

Vitamin Requirements of Swine

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Vitamins have been recognized for many years as essential nutrients for swine. The trend toward complete confinement swine production in recent years has focused more attention on the need for supplying adequate dietary sources of vitamins that are deficient in practical rations. Following 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. Each vitamin functions in a particular way, and the function of the various vitamins in the body differs widely. Vitamins do not form a part of the animal's tissue and are required in much smaller amounts than other nutrients such as protein, calcium, phosphorus, carbohydrates and fats.

Table 1 gives a summary taken from the 1979

National Research Council's "Nutrient Requirements of Swine" showing the vitamin requirements for various weights and classes of swine as established by research.

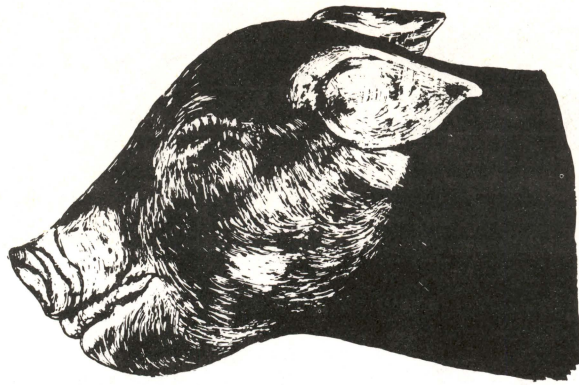
In Table 1, the vitamins to which swine producers need to pay particular attention in formulating practical swine rations in Missouri are as follows: Vitamins A, D, E, riboflavin, niacin, pantothenic acid, choline, and B₁₂. In addition to the vitamins with requirement figures, the following are needed by swine but are generally in adequate amounts in our Missouri rations: vitamins K, C, biotin, and folic acid.

Vitamin Sources and General Comments

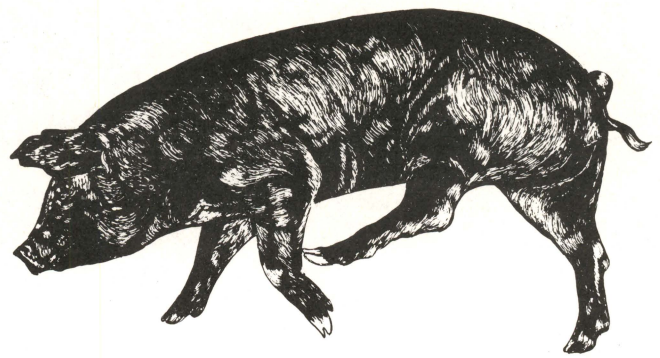
Vitamin needs of swine are met either from that contained in the feed or from synthesis in the body of

Table 1.
Vitamin Requirements of Swine
(Percent or Amount per Pound of Diet)

	(lbs)	Growing and Finishing Swine					Breeding Swine	
		10-25	25-45	45-75	75-135	135-220	Bred Gilts, Sows and Boars	Lactation Gilts and Sows
Vitamin A	I. U.	1,000	795	591	591	591	1,818	909
Vitamin D	I. U.	100	91	91	68	57	91	91
Vitamin E	I. U.	5.0	5.0	5.0	5.0	5.0	4.5	4.5
Vitamin K	mg	.9	.9	.9	.9	.9	.9	.9
Thiamine	mg	.6	.5	.5	.5	.5	.45	.45
Riboflavin	mg	1.4	1.4	1.2	1.0	1.0	1.4	1.4
Niacin	mg	10.0	8.2	6.4	5.5	4.5	4.5	4.5
Pantothenic Acid	mg	6.0	5.0	5.0	5.0	5.0	5.4	5.4
Vitamin B ₆	mg	.7	.7	.5	.5	.5	.5	.5
Choline	mg	500	409	318	250	182	568	568
Vitamin B ₁₂	mcg	10.0	7.0	5.0	5.0	5.0	6.8	6.8



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



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

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. Most natural feeds do not contain vitamin A, but do contain carotene. One milligram of B-carotene is equivalent to 500 I.U. of biologically active vitamin A for the pig. Carotene is converted to vitamin A in the intestinal wall of the pig.

Good sources of carotene or vitamin A are found in yellow corn (60 percent may be destroyed in seven 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.
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 D₂ sources include sun-cured hays, irradiated yeast, and dehydrated alfalfa meal. Sources of D₃ include fish-oils and fish meals and formation of D₃ 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; it is listed in NRC tables as 5 milligrams per pound of diet. 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. Additions of recommended selenium levels reduce the vitamin E needs. 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 found in Michigan State University herds.

Trace mineral selenium can legally be added to swine rations at a level of .1 part per million (P.P.M.). This should reduce problems from low 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 addition of 2 grams of menadione sodium bisulfite per ton corrected vitamin K deficiency symptoms in affected pigs.

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 2.
Symptoms of Vitamin Deficiency in Swine

Vitamin	Clinical Symptoms ¹	Subclinical Symptoms ²
<i>Vitamin A</i>	Poor growth, unsteady gait, birth of abnormal pigs, hyperkeratinization of skin, xerophthalmia	Low liver vitamin A, elevated cerebrospinal fluid pressure, low plasma vitamin A
<i>Vitamin D</i>	Poor growth, leg weakness	Rickets, low plasma Ca & P, elevated plasma alkaline phosphatase
<i>Vitamin E</i>	Sudden death, paleness	Liver necrosis, mulberry heart, pale musculature, edema, jaundice
<i>Vitamin K</i>	Sudden death	Internal hemorrhages, slow blood clotting time
<i>Thiamine</i>	Poor growth, loss of appetite, sudden death	Enlarged flabby heart, abnormal electrocardiogram, elevated blood pyruvate
<i>Riboflavin</i>	Poor growth, red exudate around eyes, birth of dead or weak pigs	Lens cataracts, increase of blood neutrophils
<i>Niacin</i>	Poor growth, necrotic enteritis	Normocytic anemia
<i>Pantothenic acid</i>	Poor growth, goose stepping posterior paralysis, birth of small weak pigs	Sciatic nerve degeneration
<i>Vitamin B₆</i>	Poor growth, epileptic convulsions	Low blood hemoglobin, high plasma iron, high urinary xanthurenic acid
<i>B₁₂</i>	Poor growth, irritable, birth of weak pigs	Low serum B ₁₂ , low lymphocyte count, enlarged liver
<i>Choline</i>	Birth of pigs with spraddled legs	Fatty liver, kidney necrosis
<i>Folic Acid</i>	Poor growth	Mormocytic anemia
<i>Biotin</i>	Dermatitis, cracked hoof	

¹Observations made on the animal.

²Determined from tests of postmortem examination.

Water-soluble vitamins. Vitamins are generally classified according to solubility. The four vitamins discussed (A, D, E, and K) are fat-soluble, and the remaining mentioned are water-soluble. Of this latter group biotin, vitamin C, and folic acid are not generally of practical concern in swine rations because adequate amounts appear to be synthesized by the animal. Thiamine and vitamin B₆ are supplied in more than adequate amounts by the feed in normal swine 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, 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 requirement in choline deficient diets. Sources are meat

and bone meal, soybean oil meal, fish meal, and grains. Practical swine rations should contain adequate levels of choline particularly for heavyweight hogs.

Vitamin B₁₂ 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.

Vitamin Deficiency Symptoms in Swine

Table 2 lists clinical and sub-clinical 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 UMC Guide 2351 "Evaluating Vitamin Premixes for Swine.") Missouri recommendations are that vitamins which are short or borderline in feeds should be provided in a commercial vitamin pre-mix.

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.

The following vitamins should be provided in amounts necessary to meet requirements shown in Table 1 in the vitamin pre-mix: Vitamin A, D, E, riboflavin, niacin, pantothenic acid and B₁₂. Also in the creep and starter rations, Choline can be added; however, it should be adequate in normal feeds. Other vitamins required by hogs should be adequate in normal feeds or adequately synthesized by the pig in nearly all cases in Missouri. There may be a need to supply vitamin K in special situations.