VIGORTONE® AG PRODUCTS

Animal Nutrition *At Its Best*®

BASIC NUTRITION

When developing or evaluating nutritional programs, always consider first things first.

Air

Clean, noncontaminated air is essential for profitable livestock production. Poor quality air reduces animal performance.

Air quality is reduced by:

1. Poor ventilation
2. High humidity
3. Filth (poor sanitation)
4. Pit gases
5. Overcrowding
6. Air pollution

Water

Potable water is needed to solubilize dietary nutrients and carry them via the bloodstream to all body tissues. All animal products (meat, milk, etc.) contain over 50% water. Reduced water consumption will lower feed intake and rapidly decrease animal performance.

Energy

Energy is obtained primarily from the carbohydrates (starch and fiber) in feedstuffs and is the most important dietary nutrient. Most of the dry matter consumed is converted to heat energy (calories). Life, reproduction and production (meat, milk, etc.) cannot be sustained with energy-deficient diets. Always consider energy first when balancing livestock rations and evaluating nutritional programs.

Protein

Protein (amino acids) is the second most important **dietary** nutrient. Animals must be fed balanced diets containing proper levels of dietary protein if they are to efficiently manufacture animal protein (meat, milk, etc.) for human consumption. Following energy, protein should be considered when balancing livestock rations and evaluating nutritional programs.

Macro Minerals

Macro minerals are those dietary minerals that are required in relatively large amounts.

Macro minerals: calcium, phosphorus, sodium chloride, potassium, magnesium, sulfur.

Macro minerals often constitute a large portion of certain body tissues and fluids.

Examples: 98% of the calcium, 85% of the phosphorus and 70% of the magnesium is in the animal's skeleton. Cows' milk contains 1.15% potassium, 0.92% calcium and 0.77% phosphorus on a dry matter basis.

Micro Minerals

Micro minerals are dietary minerals that are required in much smaller amounts than macro minerals.

Micro minerals: iodine, cobalt, copper, molybdenum, iron, manganese, zinc, selenium.

Micro minerals are associated with enzymes. Enzymes are required for proper body metabolism. Many enzymes require one or more micro minerals to function properly.

Example: Red blood cells contain the enzyme carbonic anhydrase which plays an essential role in the elimination of carbon dioxide from the bloodstream via the lungs. Zinc is an essential part of carbonic anhydrase.

Fat Soluble Vitamins

Fat soluble vitamins are soluble in fats and oils but not soluble in water.

Fat soluble vitamins are A, D, E and K. These vitamins are usually associated with the health and function of major body tissues.

Examples: Vitamin A is required by epithelial tissues (tissues that line the throat, lungs, gut and reproductive organs). Vitamin D is essential for absorption of calcium from the gut to the bloodstream. The blood supplies calcium for bone development and milk secretion.

(continued)

Water Soluble Vitamins

These vitamins are soluble in water and include the B-vitamins.

Water soluble vitamins: thiamin, riboflavin, niacin, pantothenic acid, vitamin B_{12}, choline, pyridoxine, biotin, folacin.

Water soluble vitamins function as co-enzymes in many enzyme systems.

Examples: Riboflavin is part of the enzyme system that metabolizes amino acids. Niacin functions in the enzyme system that metabolizes carbohydrates.

Balanced Diet

A balanced diet provides a specific animal or group of animals with the proper amounts and proportions of biologically available nutrients to perform a specific function effectively and efficiently.

Nutritional imbalances can be as harmful as nutrient deficiencies.

Example: Excessive calcium can ''tie up'' zinc, thereby creating a zinc deficiency. Proper levels of vitamin D are required for bone formation. Excessive vitamin D will greatly reduce bone development by destroying bone-forming cells.

CAUTION: The following charts provide basic information about macro minerals, micro minerals, fat-soluble vitamins and water-soluble vitamins. This information can be used as a guide to general nutrient function. The charts do not provide sufficient information for diagnosis of nutrient deficiencies, toxicities or imbalances.

MACRO MINERALS

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Sodium (Na)	Major cation in osmotic pressure and acid-base balance in body fluids, upon which depends the transfer of nutrients to the cells and the removal of waste materials and the maintenance of water balance among the tissues. Associated with muscle contraction. Important in making bile.	Reduced growth and efficiency of feed utilization in growing animals, reduced milk production and weight loss in adults. Lowered reproduction (infertility in males, and delayed sexual maturity in females). Craving for sodium, evidenced by such things as drinking urine. In laying hens, a deficiency of sodium results in lowered production, loss of weight and cannibalism.	Salt toxicity, which is accentuated with restriction of water intake, can occur in non-ruminants. It is characterized by a staggering gait; blindness and other nervous disorders. Excess Na results in hypertension.	Salt; free-choice or added to the ration at a level of 0.25-0.50%.	The body contains approximately 2.0% sodium.
Chlorine (Cl)	Major anion involved in osmotic pressure and acid-base balance (chloride shift). Chief anion of gastric juice where it unites with H ions to form hydrochloric acid.	Depressed growth rate. Chicks on Cl-deficient diet exhibit nervous symptoms induced by sudden noise.	Excess Cl is not likely.	Salt; free-choice, or added to the ration at a level of 0.25-0.50%.	In practice, Na and Cl are supplied together as common salt. The body's requirement for Cl is approximately half that of Na.

(continued)

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Calcium (Ca)	Bone and teeth formation; nerve function; muscle contraction; blood coagulation; cell permeability. Essential for milk production and for formation of eggshell in poultry.	Rickets in young. Osteomalacia in adults. Coma (hypocalcemia). Milk fever in dairy cows is a classical example of calcium influence in the body.	Calcium-phosphorus ratio for nonruminants is usually 1:1-2:1. For ruminants, it may be anywhere from 1:1-7:1. Vitamin D is involved. If adequate vitamin D is present, the ratio of calcium to phosphorus is less important. Excess Ca reduces the absorption and utilization of Zn. In swine, this causes parakeratosis. Excess Mg decreases Ca absorption, replaces Ca in the bone, and increases Ca excretion.	Calcium carbonate. Oystershells. Dicalcium phosphate. Defluorinated phosphate. Protein supplements of animal origin, legume forages and rape. Milk. Bone meal.	Over 70% of the ash of the body consists of Ca and P. Approximately 99% of the Ca of the body is present in the bones and teeth. Calcium availability of 70% is generally assumed for all feedstuffs.
Phosphorus (P)	Bone and teeth formation; a component of phospholipids which are important in lipid transport and metabolism and cell-membrane structure. In energy metabolism. A component of RNA and DNA, the vital cellular constituents required for protein synthesis. A constituent of several enzyme systems.	Rickets in young. Osteomalacia in adults. Depraved appetite (pica), but this is not specific for phosphorus deficiency. Breeding problems. Urinary problems. Hens: Reduced egg production.	Sufficient vitamin D is necessary for P assimilation and utilization. Excess Ca and Mg cause decrease in P absorption. In ruminants, excess P in relation to Ca is likely to cause calculi.	Monosodium phosphate. Diammonium phosphate. Dicalcium phosphate. Defluorinated phosphate. Bone meal. Most cereal grains and their by-products (notably wheat bran) are high in P.	Approximately 80% of the P of the body is present in the bones and teeth. Excess P may result in lameness and spontaneous fracture of long bones. High P has a laxative effect. Nonruminants do not efficiently utilize P in cereal grains.
Magnesium (Mg)	Essential for normal skeletal development, as a constituent of bone; enzyme activator, primarily in glycolytic system. Helps to decrease tissue irritability.	Vasodilation, with resulting reduction in blood pressure (manifested outwardly by a flushing of the skin). Hyperirritability. Tetany (grass tetany, or grass staggers) characterized by loss of appetite (anorexia), hyperemia, convulsions and death.	Excess of Mg upsets Ca and P metabolism. Mg toxicity from feeding has not been demonstrated.	Magnesium sulfate or oxide, mixed with salt or small amount of feed.	Deficiencies of Mg may be encountered with suckling calves and pigs.
Potassium (K)	Major cation of intracellular fluid where it is involved in osmotic pressure and acid-base balance. Muscle activity. Required in enzyme reaction involving creatine. Influences carbohydrate metabolism.	Growth retardation, unsteady gait, general muscle weakness, pica, diarrhea, distended abdomen, emaciation followed by death. Abnormal electrocardiograms.	Mg deficiency results in failure to retain potassium; hence it may lead to K deficiency. Excessive levels of K interfere with Mg absorption and result in Mg deficiency and interfere with Ca metabolism which can lead to milk fever.	Potassium chloride. Roughages usually contain ample potassium.	Potassium deficiency may occur in drylot finishing cattle or sheep on a high-concentrate ration. Incoming feedlot cattle respond to added K.

(continued)

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Sulfur (S)	Required as a component of sulfur-containing amino acids cystine and methionine. As a component of biotin, sulfur is important in lipid metabolism. As a component of thiamin, it is important in carbohydrate metabolism. As a component of coenzyme A, it is important in energy metabolism.	Retarded growth, primarily due to not meeting the sulfur amino acid requirement for proteinsynthesis. Sheep fed nonprotein N to replace protein without S supplementation show reduced wool growth (wool contains approximately 4% sulfur).	Sulfur is related to the amino acids cystine and methionine, and to biotin, thiamin, and coenzyme A (see column to left, ''Major Functions''). Sulfur toxicity is not a practical problem.	Nonruminants should be provided sulfur-containing proteins. Ruminants and horses may be provided sulfur in protein, as elemental sulfur or as sulfate sulfur.	The body contains approximately 0.15% sulfur. Sulfur requirements are primarily those involving amino acid nutrition. Ruminants fed urea as a source of protein nitrogen may benefit from supplemental sulfur.

MICRO MINERALS

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Iodine (I)	Needed by the thyroid gland for making thyroxin, an iodine-containing hormone which controls the rate of body metabolism or heat production.	Goiter (big-neck) in humans, calves, lambs, and kids; stillbirths and weak young; hairless pigs; woolless lambs at birth. There is no satisfactory treatment for animals that have developed pronounced I-deficiency symptoms.	Long-term chronic intake of large amounts of I reduces thyroid uptake of I. Marked species differences exist in tolerance to high intakes of I.	Calcium iodate. Ethylenediamine dihydriodide (EDDI).	Enlargement of the thyroid gland (goiter) is nature's way of trying to make enough thyroxin (an I-containing hormone) when there is insufficient I in the feed. Mature animal body contains less than 0.00004% I. I deficiencies are world-wide. In the U.S., the Northwest, the Pacific Coast, and the Great Lakes regions are goiter areas.
Iron (Fe)	Iron is a constituent of hemoglobin, the iron-containing compound that transports oxygen. Also, iron plays a role in cellular oxidations, being a component of certain enzymes concerned with oxygen transfer.	Fe-deficiency anemia, characterized by smaller than normal number of red cells and less than normal amount of hemoglobin.	Iron is related to hemoglobin. Cu is required for proper Fe metabolism. Pyridoxine deficiency decreases the absorption of Fe. Too much iron may be deleterious—interfering with phosphorus absorption by forming an insoluble phosphate.	Ferrous sulfate administered orally, or iron dextran injection. Leafy portions of plants, meats, legume seeds, cereal grains, and cane molasses.	Iron is stored in the liver, spleen, and kidneys. Young animals are born with a store of iron. But milk is low in iron. So when young animals are continued on milk for a long time, particularly under confined conditions and with little or no supplemental feed, nutritional anemia will likely develop.

(continued)

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Manganese (Mn)	Essential for normal bone formation (as a component of the organic matrix). Thought to be an activator of enzyme systems involved in oxidative phosphorylation, amino acid metabolism, fatty acid synthesis, and cholesterol metabolism. Growth and reproduction.	Poor growth. Lameness, shortening and bowing of the legs, and enlarged joints. ''Knuckling over'' in calves. Impaired reproduction (testicular degeneration of males; defective ovulation of females). Slipped tendons (perosis) in poultry.	Excess Ca and P decreases absorption. Mn is not toxic in moderate excesses.	High-quality mineral mixtures. Mn organic.	
Chromium (Cr)	Insulinlike effect in glucose metabolism (shown in the rat).			There is no evidence that practical animal rations need to be supplemented with Cr.	The importance of Cr in glucose metabolism of other animals (other than the rat) and man has not been established to date.
Cobalt (Co)	As a component of vitamin B_{12}. Rumen microorganisms use Co for the synthesis of vitamin B_{12} and the growth of rumen bacteria.	Deficiency of Co in cattle and sheep produces symptoms similar to a deficiency of vitamin B_{12}. Ruminants grazing in Co-deficient areas show loss of appetite, reduced growth, and loss in body weight, followed by emaciation, anemia and eventually death. Frequently a depraved appetite is noted. The disease called ''salt sick'' in Florida is due to Co deficiency associated with Cu deficiency.	Related to vitamin B_{12}. Cobalt toxicity is not likely.	Cobalt chloride, cobalt sulfate, cobalt oxide or cobalt carbonate. Also, several good Co-containing commercial minerals are on the market.	Co-deficient areas have been reported in Australia, western Canada and in the U.S. in the states of Florida, Michigan, Wisconsin, Massachusetts, New Hampshire, Pennsylvania and New York.
Copper (Cu)	Along with iron and vitamin B_{12}, copper is necessary for hemoglobin formation, although it forms no part of the hemoglobin molecule (or red blood cells). Essential in enzyme systems, hair development and pigmentation, bone development, reproduction and lactation.	Fading hair coat; light wool growth and straight, hairlike fibers, known as steely wool. Nervous symptoms, known as ataxia. Lameness, swelling of joints and fragility of bones. Nutritional anemia, commonly called ''salt sick.''	An excess of molybdenum in the presence of sulfate causes a condition which can be cured by administering copper. Excess copper (varies with species) is toxic; it accumulates in the liver, and death may result. In high-molybdenum areas, the Cu level for horses and cattle should be about 5 times higher than normal.	Copper sulfate, copper oxide or copper carbonate. Cu organic.	A variable store of copper is located in the liver and spleen. Milk is low in Cu; hence, young animals raised almost exclusively on milk may develop anemia. The soils of Florida and the Coastal Plain region are copper deficient.

(continued)

Mineral	Major Function	Some Deficiency Symptoms	Major Interrelationships; Toxicities	Good Sources For Animals	Comments
Fluorine (F)	Protects against dental caries (tooth decay) in children and possibly in animals also.	Excesses of fluorine are of more concern than deficiencies in livestock production.	High dietary Ca depresses F uptake of bone. F is a cumulative poison; hence, the toxic effects may not be noticed for some time. High levels result in enlarged bones; softening, mottling and irregular wear of the teeth; roughened hair coat; delayed maturity; and less efficient utilization of feed.	No need to supplement livestock with fluorine has been demonstrated. Should such supplementation be necessary, 1 ppm in the drinking water should suffice.	Low-quality phosphorus sources, such as soft rock phosphate, may contain unacceptable levels of F.
Molybdenum (Mo)	As a component of the enzyme xanthine oxidase especially important in poultry for uric acid formation. Stimulates action of rumen organisms.	Toxic levels of Mo are of greater practical concern than deficiencies. Reduced growth in chicks.	Mo is related to uric acid formation in poultry and microbial action in ruminants. Mo as a toxic mineral affects cattle and sheep grazing pastures grown on soils high in Mo content. Toxic levels of Mo interfere with copper metabolism; hence, increase copper requirements.	No Mo supplementation of normal rations is necessary.	Mo toxicity results in severe scours and loss of condition.
Selenium (Se)	Selenium is a component of glutathione peroxidase, which is involved in membrane stability. Se prevents degeneration and fibrosis of the pancreas in chicks.	Nutritional muscular dystrophy in lambs and calves. White muscle disease. Exudative diathesis in poultry. Liver necrosis in pigs. Mulberry heart.	Se is related to vit. E absorption. Animals consuming forage or grain produced on seleniferour soils develop blind staggers or alkali disease, characterized by emaciation, loss of hair, soreness and sloughing of hooves, lameness, anemia, excess salivation, grinding of the teeth, blindness, paralysis, and death. In poultry, egg production and hatchability are reduced and deformities are common, including lack of eyes and deformed wings and feet.	High-protein rations tend to protect against Se toxicity.	FDA has approved addition of Se to complete rations of food producing animals at level of 0.3 ppm.
Silicon (Si)	Involved in the mineralization process in bones.		From a practical standpoint, adverse effects of high-Si intake rather than Si deficiency appear to be of concern. Urinary calculi may develop upon excessive Si intake.	One of the most abundant elements on earth. Present in large amounts in soils and plants.	On purified diets, the addition of Si has increased the growth rate of chicks and rats.
Zinc (Zn)	Needed for bone and feather development. Zn is a component of several enzyme systems, including carbonic anhydrase. Zn required for normal protein synthesis and metabolism. Important in maintaining the integrity of skin and hooves.	Loss of appetite and stunted growth. Poor hair or feather development; slipping of wool. Rough and thickened skin in swine, known as parakeratosis.	Excess Ca reduces the absorption and utilization of Zn, precipitating parakeratosis in swine. Excess Zn interferes with Cu metabolism and may cause anemia.	Zinc carbonate. Zinc sulfate. Zinc oxide. Zn organic.	Zinc imparts ''bloom'' to the hair coat.

(continued)

FAT SOLUBLE VITAMINS

Name Of Vitamin	Animals Most Affected	Functions	Some Deficiency Symptoms	Good Sources For Animals	Comments
Vitamin A	Affects all farm animals, including poultry.	Bone growth. Night vision. Epithelial tissue maintenance — respiratory, urogenital and digestive tracts, and the skin. Reproduction.	Stunted growth or loss of weight and loss of appetite, xerophthalmia (an eye disease), night blindness, nervous incoordination as shown by a staggering gait, and sterility in males and females or young which are born weak or dead. Reproductive failure. Hydroencephaly in young rabbits born to deficient females. *Chicks:* Wobbly gait. *Hens:* Reduced egg production and hatchability.	Vitamin A can be provided as the synthetic vitamin or as its precursor, carotene. Rich sources of carotene follow: Green, leafy hays, not over 1 year old. Grass silages. Lush, green pastures. Yellow corn. Green and yellow peas. Fish oils. Carrots. Whole milk. Dehydrated alfalfa meal.	Vitamin A is found only in animals; plants contain the precursor, carotene. Animals are able to store considerable vitamin A, but because of their greater requirements and less storage, young animals suffer from a deficiency much sooner than those that are mature. Both carotene and vitamin A are readily destroyed by oxidation, thus resulting in considerable losses in processing and storing (as in making or storing of hay).
Vitamin D	Affects all farm animals, including poultry.	Aids in the assimilation and utilization of calcium and phosphorus and necessary in normal bone development of animals, including the bones of the fetus. Proper formation of eggshell in hens.	Rickets in young. Osteomalacia in adults. *Chicks:* Reduced growth, soft bones (rickets), leg deformities. *Hens:* Poor eggshells and lowered hatchability.	Vitamin D_2 (irradiated ergosterol), the plant form. Vitamin D_3,the animal form. Sunlight. Sun-cured hays. Cod and certain other fish-liver oils. Irradiated yeast.	Most mammals can use either D_2 or D_3 but birds require vitamin D_3. When animals are exposed sufficiently to direct sunlight, the ultraviolet light in the sunlight penetrates the skin and produces vitamin D_3 from traces of 7-dehydrocholesterol in the tissues. The vitamin D requirement is less when a proper balance of calcium and phosphorus exists.
Vitamin E	Calves, sheep, horses, poultry, rats, and perhaps certain other animals.	Antioxidant. Muscle structure. Reproduction. Immune function.	Muscular dystrophy (stiff lamb disease and white muscle disease). Reproductive failure. Steatitis. *Chicks:* Encephalomalacia (crazy chick disease), exudative diathesis. *Hens:* Poor hatchability. *Turkeys:* Myopathy of the gizzard.	Alpha-tocopherol. Germ or germ oils of plants. Green plants. Green hays.	Vitamin E is widely distributed in all fresh natural feeds. Storage reduces vitamin E levels. Utilization of vitamin E is dependent on adequate selenium.
Vitamin K	Likely all species.	Essential for prothrombin formation and blood clotting.	Prolonged blood clotting time, generalized hemorrhages, and death in severe cases.	Menadione (vitamin K_3). Green pastures. Well-cured hays. Fish meal. In general, this factor is widely distributed in normal farm rations. Also, all classes of farm animals synthesize it.	Menadione is widely used commercially as a source of vitamin K. Antagonists of vitamin K are dicoumarol, various mycotoxins and warfarin.

(continued)

WATER SOLUBLE VITAMINS

Name Of Vitamin	Animals Most Affected	Functions	Some Deficiency Symptoms	Good Sources For Animals	Comments
Vitamin B_{12}	Swine, rats, poultry and man. Ruminants synthesize B_{12} unless cobalt is deficient.	Coenzyme in several enzyme systems. Closely linked with folic acid.	All animals show retarded growth. Pigs show uncoordinated hind leg movements; reproductive failure in sows. Eggs from B_{12} deficient hens fail to hatch.	Synthetic B_{12}. Protein supplements of animal origin. Fermentation products.	B_{12} is apt to be lacking in swine and poultry rations.
Biotin	Required by all species.	Component of several enzyme systems.	Pigs exhibit spasticity of the hind legs, cracks in the hooves and a dermatitis. There is also lowered efficiency of feed utilization. Chicks and turkey poults show dermatitis and perosis. *Hens:* Poor hatchability.	Synthetic biotin. Yeast, milk, egg yolk, liver and kidney are especially rich sources of biotin.	Ordinary farm rations probably contain ample biotin, or farm animals synthesize all they need. Sows benefit from added biotin. Biotin is rendered unavailable by raw egg white.
Choline	Swine, rats and poultry.	Involved in nerve impulses. A component of phospholipids. Donor of methyl groups.	Fatty livers in most species. Kidney hemorrhaging. In swine, abnormal gait in growing pigs and reproductive failure in adult females. In chicks, slipped tendon (perosis).	Choline chloride. Choline content of normal feeds.	With a high-protein diet, enough choline is synthesized from certain precursors and amino acid. Deficiency symptoms are more readily obtained as the protein content is lowered.
Folic acid (Folacin)	All animals and birds may be affected.	Related to B_{12} metabolism. Metabolic reactions involving incorporation of single carbon units into larger molecules. DNA formation.	Poor growth. Macrocytic anemia. Reduced litter size.	Synthetic folacin. Some animal proteins; well-cured, green leafy alfalfa; green pastures.	Folic acid is widely distributed in both plants and animals. It was given this name because of the abundance of the factor in plant leaves.
Inositol	Not clearly established.	Not known.	Spectacled-eye appearance in rats.	Synthetic inositol. All feeds.	Widely distributed in animal feeds. Synthesized in intestines.
Niacin (nicotinic acid)	It is a dietary essential of pigs, chickens, monkeys and man. Apparently synthesized in the digestive tract of ruminants (sheep and cattle) and the horse.	Constituent of coenzymes. Hydrogen transport. Energy metabolism.	Reduced growth and appetite. Swine exhibit diarrhea, vomiting, dermatitis, unthriftiness and ulcerated intestine. Chicks show poor feathering, scaly dermatitis and sometimes a ''spectacled eye.'' Dogs show a darkening of the tongue (black-tongue) and mouth lesions.	Synthetic niacin. Animal byproducts. Green alfalfa is a fair source.	Niacin present in most cereal grains is not available to the pig and other simple-stomached animals. Niacin can be synthesized in the body from surplus tryptophan. Mature ruminants do not need dietary niacin under most conditions because of synthesis of rumen microflora.

(continued)

Name Of Vitamin	Animals Most Affected	Functions	Some Deficiency Symptoms	Good Sources For Animals	Comments
Pantothenic acid	Rats, dogs, pigs, chickens and turkeys. Synthesized in rumen of cow and sheep; perhaps the horse also synthesizes it.	Component of coenzyme A, required for energy metabolism.	All species exhibit reduced growth, loss of hair, and enteritis. Mature ruminants synthesize pantothenic acid in rumen. Signs of deficiency in calves are rough coat, dermatitis, anorexia and loss of hair around eyes. Pigs develop ''goose-stepping'' gait. Chicks show dermatitis and embryonic death. Dogs vomit and show fatty infiltration of liver.	Calcium pantothenate. Fish solubles.	Grain is very deficient in pantothenic acid. Of all of B vitamins, it is most likely to be deficient under dry-lot conditions.
Pyridoxine (B_6)	B_6 is a dietary essential for the rat, pig, chick and dog. It is synthesized in the rumen of cattle and sheep and perhaps in the cecum of the horse; thus, no deficiency symptoms in these species have been reported.	As coenzyme in protein and nitrogen metabolism. Involved in red blood cell formation. Important in endocrine system.	All species exhibit convulsions. Pigs show anorexia and poor growth. Chicks show retarded growth and abnormal feathering. Hens show lowered egg laying and hatchability.	Synthetic vitamin B_6. Cereal grains and their byproducts. Rice bran and polished rice. Green pastures. Well-cured alfalfa hay. Yeast.	Normally, animal rations are not lacking in vitamin B_6.
Riboflavin (B_2)	Thought to be required by all animals, but deficiency symptoms not observed in ruminants, perhaps due to rumen synthesis. Deficiency symptoms noted in poultry, swine and horses.	Promotes growth and functions in the body as a constituent of several enzyme systems and as such is important in carbohydrate and amino acid metabolism.	Retarded growth in most species, with a wide variety of other symptoms somewhat variable with the species. Periodic ophthalmia (moon blindness) in horses; reproductive failure in the sow, and slow growth, anemia, diarrhea, unthrifty appearance, eye opacities, and an abnormal gait in the young pig; and curled toe paralysis in birds.	Synthetic riboflavin. Green pastures. Well-cured, green, leafy hays. Grass silage. Milk and milk products. Meat scraps and fish meal.	Grains are a poor source of riboflavin.
Thiamin (B_1)	All animals must have a dietary source, unless there is rumen synthesis, as in cattle and sheep.	As a coenzyme in energy metabolism. Promotes appetite and growth, required for normal carbohydrate metabolism, aids reproduction.	Reduction in appetite (anorexia) and loss in weight. Cardiovascular disturbances. Lowered body temperature. *Chicks:* Polyneuritis (retraction of the head). *Hens:* Lowered egg production.	Thiamin hydrochloride. Thiamin mononitrate. Green pastures. Well-cured, green, leafy hays. Cereal grains. Peas.	Seldom deficient in animals. Some fish feeds possess an enzyme, thiaminase, which is antagonistic to thiamin.
Vitamin C (ascorbic acid)	Dietary need is limited to man, the guinea pig and the monkey. Probably required by other species but synthesized in the body.	Collagen formation. Formation of the intercellular substances of the teeth, bones and soft tissues, increases resistance to infection, promotes firm gums.	Scurvy; swollen, bleeding and ulcerated gums; loosening of teeth and weak bones.	Ascorbic acid. Citrus fruits. Green pastures. Well-cured hays.	Ordinary farm rations and body synthesis provide adequate vitamin C.