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## Vitamins for Swine

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Vitamins are one of the classes of nutrients required for normal metabolic functions in the animal body. They are required in much smaller amounts than most other nutrients and can be referred to as micronutrients. Vitamins are not used as energy sources or structural components, but are generally required as co-enzymes in metabolic reactions. Some vitamins can be synthesized within the pig's body in sufficient quantities to meet the pig's requirement. Others are present in adequate amounts in feedstuffs commonly used in diets. However, the potency of certain vitamins in feedstuffs is greatly reduced during storage and drying. Therefore, several vitamins should be added to swine diets to obtain optimal performance. Attention to vitamin needs is more critical today than previously because of the simpler diets containing fewer ingredients, and the trend toward modern housing which has reduced both coprophagy and access to pasture. Young, lush, green grass or legumes are good sources of many vitamins.

### Vitamins Needed

Those vitamins that should be added to swine diets can be divided into two groups:

- Fat soluble vitamins
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K
- Water soluble vitamins
  - Riboflavin
  - Pantothenic acid
  - Niacin
  - Vitamin B<sub>12</sub>
  - Choline
  - Folic acid
  - Biotin

The need for addition of biotin to practical diets is not well-established.

Several other vitamins function in the pig's body. These include pyridoxine (B<sub>6</sub>), thiamine and vitamin C (ascorbic acid). There is only questionable evidence that pigs fed practical diets will benefit from the inclusion of supplements containing these vitamins. Therefore, it is not recommended that they be routinely added to swine diets.

**Vitamin A.** The vitamin A needs of swine can be met by either vitamin A or B-carotene. Vitamin A does not occur in plant products, but the plant pigment, B-carotene, can be converted to vitamin A in the intestinal wall of the pig. Good, natural sources of B-carotene include green pastures and green, leafy alfalfa hay or meal. Yellow corn contains B-carotene but is not a dependable source because much may be destroyed in storage. Therefore, in formulating diets, the B-carotene concentration of corn is disregarded. Other cereal grains are low or devoid of B-carotene.

Deficiency symptoms in growing pigs are incoordinated movement, weakness of the back, paralysis, night blindness and total blindness. Sows may fail to come into estrus, have poor conception rates, resorb their fetuses, and have weak pigs at birth or pigs born dead with various deformities. Sterility may occur in boars.

**Vitamin D.** Swine that have daily access to sunlight produce their own vitamin D. However, fortification of diets with vitamin D is necessary when pigs are fed inside. Also, most feedstuffs are practically devoid of vitamin D except for sun-cured hays. Both vitamin D<sub>2</sub>, the form found in plant products, and vitamin D<sub>3</sub>, the animal product form, have the same value for swine.

Vitamin D is needed for the efficient absorption and metabolism of calcium and phosphorus and therefore is required for normal calcification of bones. A deficiency in young pigs results in rickets, stiffness and lameness, enlargement of the joints and general unthriftiness. In mature animals, fractures of the bones are common. Excessive levels of vitamin D in the feed or as an



injectable have been shown to be harmful. Therefore, it is important to prevent excessive intakes.

**Vitamin E.** A decline in the use of pasture for pigs and an increase in artificial drying of grains have resulted in a lowering of vitamin E intake and an increase in occurrence of deficiency symptoms. Grains low in selenium increase the need for vitamin E as the dietary level of one of these nutrients affects the requirement for the other.

Vitamin E functions as an antioxidant in intracellular membranes. Deficiency signs in the growing pig are sudden death, jaundice, edema, white muscles and liver necrosis. The deficiency condition is often referred to as mulberry heart disease. Pregnant sows may have a higher incidence of embryonic death. Pigs nursing sows deficient in vitamin E may show muscular incoordination.

**Vitamin K.** Although Vitamin K occurs in many natural feedstuffs and is synthesized by intestinal microflora of the pig, a deficiency in practical diets has been demonstrated. The deficiency is frequently associated with moldy feeds. Its characteristics are hemorrhaging (both internal and external) and prolonged blood-clotting time, and also may include blood-tinged urine, lameness and listlessness. Vitamin K can be supplied by using 2.5% dehydrated alfalfa meal or one of the synthetic vitamin K compounds (menadione) in the diet at the level suggested in Table 1.

**Riboflavin.** Cereal grains and plant by-products such as soybean meal are relatively poor sources of this B vitamin. It functions in the body as a constituent of several enzyme systems. Therefore, a deficiency of riboflavin results in a wide variety of symptoms. In growing pigs, a deficiency may cause loss of appetite, stiffness, dermatitis and lowered growth rate. Poor conception and reproduction have been noted in sows fed riboflavin-deficient diets. Pigs may be born prematurely, dead or too weak to survive.

**Pantothenic Acid.** Corn-soybean meal diets will be deficient in pantothenic acid, another of the B-complex vitamins. A deficiency may result in lowered fertility, reduced growth rate, diarrhea, and an incoordinated, wobbly or high-stepping gait called goosestepping. Many of these symptoms are similar to those observed from other deficiencies and indicate that, in practical feeding situations, it is difficult to determine which vitamin may be lacking. In fact, in many cases, it is a combination of observable vitamin deficiencies.

**Niacin.** Although niacin is present in adequate amounts in cereal grains, it exists in a bound form that is largely unavailable to the pig. The protein source and content of the diet also can affect the dietary need for niacin because the amino acid tryptophan is converted into niacin. This can develop into a tryptophan deficiency in a diet low in niacin and tryptophan. Slow growth, diarrhea, dermatitis, loss of hair and occasional vomiting are deficiency symptoms. Alfalfa meal and good pasture are natural sources of riboflavin, pantothenic acid and niacin.

**Vitamin B<sub>12</sub>.** Cereal grains and other plant products are poor sources of B<sub>12</sub>, but animal products are good sources. The requirement for this vitamin is approximately one-thousandth the amount of the other B vitamins discussed. Signs of a deficiency include reduced growth rate and anemia. Vitamin B<sub>12</sub> also is known as cyanocobalamin.

**Choline.** Recent research has indicated that supplemental choline resulted in an increased litter size in gestating sows fed corn-soybean meal diets. Choline deficiency also has been implicated by some as the cause of spraddle legs in newborn pigs. However, this has not been proven in research where sows were fed practical diets during gestation. Apparently, there are other causes of the spraddle leg condition. The choline requirement of growing and finishing pigs is met by natural feedstuffs. However, the need for supplemental choline is increased in diets low in the amino acid methionine.

Table 1. Suggested vitamin mix.<sup>1</sup>

Vitamin	Amount/lb. of premix	Suggested source
Vitamin A	900,000 IU	Vitamin A palmitate-gelatin coated
Vitamin D	100,000 IU	Vitamin D <sub>3</sub> - stabilized
Vitamin E	5,000 IU	dl-tocopherol acetate
Vitamin K (Menadione Equivalent) <sup>2</sup>	660 mg	Menadione sodium bisulfite
Riboflavin	1,200 mg	Riboflavin
Pantothenic acid	4,500 mg	Calcium pantothenate
Niacin	7,000 mg	Nicotinamide
Choline <sup>3</sup>	20,000 mg	Choline chloride (60%)
Vitamin B <sub>12</sub>	5 mg	Vitamin B <sub>12</sub> in mannitol, (.1%)
Folic acid	300 mg	Folic acid
Biotin	40 mg	D-Biotin

<sup>1</sup>Premix is designed to be used at a rate of 5 lb. per ton of complete feed for sows and baby pigs, and 3 lb. per ton of complete feed for growing-finishing swine.

<sup>2</sup>Menadione conversion values are 1 g of menadione = 3 g of menadione sodium bisulfite complex (MSBC) or 2 g of menadione dimethylpyrimidinol bisulfite (MPB) or 2.2 g of menadione sodium bisulfite (MSB).

<sup>3</sup>It is also recommended that during gestation period, additional choline (550 grams per ton) be added to the sow diets. This can be provided by adding 2.5 lb. of choline chloride premix containing 50% choline or 2.0 lb. of a chloride premix containing 60% choline.



Table 2. Suggested vitamin additions per ton of feed.

Vitamin	Starter	Grower-finisher	Gestation-lactation
Vitamin A, IU	4,500,000	2,700,000	4,500,000
Vitamin D, IU	500,000	300,000	500,000
Vitamin E, IU	25,000	15,000	25,000
Vitamin K (menadione),g	3.3	2	3.3
Riboflavin, g	6	3.6	6
Pantothenic acid, g	22.5	13.5	22.5
Niacin, g	35	21	35
Vitamin B <sub>12</sub> , mg	25	15	25
Choline, g <sup>1</sup>	--	--	100
Folic acid, g	--	--	1.5
Biotin, mg	--	--	200

<sup>1</sup>It is also recommended that during gestation period, additional choline (550 grams per ton) be added to the sow diets. This can be provided by adding 2.5 lb. of choline chloride premix containing 50% choline or 2.0 lb. of a chloride premix containing 60% choline.

**Folic Acid (Folacin).** The pig's requirement for folic acid for growth and maintenance is met by folic acid from feedstuffs and bacterial synthesis in the hind-gut. However, recent research has demonstrated that folic acid supplementation in gestation and lactation diets increased the number of pigs born alive and weaned. Weakness, poor growth and anemia are symptoms of folic acid deficiency. Green, leafy plants are excellent sources of this vitamin.

**Biotin.** Common feedstuffs contain enough biotin to meet the requirement of the growing pig, but the bioavailability is poor in small grains. Biotin supplementation of gestating sow diets may enhance reproductive performance, but no single reproductive parameter has consistently responded to biotin supplementation. A biotin deficiency is characterized by cracking of the feet and dermatosis.

**Vitamin C (Ascorbic Acid), Thiamine, Pyridoxine (B<sub>6</sub>).** Although these vitamins are required by the pig, the levels required in the diet are not known. Deficiency signs may be produced when diets contain an antagonist or high levels of sulfa drugs. It has been suggested that environmental stress increases the need for ascorbic acid for normal growth. However, the amount of these vitamins present in practical diets plus that synthesized by microorganisms (thiamine and B<sub>6</sub>) in the digestive tract are considered to be sufficient to meet the requirements of the pig.

### Synthetic Vitamins

The chemical structure of a given vitamin is identical regardless of source. Therefore, natural and synthetic vitamins are of equal value to the pig. Since the natural ingredients used in practical swine diets may not contain adequate amounts of certain vitamins, it is recommended that a vitamin supplement be added. Synthetic vitamins are produced by many companies and

sold individually or in various combinations of vitamins, or as vitamin-mineral combinations. These can be purchased in prepackaged quantities ready to be added to one ton of feed. The vitamin premix in Table 1 contains all the vitamins that need to be added to swine diets. A 5 lb./ton of complete feed inclusion rate should be used for swine starter, gestation, and lactation diets based on daily gestation and lactation feed intake of 4 to 5 and 9 to 12 lb./head, respectively. The vitamin needs of growing and finishing pigs are met when the premix is added at 3 lb./ton of complete feed. Commercial complete feeds and protein supplements generally contain supplemental vitamins. Check to see if the levels are adequate. If not, seek another supplier or add vitamins that are needed in the necessary amounts. Suggested vitamin additions per ton of feed are shown in Table 2.

### Mixing Instructions

The vitamin premix should be purchased from a commercial company. These suppliers have much better quality control and mixing facilities than producers have to handle the small quantities of vitamins. Purchase no more than what will be used in 3 to 4 months (use 3 months in hot, humid areas) and store in a cool, dry place to reduce storage losses. Mix only enough feed for 3 to 4 weeks as certain combinations of ingredients can increase vitamin losses over time. Follow mixing guidelines according to the manufacturer's recommendations. Do not add more than recommended levels or a potential toxicity may occur.

Special care should be taken when adding the vitamin premix to obtain a thorough dispersion throughout the feed. Since vertical, on-farm grinder mixers are not designed to handle small quantities, the 3 or 5 lb. of vitamins need to be premixed with a carrier (ground corn, soybean meal, etc.). One method is to thoroughly mix the vitamins with at least 50 lb. of a carrier in a tub or cement mixer, and then add this mixture to the grinder-mixer.

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Issued in furtherance of Cooperative Extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gail L. Imig, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

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