14 or an 18% diet. Figures 2 and 3 are applicable to pigs weighing 100-170 pounds and 170-250 pounds, respectively.

If the point arrived at is on the boundary line, the higher protein diet may be chosen because the pig would probably reach market weight at the same time or sooner for the same cost. Other alternatives that could be chosen are:

1. Feed the higher protein ration while the pigs are in the lower part of the weight range, and then start feeding the lower protein ration when they reach the upper part of the weight range.
2. Consider feeding a diet with a protein level which is between the two levels of protein on each side of the boundary line.
3. If a new group of pigs is not waiting for the facility, and if the producer has extra time to care for the pigs, the lower protein level could be chosen.

The figures consider the added costs of slower gaining pigs resulting from the lower protein diets. Producers who have a loose production schedule and the extra time can feed a slightly lower protein level than those shown in the charts.

[1/] Bitney, Larry L. and Bobby D. Moser. 1974. Feed prices and protein levels for pigs. Nebraska Swine Report, pp. 3-4.

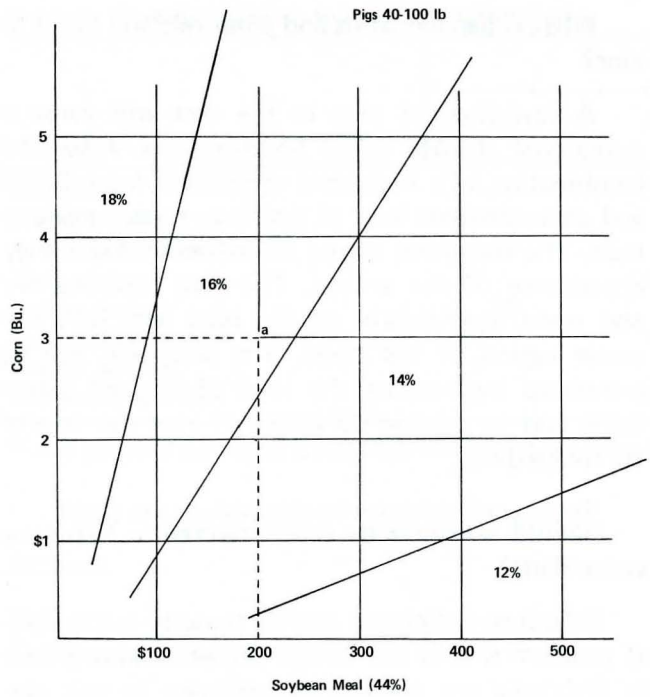

Figure 1. Suggested protein levels for growing-finishing rations, based on corn and soybean meal prices, for pigs from 40-100 pounds.

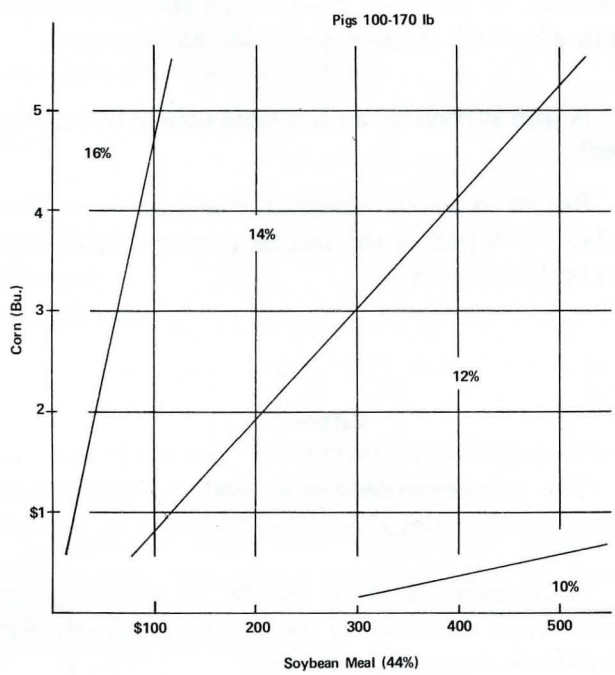

Figure 2. Suggested protein levels for growing-finishing rations, based on corn and soybean meal prices, for pigs from 100-170 pounds.

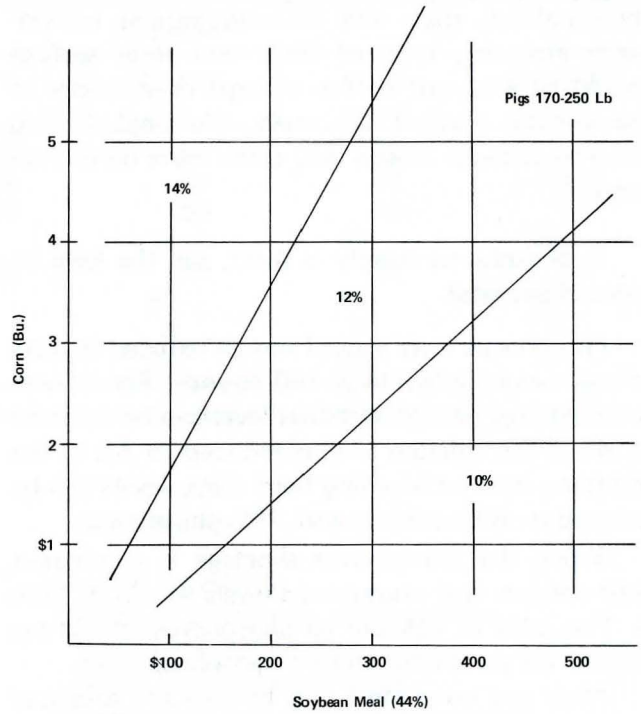

Figure 3. Suggested protein levels for growing-finishing rations, based on corn and soybean meal prices, for pigs from 170-250 pounds.

Minerals

What minerals and what level of each should be included in rations for swine?

See Table 3 for minerals and levels of each to include in swine rations.

How should the minerals be fed — as part of a complete ration, part of a protein supplement or self-fed free choice?

Many instances have been reported in Nebraska where swine fed free choice have overeaten or undereaten minerals. If we wish to make sure that pigs meet their daily requirement for minerals, but do not exceed these, minerals should be fed in a completely mixed diet.

What occurs if high levels of minerals are fed?

If the level of calcium in the ration exceeds 0.8% in growing-finishing diets, there may be a decrease in pig gains and feed conversion. Most commercial protein supplements are balanced in minerals to meet the pig's needs when supplement is combined with grain according to the manufacturer's recommendations. Minerals should not be

added haphazardly. If problems develop such as leg abnormalities, diets and all management components including type of floor and floor surface should be analyzed before changes or additions in the mineral content are made. Warning! Adding minerals without reason may cause more harm than good.

If phosphorus supply is short, can the level be reduced in diets?

Phosphorus level should not be reduced in diets of pigs weighing less than 150 pounds. For heavier finishing pigs, the phosphorus level can be reduced to .4% if the calcium level is reduced to .5% of the complete diet. In breeding herd diets, levels can be reduced to .80% calcium and .70% phosphorus.

When the phosphorus shortage is eliminated, feed calcium and phosphorus levels shown in Table 3. The ratio of calcium to phosphorus should not exceed 1.3 parts calcium to 1 part phosphorus.

Meat and bone meal may be used as a source of supplemental phosphorus. The growing-finishing pig from 30 pounds to slaughter weight requires about .50% phosphorus in a complete diet. For example, this phosphorus requirement can be met with corn, soybean meal and 5% of the total diet in the form of meat and bone meal, thus eliminating the need for a source of supplemental phosphorus. Remember, though, that proper supplemental levels of other minerals such as calcium and trace elements must be supplied to the diet also.

The fluorine content of fertilizers should be determined before using them for a source of phosphorus. Fluorine content in a complete swine diet should not exceed 100 ppm. Addition of 8 pounds of a fertilizer containing 2.5% fluorine to a ton of a complete swine diet would give 100 ppm. When phosphorus supplies are adequate, producers should use the standard sources of feed phosphorus.

Are mineral supplements available which will allow you to add phosphorus to the ration without adding calcium too?

There are several commercial compounds that contain phosphorus hut no calcium. Three compounds generally recommended are monosodium phosphate and sodium tri-poly phosphate (about 25% phosphorus) and disodium phosphate (about 21% phosphorus). The non-protein nitrogen in ammonium phosphate restricts its use in swine diets.

What is parakeratosis and what relation has it to zinc?

A low level of zinc in the diet will cause a nutritional disease called parakeratosis. Also, the combination of a high level of calcium (over 0.8%) and an inadequate level of zinc may cause parakeratosis. The condition can be identified by the mangy appearance of the animal. The skin becomes dry and scaly, particularly on the hind legs, tail, and under region of the body. The condition can be prevented by keeping the level of calcium below 0.8% and by adding 90 grams of zinc per ton of complete diet.

Should selenium be supplemented in Nebraska swine diets?

Selenium deficiency and/or toxicity is a regional problem within the United States. Grains grown in Nebraska are considered adequate in this element. Some areas of northeast Nebraska have a history of too high selenium content. Therefore, swine diets containing Nebraska grown feed grains should be adequate in selenium. If selenium supplementation is needed, it can be legally added up to .1 ppm of a complete swine ration. However, in Nebraska, if selenium is added to complete swine diets, a level of .05 ppm is considered adequate.

Is iron carbonate an available source of iron for pigs?

Recent research indicates that iron from iron carbonate is poorly utilized by pigs. Iron sulfate is an excellent source.

Vitamins

The recommended total levels of vitamins in swine rations from all sources are given in Table 4.

How much carotene should be considered in grains when determining the amount of supplemental vitamin A to add in the diet?

Vitamin A and carotene are easily destroyed by heat and light. This results in varying levels of carotene between grain samples. Thus, in diet formulation, we consider that corn, milo and other cereals contain no carotene.

Table 3. Minerals and levels to include in swine diets.

Mineral	*Pig weight*				
	10-30 lb	*30-50 lb*	*50-125 lb*	*Market weight*	*Breeding[a] stock*
Calcium %	.70	.65	.65	.65	.90
Phosphorus %	.60	.50	.50	.50	.80
Salt % (chlorine & sodium)	.50	.50	.50	.50	.50
Zinc, gm/ton	90	90	90	90	90
Iodine, gm/ton	.20	.20	.20	.20	.20
Iron, gm/ton	90	90	90	90	90
Copper, gm/ton	9	9	9	9	9
Manganese, gm/ton	25	25	25	25	25

[a] *4 lb per head per day of a complete diet during pre-gestation and gestation; full-feed of a complete diet during lactation.*

What are the sources of minerals for swine?

Mineral	*Source*
Calcium	Ground limestone
Calcium and phosphorus	Dicalcium phosphate, monocalcium phosphate, defluorinated phosphate, steamed bone meal
Phosphorus	Monosodium and disodium phosphate, sodium tri-poly phosphate, others
Sodium and Chlorine	Salt
Iodine	Iodized salt, trace mineralized salt, and trace mineral mixes
Iron (baby pigs)	Iron injections, clean soil, pills or paste containing iron
Iron (growing and mature pigs)	Iron sulfate, trace mineral mixed, trace mineralized salt
Zinc	Zinc carbonate, zinc sulfate, trace mineral mixes, trace mineralized salt
Cobalt, potassium, magnesium, sulfur	Usually adequate in natural feedstuffs
Copper	Copper sulfate, Copper oxide
Manganese	Manganese oxide, Manganese sulfate

Are there any differences in stabilized vitamin A between commercial feeds?

Generally not. Most commercial companies fortify their feed with a stabilized form of vitamin A. The stabilized form of vitamin A is active over an extended period of time.

Should vitamin E be added to Nebraska swine diets?

Vitamin E and selenium are interrelated and present in adequate amounts in Nebraska grown feedstuff. Vitamin E and selenium are both antioxidants. Vitamin E spares selenium. Leafy alfalfa hay is an excellent source of vitamin E.

Should choline be supplemented in swine diets?

Yes. Research indicates that supplementing choline at a level of 700 grams per ton of complete feed during gestation increases number of live pigs born and weaned. Choline Supplementation is recommended at a 200 gram level per ton of complete feed in growing-finishing swine diets. This level supports maximum gain. Higher levels of choline for the growing-finishing pig have not

Table 4. Recommended total levels of vitamins in swine diets.

Vitamin	Pig weight			
	10-30 lb	*30-50 lb*	*50 lb to market*	*Breeding stock* [c]
Vitamin A (million IU)[a]	4	3	3	5 [b]
Vitamin D (million IU)[a]	.72	.40	.40	.40 [b]
Riboflavin (gm)	4	3	3	3 [b]
Niacin (gm)	20	16	16	30 [b]
Pantothenic acid (gm)	20	16	16	24 [b]
Choline (gm)	900	700	700	1,300 [b]
Vitamin K[d] (gm)	2	2	2	2 [b]
Vitamin B_{12} (mg)	40	20	10	30 [b]

a/ IU or USP units.

b/ See Table 10 for levels to be added to corn-soybean meal rations.

c/ Four pounds per head per day of a complete diet during pre-gestation and gestation; full-feed of a complete diet during lactation.

d/ Menadione sodium bisulfite (MSB) or equivalent.

corrected the condition of "shakers" or "spraddlers" in field tests. Recent evidence would indicate that this condition may be caused by a virus or combination of viruses.

What is biotin and should swine diets contain supplement levels?

It does not appear that biotin, sometimes called vitamin H, is deficient in normal swine diets used in the corn belt. Symptoms of biotin deficiency are non-specific and resemble those of a number of conditions or diseases.

What value does live cell yeast have as a source of vitamins or as a source of other feed ingredients for swine?

Live yeast is a good source of protein and the B vitamins. There are no "magic" factors in live yeast which will make pigs grow faster than those fed a balanced diet. From a practical standpoint, the relative cost of B vitamins from live yeast must be competitive with B vitamins from a commercial protein supplement or a vitamin premix before being considered.

How about the use of electrolytes?

Electrolytes appear to have a beneficial role in pigs dehydrated as a result of diarrhea or dysentery. Other than a disease situation, electrolytes have no particular value over elements present in a balanced swine diet.

When buying vitamins and minerals, should they be bought in separate premixes or together in the same mix?

Some vitamins are destroyed when in contact with minerals over a prolonged period of time. Therefore, we recommend that vitamins and minerals be bought in separate premixes. If the vitamins and minerals are purchased in one premix they should be used within 30 days of purchase. Vitamin and mineral premixes should be stored in a cool, dry and dark place.

What is the approximate cost of adding premixes to corn-soybean rations and where can they be obtained?

The cost of a premix containing only vitamins will vary up to $6 per ton of complete feed. The cost of a premix containing both vitamins and minerals may cost $6 to $8 per ton of complete feed. Addresses of companies selling premixes in Nebraska are available at your County Extension office or the Animal Science Department.

With the metric system being adopted, the following table lists commonly used conversion factors:

1 pound = 454 grams
1 ounce = 28.4 grams

1 gram = 1,000 milligrams
1 milligram = 1,000 micrograms
1 microgram per gram = 1 part per million
.6 microgram of B carotene = 1 IU of Vitamin A

To convert milligrams per gram to milligrams per pound, multiply by 454.

To convert micrograms per gram or per pound to milligrams per gram or per pound, divide by 1,000.

To convert milligrams per pound to micrograms per gram or parts per million, divide by .454 or multiply by 2.2. These conversion factors are particularly useful in mineral and vitamin formulation.

Feed Additives

What antibiotics should be fed and at what levels?

The response to specific antibiotics varies considerably due to disease level, kind, level of antibiotics, season of year, and other environmental factors. As a result, rotation of antibiotics and use of mixtures seems to be more effective than antibiotics used singly and/or continually. Rotation may be yearly or with changes in protein levels.

Antibiotics should not be used to replace good management.

What are the recommended levels of antibiotics per ton of complete feed?

Table 5 gives recommended levels of antibiotics.

Table 5. Recommended levels of antibiotics.

Ration	*Grams per ton*
Starter	100-250 gm
Grower (16%)	50-250 gm
Growing-Finish (14%)	20-50 gm
Growing-Finish (12%)	0 or 20 gm

How about feeding antibiotics to the breeding herd?

Several experiments have been conducted where high levels of antibiotics were fed before breeding and after breeding to determine effect on conception rates and litter size. Results have been variable. However, in instances of poor litter size and low conception rate there has been a positive response to antibiotics. The minimum suggested level is 200 grams per ton of complete feed or about ½ gram per sow per day.

When should arsenicals be used in the ration?

Besides their growth-promoting effect, arsenicals may also help where scours is a problem. Arsenicals can be added in the form of arsanilic acid, 90 grams per ton of complete feed, or 3-nitro-4-hydroxy phenylarsonic acid (3-nitro) at 22.7 grams per ton of complete feed.

Table 6. Withdrawal time for additives in swine feeds.

Feed additive	*Time or weight of pig*
Arsanilic acid	5 days
ASP 250	7 days
Aureomycin (Chlortetracycline)	none
Bacitracin	none
Iodinated Casein	none
Neomycin Sulfate	none
Roxarsone (3 Nitro)	5 days
NF 180 or Furox (Furazolidone)	none
Dichlorvos (Atgard)	none
Piperazine	none
Banminth	24 hours
Tramisol	72 hours
Penicillin	none
Terramycin (Oxytetracycline)	none
Tylan (Tylosin)	none
Tylan and Sulfa (Tylosin and Sulfamethazine)	5 days
Mecadox (Carbadox)	75 lb.-10 weeks (whichever is applicable)

What are the withdrawal periods for feed additives?

Feed tags are required by law to state any withdrawal required when feed additives are contained in the feed. Withdrawals must be followed to insure carcasses free from residuals. Some common withdrawal periods are listed in Table 6.

Feed Grains

What are the feeding values of grains other than corn when fed to swine?

Feeding values of grains other than corn when fed to swine are given in Table 7.

Although some feed grains may produce the same gains as corn, the amount of feed required to produce a unit of gain may be greater, as in the case of milo (5% more).

What limits the use of oats in swine finishing diets?

The high fiber content of oats (12%) reduces the energy content of rations and consequently results in reduced growth rate and feed efficiency of growing-finishing pigs when oats exceeds 20% of the diet. Young pigs (up to 100-125 lb) should be fed high energy rations to produce maximum lean pork efficiency. Oats is an excellent feed grain, particularly for brood sows.

What rule should you follow when replacing corn with milo in a corn-soybean diet?

A good procedure is to substitute milo for corn pound for pound if the protein content of the milo is greater than 9%. If the protein content of milo falls below 9%, recalculate your diets on a protein basis. It is usually profitable to have your milo analyzed for protein content.

Table 7. Feeding values of grains other than corn.

Grain	*Feeding value as compared to corn*
Corn	100%
Milo	97%
Wheat	100%
Barley	90%
Rye	85%
Oats	80%
Millet	93%

If economics favor the feeding of wheat to swine, what proportion of wheat to corn will provide best feed conversion and gain?

Wheat is an excellent feed grain for swine. It can replace part or all of the corn pound for pound in a swine diet without affecting performance. Since wheat tends to flour, it should be coarsely ground. If ground too fine, the palatability may decrease and result in lowered performance. Growth rate apparently is not affected by fine grind.

What is high lysine corn?

Opaque-2 (high lysine) corn is higher than regular corn in all the essential amino acids except leucine where it is lower. High lysine corn is especially higher in lysine and tryptophan. Since the lysine content of high lysine corn may vary, it is suggested that the high lysine corn be analyzed for lysine content. When using mechanical drying, high lysine corn drys more rapidly than normal corn. Therefore, if high lysine corn is being mechanically dried for storage, corn moisture should be watched carefully. High lysine corn should be ground coarser than normal corn. A ½" screen is suggested. Some producers prefer a roller mill for processing high lysine corn.

If high lysine corn contains .38% lysine or higher on an 86% dry matter basis or .44% lysine or higher on a 100% dry matter basis, the following recommendations are suggested when feeding high lysine corn:

1. Reduce growing-finishing rations 2% in crude protein below the protein level being fed in rations containing normal corn.
2. Feed a pre-gestation and gestation diet containing 12% protein.
3. Feed a lactation diet containing 14% protein.

If swine producers consider growing high lysine corn, they must evaluate such economic factors as the yield of high lysine corn and the price of normal corn and supplemental protein.

Methods of Feeding

The main methods of feeding swine are (1) grain and supplement free choice, (2) complete rations either full-fed or limited-fed, and (3) liquid feeding.

The authors prefer the use of complete diets

because the producer can be sure of better control of protein, mineral and vitamin problems. Over-consumption of protein supplement is eliminated. Each pig gets a balanced ration with every pound of feed. Although complete feeds are preferred, grain and protein supplement, self-fed free choice, is still an economical practice particularly if mixing and grinding equipment is not readily available.

Will it pay to mix and formulate diets on the farm?

One method of mixing a complete diet is by mixing ground corn with a commercial protein supplement in proportions suggested by the manufacturer or as suggested in Table 2. The mixing can be done either commercially or with a mixer-grinder. A self-unloading wagon does a poor job of mixing corn and supplement.

A second method is to use the feeding program suggested in this circular. This requires the producer to buy all ingredients indicated in those rations used in Tables 8, 9, and 11 and to do a thorough job of mixing.

Many factors are involved in the success of home mixing. Some of these include the efficiency of grinding, mixing, size of operation, quality of feed, availability of ration ingredients and labor. There will not be much cost saving in mixing your own rations unless (1) you can buy 44% soybean meal for at least $20 a ton less than good 40% supplement and unless (2) you can buy minerals, vitamins, and antibiotics to fortify a ton of complete ration for $6 to $10.

In addition, feed manufacturers today offer a service program for swine producers that can be invaluable to a swine enterprise.

Can I mix my own protein supplement?

Yes. Simply remove the grain from the appropriate diet in Tables 8, 9 and/or 11 and determine the proportion of each remaining ingredient. These proportions can be used to mix any volume of the supplement desired.

Should feed be limited to growing-finishing hogs, and if so, at what weight should you start?

The question must be answered on an individual farm basis. There are two possible reasons for limiting feed for finishing hogs. These are (1) the amount of feed required to produce a pound of gain may be reduced by 5% to 15% and (2) the backfat thickness can be reduced 0.1 inch at 200 pounds.

The economic advantages here will depend upon the extra investment required in automatic feeding systems and housing. Also, limited feeding will increase the time required for pigs to reach market weight. Thus, reduced feed costs may be offset by increased investment and a longer feeding time.

If limited feeding is planned, pigs should weigh about 125 pounds before feed intake is reduced. Feed intake may be reduced by feeding 70 to 80% of full feed or feeding a constant amount of 5 pounds per pig daily to market weight. Limited feeding is not widely practiced in the U.S. for G-F swine.

What are the advantages and disadvantages of liquid feeding for growing-finishing swine?

Research conducted at universities throughout the country shows little or no difference in feed efficiency between dry and liquid feeding of market hogs. In these tests feed wastage was controlled in the dry feeding system. It is possible under farm conditions when feed wastage is a problem that liquid feeding may reduce this wastage and as a result improve efficiency. However, it may be less costly to correct the wastage problem than to buy new equipment. Possible advantages of liquid feeding may be increased feed consumption in pigs after weaning and no investment in pen waterers. Possible disadvantages are the extra cost of liquid feeders and the requirement of semi-controlled environment during the winter. Also for optimum growth rate and feed conversion strict management is necessary to maintain the proper water/feed ratio. The so-called increased contentment of pigs on liquid feeding has not been generally observed.

What influence does fineness of grind have on pig performance?

Varying results have been reported due to (1) age of the pig, (2) method of processing, (3) type of grain, and (4) amount of feed wastage. Generally, the young pig (20 to 50 lb) will convert feed grain more efficiently when feed is ground fine (¼" screen) whereas little value is received with older pigs (75 lb to market weight) with fine grinding. However, fine grinding tends to increase feed wastage and increase the incidence of gastric ulcers.

From a practical standpoint it appears that a medium grind (3/8" to 1/2" screen) will give the best total results. Milo and millet should be cracked.

What is the feed value of high moisture corn?

High moisture corn is similar in feed value to regular corn on a dry matter basis. High moisture corn is usually fed free choice. Protein, vitamins, and minerals can be supplemented by either hand feeding daily or feeding free choice in separate feeders. If high moisture corn is fed in a complete diet, diets should be prepared frequently (every 1 or 2 days) to prevent spoilage. Diets also should be prevented from bridging in the feeders. *The major factor to consider in deciding to feed high moisture corn is how the producer desires to harvest and store his corn.*

Diets for Various Classes of Swine

Baby Pig Diets

Orphan Pig Diets. There is no replacement for the sow's colostrum. If the newborn pig does not receive colostrum, he has a lesser chance for survival. An orphan pig can obtain colostrum by being placed with another sow that has just farrowed. If there is not another sow available the orphan pig can be fed a milk replacer. Commercial milk replacers are available. A homemade milk replacer can consist of a mixture of the following:

1 quart milk
1 pint half-and-half
1 raw egg

Portions of this mixture can be fed about every three hours. The orphan pig can be fed a dry 22% pig starter from 5-7 days of age until about 2-3 weeks of age. At this time he can be switched to a 20 or 18% pig starter.

Starter Diets. The complexity of good starter diets plus the small amount consumed are primary factors responsible for recommending commercial pig starter rations. If you wish to mix your creep feed, rations in Table 8 are suggested. Creep feed an 18% starter ration until weaning or 30 pounds.

The 16% starter-grower ration may be more acceptable to the pig when changing from a complex starter to a simple corn-soy ration. Also, it can be used for slow growing pigs which are beyond the starter stage.

Growing-finishing Diets

Diets for the growing-finishing pig are found in Table 9.

Some possible substitutions when using these rations are:

1. Milo, wheat or millet can be substituted for corn pound for pound. If milo contains less than 9% protein, substitute on a protein basis.
2. Forty-eight and one half percent soybean meal can be substituted for 44% soybean meal by substituting 88 pounds of 48.5% soybean meal and 12 pounds of corn or milo for each 100 pounds of 44% soybean meal.
3. Dehydrated alfalfa meal is included as a nutrient safety factor in these rations. Therefore, if excellent mixing is available, dehydrated alfalfa can be replaced by corn pound for pound provided adequate vitamin and mineral supplements are available.
4. Iodized salt and trace minerals can be replaced by trace mineralized salt so that it will supply 90 grams of zinc and 90 grams of iron, 0.2 gram of iodine, and 10 pounds of salt per ton.
5. Leafy ground alfalfa hay can replace dehydrated alfalfa meal.

Pre-gestation, Gestation, Lactation Diets

Pre-gestation, gestation and lactation diets are found in Table 11.

The success of limited-fed sows and gilts depends upon controlling the intake of each female. Care must be taken to see that each gets her share. Individual sow feeding stalls are effective devices for controlling boss sows. Also, interval feeding has had good success.

If constipation is a problem before and immediately after farrowing, feed a diet containing 10 to 15% beet pulp as shown in Table 11.

How Are Sow Diets Adjusted for Limit Feeding?

Diets for a gestating sow must meet her daily requirements for all essential nutrients. When limit feeding, energy is the only factor which should be limited. The daily allowance for protein is 0.55 to 0.60 pounds. This allowance can be met by feeding 4 pounds of a 14% protein diet per head per day. Feeding levels lower than 4 pounds per head per day requires a higher protein percentage. Daily nutrient requirements for minerals and vitamins are given in Tables 12 and 13.

Table 8. Rations for various classes of swine.

Ingredients	Percent protein [a] 22 Pre-starter	18 Simple starter	18 Starter-grower	16 Starter-grower
Sugar (beet or cane)	15.00	10.00	--------	--------
Ground yellow corn	19.35	33.50	54.58	69.10
Ground oats	5.00	10.00	--------	--------
Ground wheat	5.00	--------	--------	--------
44% soybean meal	4.00	--------	30.00	18.70
Dried skimmilk	40.00	26.00	--------	--------
Dried whey	--------	10.00	5.00	2.50
Dried fish solubles	5.00	2.50	2.50	2.50
Dried brewer's yeast	1.00	1.00	1.00	--------
Lard or fat (stabilized)	2.50	2.50	2.50	2.50
Dicalcium phosphate	0.10	1.25	1.12	1.50
Monosodium phosphate	0.40	--------	--------	--------
Ground limestone	--------	0.60	0.70	0.60
Trace mineral mix[b]	0.15	0.15	0.15	0.10
Salt (iodized)[b]	0.50	0.50	0.50	0.50
Vitamin-antibiotic mix	2.00[c]	2.00[d]	2.00[d]	2.00[e]
	100.00	100.00	100.00	100.00

[a] *All rations are calculated to contain 0.7% calcium and 0.6% phosphorus.*

[b] *The trace mix and/or iodized salt should supply: 90 grams of zinc; 0.15 to 0.20 grams of iodine; 90 grams of iron; 9 grams of copper; 25 grams of manganese and 10 pounds of salt per ton of feed.*

[c] *Added at the following rate per pound of ration: Vit. A, 2,000 I.U.; Vit. D_2, 180 I.U.; Vit. B_{12}, 20 mcg; riboflavin, 1.0 mg; calcium pantothenate, 3.0 mg; choline chloride, 80.0 mg; thiamine, 2.0 mg; niacin, 6.0 mg; pyridoxine, 2.0 mg; Vit. E, 1.0 mg; MSB, 1.0 mg and antibiotics, 50-125 mg.*

[d] *Added at the following rate per pound of ration: Vit. A, 2000 I.U.; Vit. D_2, 180 I.U.; Vit. B_{12}, 20 mcg; riboflavin, 1.5 mg; niacin 10.0 mg; calcium pantothenate, 2.0 mg; choline chloride, 100.0 mg; MSB, 1.0 mg and antibiotics, 50-125 mg.*

[e] *Added at the following rate per pound of ration: Vit. A, 1500 I.U.; Vit. D_2, 180 I.U.; Vit. B_{12}, 7.5 mcg; riboflavin, 1.5 mg; niacin, 4.0 mg; calcium pantothenate, 4.5 mg; choline chloride, 50.0 mg; MSB, 1.0 mg and antibiotics, 25-125 mg.*

Note: MSB (Menadione Sodium Bisulfite, or equivalent) may be used as a source of Vitamin K.

Table 9. Diets for various classes of growing-finishing swine.

	% Protein 18	17	16	15	14	13	12	11	10
Ground corn or milo	1352	1410	1471	1530	1583	1643	1700	1756	1812
44% soybean meal	523	465	410	350	296	236	178	122	65
17% dehydrated alfalfa	50	50	50	50	50	50	50	50	50
Ground limestone	13	13	17	16	16	15	15	14	14
Dicalcium phosphate	30	30	20	22	23	24	25	26	27
Salt (iodized)[a]	10	10	10	10	10	10	10	10	10
Trace mineral mix[a]	2	2	2	2	2	2	2	2	2
Vitamin-antibiotic premix[b]	20	20	20	20	20	20	20	20	20
Total (lb)	2000	2000	2000	2000	2000	2000	2000	2000	2000

[a] *The trace mineral mix and/or iodized salt should supply: 90 grams of zinc; 0.15-0.20 grams of iodine; 90 grams of iron; 9 grams of copper; 25 grams of manganese and 10 pounds of salt per ton of feed.*

[b] *Composition of vitamin premix shown in Table 10.*

Table 10. Recommended vitamin additions per ton of feed.

	Growing-finishing				
	% Protein				
	18-17	*16-15*	*14-13*	*12-11-10*	*Breeding stock*
Vitamin A, I.U.	4,000,000	3,000,000	2,400,000	2,400,000	5,000,000
Vitamin D_2 or D_3 I.U.	400,000	400,000	400,000	400,000	400,000
Riboflavin	3.0	2.0	2.0	2.0	5.0
Niacin, gm	20.0	16.0	16.0	16.0	30.0
Pantothenic acid, gm	9.0	9.0	6.0	6.0	12.0
Choline, gm	200.0	200.0	200.0	200.0	700.0 or 300[a]
Vitamin B_{12}, mg	40.0	20.0	10.0	10.0	30.0
Vitamin K, gm[b]	2.0	2.0	2.0	2.0	2.0
Antibiotics, gm	100-250	50-250	20-50	0-20	Variable

[a] *Choline, 700 gm during gestation, 300 gm during pre-gestation and lactation.*

[b] *MSB (menadione sodium bisulfite or equivalent).*

Table 11. Suggested rations for pre-gestation and lactation.

Ingredient	*14% Protein Pre-gestation and gestation (limited-fed)*				*15% Protein Lactation (full-fed)*		
Ground milo or corn	1544 lb	------	------	449 lb	1263 lb	------	1257 lb
Ground ear corn	------	1553 lb	------	------	------	1533 lb	------
Ground oats	------	------	1749 lb	------	------	------	302
Soybean meal (44% protein)	300	353	159	104	349	373	347
Dehydrated alfalfa meal (17% protein)	50	------	------	------	100	------	------
Alfalfa hay (15% protein)	------	------	------	1320	------	------	------
Ground dried beet pulp	------	------	------	------	200	------	------
Ground limestone	6	11	10	------	4	12	12
Dicalcium phosphate	58	51	50	4	52	50	50
Monosodium or Sodium tri-polyphosphate	------	------	------	41	------	------	------
Salt (iodized)[a]	10	10	10	10	10	10	10
Trace minerals[a]	2	2	2	2	2	2	2
Vitamin premix[b]	20	20	20	20	20	20	20
	2000 lb	2000 lb	2000 lb	2000 lb	2000 lb	2000 lb	2000 lb

[a] *The trace mineral mix and/or iodized salt should supply: 90 grams of zinc, 0.15-0.20 grams of iodine, 90 grams of iron, 9 grams of copper, 25 grams of manganese and 10 pounds of salt per ton of feed.*

[b] *See Table 10.*

Boar Diets

Boars can be fed the pre-gestation and gestation diets in Table 11.

Alfalfa in Swine Diets

Should alfalfa be considered in formulation of swine diets?

Yes. Gestation diets containing from 25 to 96% alfalfa hay have supported good reproductive performance. High levels of alfalfa hay can be fed most accurately when mixed with other ration components in a pelleted diet. However, the cost may not justify feeding a pelleted diet. Therefore, if diets contain more than 66% alfalfa hay, feed the proper daily level of ground alfalfa hay plus 1 pound of a corn-vitamin-mineral mixture per head per day. In this example, the proper levels of supplemental vitamins and minerals have been mixed with ground corn, which serves as a carrier. The alfalfa hay is fed separately from the corn-vitamin-mineral mixture.

If diets contain 66% alfalfa hay or less, alfalfa hay can be fed as a ground mixture with other additional needed diet constituents. Dehydrated alfalfa meal should not exceed 25% of the gestation diet.

Alfalfa is often added in growing-finishing swine diets at the rate of 2.5% of the total diet. This level serves as a safety factor to help insure the presence of certain vitamins, minerals and unidentified growth factors. Higher levels of alfalfa in the growing-finishing diet depend on the price of the supplemental protein source, energy source, such as corn, and the performance obtained.

Table 12. Mineral needs of bred sows (daily requirements).

Mineral	*N.R.C. requirement*	*Nebraska's allowances*
Calcium gm/day	15.0	16.0
Phosphorus gm/day	10.0	14.5
Salt, gm/day	10.0	10.0
Zinc, mg/day	90.0	180.0
Iodine, mcg/day	364.0	400.0
Copper, mg/day	11.0	18.0
Iron, mg/day	------	180.0
Manganese, mg/day	36.0	50.0

Table 13. Vitamin needs of bred sows (daily requirements).

Vitamin	*N.R.C. requirement*	*Nebraska's allowances*
Vit. A, IU/day	8,200	10,000
Vit. D, IU/day	500	800
Riboflavin, mg/day	8.2	12.0
Niacin, mg/day	44.0	60.0
Pantothenic Acid, mg/day	33.0	36.0
Choline, mg/day	------	1,800.0
Vit. B_{12} mcg/day	28.0	60.0
Thiamine, mg/day	2.8	4.0
Vit. K (menadione sodium bisulfite) mg/lb.	------	4.0

Table 14. Feed analysis.

Feedstuffs	*Protein* %	*Metabolizable energy, Kcal/lb*	*Fiber* %	*Calcium* %	*Phosphorus* %	*Ribo-flavin*	*Niacin*	*Pantothenic acid*	*Choline*	*Lysine* %
						---------- Mg/lb ----------				
Alfalfa meal (dehydrated)	17	600.0	24.3	1.30	.24	6.5	20.0	13.6	680	.80
Alfalfa meal	20	920.0	20.2	1.50	.27	7.0	24.0	14.9	730	.90
Alfalfa hay (early bloom)	16	620.0	27.0	1.20	.28	5.4	19.0	9.0	550	.60
Barley	11.5	1350.0	8.0	.08	.42	.9	26.0	3.0	460	.40
Beet pulp	9	1200.0	19.0	.68	.10	.3	7.0	.7	370	.60
Corn (yellow)	8.9	1550.0	2.5	.02	.28	.5	10.0	2.2	240	.25
Corn & cob meal (yellow)	8	1330.0	8.5	.04	.27	.4	9.0	2.0	160	.18
Fish meal, medhaden	65	1170.0	1.0	4.50	2.40	2.5	28.0	3.0	1300	4.80
Meat & bone scraps	50	1106.0	2.5	10.00	5.00	1.9	21.0	2.0	900	3.00
Millet	12	1225.0	8.0	.05	.28	.7	24.0	3.4	360	.25
Milo (maize)	9	1470.0	2.7	.03	.30	.5	18.0	5.0	310	.28
Molasses, beet	6	1060.0	0.0	.16	.02	1.0	18.0	2.0	400	----
Molasses, cane	3	1060.0	0.0	.50	.08	1.5	16.0	17.0	350	-----
Oats	12	1210.0	11.5	.10	.35	.7	7.0	5.8	420	.40
Oats, feed rolled, oat groats	16	1360.0	3.5	.07	.43	.6	3.7	6.5	500	.10
Rye	12.2	1398.0	2.2	.08	.34	.8	.5	3.3	-----	.45
Skim milk, dried	33	1530.0	0.0	1.25	1.00	9.0	5.0	1.5	500	2.80
Soybean meal (solvent)	44	1282.0	6.5	.25	.60	1.3	12.0	6.5	1200	2.90
Soy meal (solv.) (dehulled)	48.5	1308.0	3.0	.20	.62	1.3	9.6	6.2	1225	3.20
Tankage	60	1200.0	2.2	5.50	3.00	1.0	17.0	1.2	1000	4.00
Wheat, hard	13	1509.0	2.5	.05	.40	.45	24.0	5.0	400	.40
Wheat, bran	15	1055.0	10.5	.12	1.15	1.4	95.0	12.5	500	.60
Wheat, middlings	16	1340.0	7.0	.08	.70	1.0	44.0	8.0	500	.65
Whey, dried whole	12	1450.0	0.0	.90	.75	13.3	5.09	21.0	900	1.00
Dicalcium phosphate	------	------	------	24.00	18.50	------	------	------	------	------
Monocalcium phosphate	------	------	------	20.00	21.00	------	------	------	------	------
Steamed bone meal	------	------	------	28.00	14.00	------	------	------	------	------
Defluorinated rock phosphate	------	------	------	32.00	18.00	------	------	------	------	------
Disodium phosphate	------	------	------	------	21.00	------	------	------	------	------
Monosodium phosphate	------	------	------	------	25.50	------	------	------	------	------
Ground limestone	------	------	------	38.00	------	------	------	------	------	------
Sodium Try-Polyphosphate	------	------	------	------	25.00	------	------	------	------	------