

# MU Guide

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## Vitamin Requirements of Swine

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Vitamins are essential nutrients for swine. The trend toward complete confinement swine production, however, has focused more attention on the need to supplement practical rations with adequate dietary sources of vitamins. This Guide will help swine producers overcome vitamin deficiencies in rations. It is a summary of important aspects of vitamin requirements of swine, with emphasis on meeting the needs of hogs fed practical swine rations in Missouri.

Vitamins are specific chemical compounds or organic nutrients whose major function is to regulate body processes. Vitamins do not form a part of the animal's tissue and are required in smaller amounts than other nutrients such as protein, calcium, phosphorus, carbohydrates and fats. Each vitamin functions in a particular way, and the function of the various vitamins in the body differs widely.

As a starting point, feed manufacturers and hog producers should use the National Research Council's

(NCR) "Nutrient Requirements of Swine" as a basis for vitamin supplementation.

Table 1 lists the Missouri vitamin recommendations for growing pigs on a nutrient added per ton basis. All of these recommendations are above 1988 NRC requirements.

The vitamins to which swine producers need to pay particular attention in formulating practical growing swine rations in Missouri are as follows: A, D, E, riboflavin, niacin, pantothenic acid, choline and B<sub>12</sub>. In addition to these vitamins, the following are needed but are generally in adequate amounts in Missouri rations for growing pigs: K, C, biotin and folic acid.

Table 2 lists recommended vitamin additions for breeding swine. Recent research indicated sows receiving supplemented folic acid have larger litters farrowed. With sows in complete confinement adding folic acid, along with choline and biotin at the levels shown seem justified.

**Table 1. Missouri recommended vitamin additions per ton of feed (growing-finishing pigs).**

Nutrient	Unit	Addition Per Ton	
		Grower	Finisher
Vitamin A	Mil. I.U.	5.0	3.0
Vitamin D	Thou. I.U.	500.0	300.0
Vitamin E	Thou. I.U.	20.0	10.0
Vitamin K	g	2.0	1.0
Riboflavin	g	4.0	2.0
Niacin	g	30.0	18.0
Pantothenic acid	g	16.0	8.0
Choline	g	200.0	100.0
Vitamin B <sub>12</sub>	mg	25.0	12.5

**Table 2. Missouri recommended vitamin additions per ton (breeding swine).**

Nutrient	Unit	Addition Per Ton
Vitamin A	Mil. I.U.	5.0
Vitamin D	Thou. I.U.	500
Vitamin E	Thou. I.U.	25
Vitamin K	g	2.0
Riboflavin	g	5.0
Niacin	g	30.0
Pantothenic acid	g	18.0
Vitamin B <sub>12</sub>	mg	25.0
Choline Chloride	g	700
Folic acid	mg	300
Biotin	mg	200

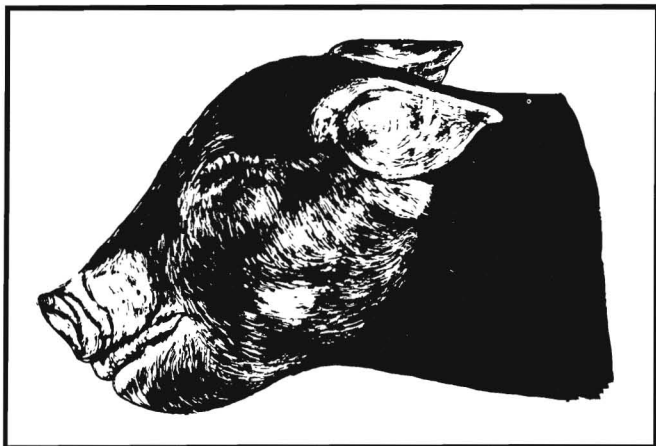


Figure 1. Weak, malformed, blind, and eyeless pigs may be farrowed by sows deficient in vitamin A.

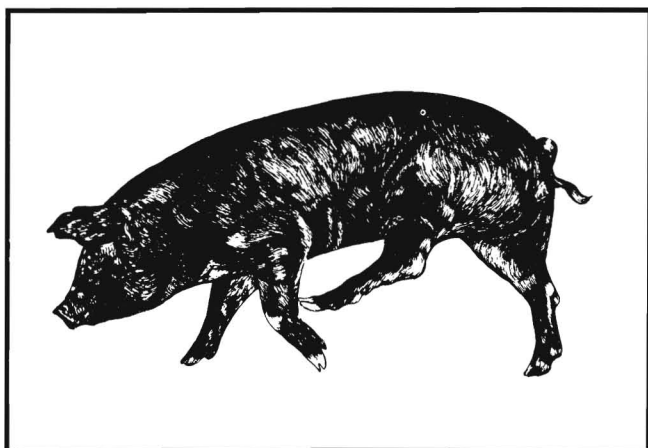


Figure 2. "Goose-stepping" is a common symptom of pantothenic acid deficiency.

## Vitamin sources and general comments

Vitamin needs of swine are met either from that contained in the feed or from synthesis in the body of the animal. Determinations have been made of the vitamin content of many swine feeds. These are average figures and, in some cases, are influenced drastically by the method of harvesting, processing and storing.

**Vitamin A.** Vitamin A functions in the growth of both skeletal and soft tissues of the body: in vision, reproduction and disease resistance. Vitamin A does not occur in plant products but the plant pigment carotene can be converted to vitamin A in the intestinal wall of the pig. Yellow corn is the only cereal grain that contains significant amounts of carotene. Forages are good sources of carotene, however, they seldom are

used in today's practical rations. One milligram of B-carotene is equivalent to 500 I.U. of biologically active vitamin A for the pig.

Good sources of carotene or vitamin A are found in yellow corn (60% may be destroyed in several months of storage by light, high temperature, air, etc.), green forages, sun-cured legumes, dehydrated alfalfa meal, cod-liver oil and fish oils. Both carotene and vitamin A are readily destroyed by the following:

1. Storage and exposure to air;
2. Exposure to light and high temperature;
3. Exposure to metals such as iron hasten destruction;
4. Exposure to rancid fats; and
5. Grinding, which helps destroy the carotene in corn.

For these reasons on a practical basis, we should assume that pigs in drylot receive very little, if any, vitamin A in their diets.

**Vitamin D.** Vitamin D functions in the pig's body to increase the absorption of calcium and phosphorus from the intestines. It is necessary for good bone growth and calcification. Vitamin D<sub>2</sub> sources include sun-cured hays, irradiated yeast and dehydrated alfalfa meal. Sources of D<sub>3</sub> include fish-oils and fish meals and formation of D<sub>3</sub> in the skin by sunshine. Swine exposed to sunshine in the summer should not need dietary vitamin D. During the winter months and in confinement rearing, it is important that rations be supplemented with vitamin D.

**Vitamin E.** Vitamin E is required for normal reproduction and growth. Common swine feeds are good sources—green pastures, cured hay, alfalfa meal, whole grains and germ parts of grain. In Missouri, vitamin E deficiencies are not common, but as a safeguard, it can be added cheaply in a premix.

Deficiency symptoms have been diagnosed in some of the northern midwest states. Michigan State University has reported several vitamin E—selenium deficiencies in swine herds. In areas where selenium levels are low, reports of vitamin E shortages have been more common.

There is a definite relationship between vitamin E and the trace mineral selenium. Adding recommended selenium levels reduces the need for vitamin E. Apparently selenium is needed for good utilization of vitamin E. Loss of vitamin E in normal feeds due to handling and storage, less use of pasture and alfalfa meal, and extensive use of some drugs are believed to contribute to the vitamin E deficiencies in some herds.

Trace mineral selenium can legally be added to swine rations at a level of .3 part per million. This should reduce problems from marginal vitamin E levels.

**Vitamin K.** Under ordinary circumstances vitamin K is supplied in adequate amounts in normal swine diets and the microbial synthesis in the intestines. The

major function of vitamin K is its blood clotting role.

From time-to-time cases are reported which seem to indicate a shortage of vitamin K in swine rations. The presence of mold in feed has been found to interfere with normal utilization of vitamin K by pigs. In Nebraska, studies with moldy feed, the additional of 2 grams of menadione sodium bisulfite per ton corrected vitamin K deficiency symptoms in affected pigs. Check

moisture levels at the time grains are stored and again in the spring and process to reduce mold risk.

With normal feeds vitamin K should be adequate in Missouri swine rations, but it may be included where mold is present or past experience indicates a need for additional vitamin K.

**Table 3. Symptoms of vitamin deficiency in swine.**

Vitamin	Clinical Symptoms <sup>1</sup>	Subclinical Symptoms <sup>2</sup>
Vitamin A	Poor growth, unsteady gait, birth of abnormal pigs, hyperkeratinization of skin, xerophthalmia	Low liver vitamin A, elevated cerebrospinal fluid pressure, low plasma vitamin A
Vitamin D	Poor growth, leg weakness	Rickets, low plasma Ca & P, elevated plasma alkaline phosphatase
Vitamin E	Sudden death, paleness	Liver necrosis, mulberry heart, pale musculature, edema, jaundice
Vitamin K	Sudden death	Internal hemorrhages, slow blood clotting time
Thiamine	Poor growth, loss of appetite sudden death	Enlarged flabby heart, abnormal electrocardiogram, elevated blood pyruvate
Riboflavin	Poor growth, red exudate around eyes, birth of dead or weak pigs	Lens cataracts, increase of blood neutrophils
Niacin	Poor growth, necrotic enteritis	Normocytic anemia
Pantothenic Acid	Poor growth, goose stepping posterior paralysis, birth of small, weak pigs	Sciatic nerve degeneration
Vitamin B <sub>6</sub>	Poor growth, epileptic convulsions	Low blood hemoglobin, high plasma iron, high urinary xanthurenic acid
Vitamin B <sub>12</sub>	Poor growth, irritable, birth of weak pigs	Low serum B <sub>12</sub> , low lymphocyte count, enlarged liver
Choline	Birth of pigs with spraddle legs	Fatty liver, kidney necrosis
Folic Acid	Poor growth	Mormocytic anemia
Biotin	Dermatitis, cracked hoof	

<sup>1</sup>Observations made on the animal

<sup>2</sup>Determined from tests of postmortem examination

**Water-soluble vitamins.** Vitamins generally are classified according to solubility. The four vitamins discussed (A, D, E and K) are fat-soluble, and the remaining mentioned are water-soluble. Of the latter group, biotin, vitamin C and folic acid are not generally of practical concern in growing swine rations because adequate amounts appear to be synthesized by the animal. Thiamine and vitamin B<sub>6</sub> are supplied in more than adequate amounts by the feed in normal swine rations. Recent research showing an increase in pigs per litter by adding folic acid to sow rations.

**Riboflavin** functions in the animal's enzyme system. It is heat-stable, but is destroyed by alkali and light. It is available in good amounts in legume hays, dairy by-products and in fair amounts in tankage and soybean oil meal. Cereal grains are a rather poor source of riboflavin.

**Niacin** functions as a co-enzyme. It is resistant to heat and is quite stable in feeds. Fish meals, corn distillers solubles and wheat bran are good sources of niacin. It may be in a bound or unavailable form in cereal grains, especially corn.

**Pantothenic acid** is stable in heat and light. Common feed sources are milk products, alfalfa meal, wheat bran and fish solubles. Practical diets tend to be borderline in pantothenic acid. Corn is a poor source.

**Choline** is required for small pigs. It can be synthesized from methionine. This increases the methionine requirements in choline deficient diets. Sources are meat and bone meal, soybean oil meal, fish meal and grains. Practical swine grower rations should contain adequate levels of choline, particularly for heavyweight hogs. Research has shown that feeding pregnant sows supplemental choline generally increases numbers of pigs born, and in some experiments, pigs weaned.

**Vitamin B<sub>12</sub>** is required for growth, hemoglobin and red blood cell formation. It is available in animal by-products and commercial preparations. Plant products are deficient, and where rations are formulated based primarily on corn and soybean-oil meal, supplemental sources need to be supplied.

**Folic acid** is an essential B-vitamin for swine. Green leafy plants are an excellent source of this vitamin. Also, bacteria in the pigs' lower gut can synthesize folic acid making feces a source of this vitamin. Confinement practices of raising hogs has reduced both of these sources of the vitamins so research now indicates supplemental sources of folic acid should be added to the feed. Recent research has shown a mild increase in pigs born when folic acid is added to sow rations.

## Vitamin deficiency symptoms in swine

Table 3 lists clinical and sub-clinic symptoms of vitamin deficiencies. Some of these are more specific than others. Some deficiencies don't occur on practical swine rations. However, studies have been made using semi-purified rations which are lacking in specific vitamins, and deficiency symptoms have been determined.

## Meeting vitamin needs in practical swine rations

Producers buying complete mixed feeds or commercial supplements to feed with home-grown grains in general must rely on their company to provide adequate amounts of vitamins. Those formulating and mixing complete rations need to pay particular attention to meeting vitamin needs. (See University of Missouri Agricultural Guide 2351, "Evaluating Vitamin Premixes for Swine.") Missouri recommendations are that vitamins which are short of borderline in feeds should be provided in a commercial vitamin pre-mix at levels shown in tables 1 and 2.

Vitamin pre-mixes don't add much to the total cost per ton of feed, and there is less chance for error providing these vitamins in this form rather than relying on average amounts of feed particularly with variations in processing and storing and changes in management of hogs.