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## Role of vitamins in animal health and production

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### Abstract

The importance of vitamins is now well recognized from requirement point of view on the basis of their chemical nature, physiological, functions, metabolism and symptoms of deficiency. Rickets, osteomalacia, night blindness, parakeratosis, infertility, haemorrhagic sweet clover disease, beriberi, polyneuritis, curled toe paralysis, scurvy and pellagra are some of the disease occurring as a result of different vitamin deficiencies.

Vitamins are therefore, accessory food factors which are not only required for productive purposes but are essential from disease prevention point of view. The requirements of vitamins depend upon the physiological status of Animals. The needs are likely to according to nutritional status, age, health and functions.

**Keywords:** Role, vitamins, animal health, production

### Introduction

Vitamins are organic constituents of feed. They are essential for life and good health. Deficiency of some vitamins may lead to health disorder (Iqbal Shah S., 1994) [6]. There are at least 14 vitamins, which have been accepted as essential factors, and the vitamins are divided in to two main groups, the fat soluble and the water soluble (table 1).

**Table 1:** fat soluble and water soluble vitamins

Fat- soluble vitamins	Water- soluble vitamins
Retinol (A)	Thiamin (B <sub>1</sub> )
Calciferol (D)	Riboflavin (B <sub>2</sub> )
Tocopherol (E)	Nicotinamide (PP)
Phylloquinone (K)	Byridoxin (B <sub>6</sub> )
	Pantothenic acid
	Biotin
	Folacin
	Choline
	Cyanocobalamin
	Ascorbic acid (C)

All fat soluble vitamins require some quantity of oil in the diet for their transport. Fat soluble vitamins are vitamins A, D, E and K whereas water soluble vitamins are recovered under B and C groups. Being water soluble, water acts as a carrier for their transport into various tissues (Arora S.P. and Kaur Harjit., 2010) [1].

Vitamins may be defined as organic compounds, required in small amounts for normal growth and maintenance of animal life. Some compounds function as vitamins only after undergoing a chemical change. Many vitamins are destroyed by oxidation; a process speeds up by the action of heat, light and certain metals such as iron. Thus, storage condition of a food affects its final vitamin potency (Garg, A.K., 2004) [5].

### Vitamins in immunity and disease resistance

Vitamins play a significant role in the immunity response and disease resistance of the animals. Immunity response of animal for vitamins E is due to its antioxidant property. It protects the cell and tissues of the body from oxidative damages caused due to free radicals

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action. The high content of vitamin A, D and E in colostrum are the major source of developing immunity in newborn calves. It has been observed that calves feed on vitamin E enriched colostrum have better immune response and survival rate from disease conditions like diarrhea and pneumonia. Similarly, vitamin A improves the disease resistance and immune response through its involvement in maintaining a functional epithelium and its effect on stress and glucocorticoid levels. Vitamin A and  $\beta$ -carotene play a protective role against mastitis and udder health (Garg, A.K., 2004) [5].

## Deficiency diseases of animal

### Vitamin A

Vitamin A is essential for normal growth of all tissue cells in growing animals, because it stimulates cell mitosis and retinoic acid is the form, which is utilized. Another important function of vitamin A is that it is utilized in the vision process in the retina of eye in the form of retinol for normal sight.

Night blindness is a common vitamin A deficiency disease recorded in young animals. Xerophthalmia is the secondary stage of this vitamin deficiency caused as a result of secondary infection. The symptoms shown by the sick animals are dry condition of cornea. Lack of eye sight and sometime corneal ulceration, the skin of animals is very sensitive to vitamin A deficiency and leads to hyperkeratosis. The symptoms of hyperkeratosis can occur either due to zinc deficiency or due to vitamin A deficiency or both (Arora S.P. and Kaur Harjit., 2010, Kaushish S.K., 2012) [1, 7]. A lack of vitamin A results in decreased reproductive efficiency in both males and females. Reproductive disorders, such as increased frequency of abortions, retained placenta, birth of weak, blind and dead calves may also be caused by vitamin A deficiency (Dass R. S., 2013) [2].

### Vitamin D

Vitamin D plays an important role in the metabolism of both Ca and P to synthesize supporting structure such as bones. It has a nutritional significance because Ca and P salts get transported from the blood in to the bones for deposition and development.

All vitamin D deficiency disease which occurs in livestock are similar to disturbed Ca and P metabolism because all the three are concerned in proper formation of bones (Arora S.P. and Kaur Harjit., Garg, A.K., 2004) [1, 5]. A vitamin D deficiency in growing calves is referred to as rickets and in adult cattle as osteomalacia. The signs of deficiency are bent forelegs, swollen and stiff joints and thickening of the metatarsal and metacarpal bones. A deficiency of vitamin D is rare under normal feeding regimes and upon adding vitamin D to the diet of a calf with rickets, clinical symptoms disappear rapidly (Dass R. S., 2013) [2].

### Vitamin E

Vitamin E has been shown to be an essential vitamin in the diet of all livestock and poultry and the most important physiological function of vitamin E is its antioxidant property in preventing the formation of peroxides in different tissues.

Vitamin E deficiency is likely to hamper the process of normal reproduction involving both male and female sexes. Degeneration changes take place in ovaries, testicles and uterus. The litters may either be underdeveloped at birth or may be delivered dead. In early pregnancy, the resorption of fetus may take place. Such types of symptoms have been sometime noticed in poultry. Selenium is not protective to these disease problems e.g., cattle, sheep and goats. Vitamin E

deficiency in young lambs may contribute to nutritional muscular dystrophy if selenium intake is low (Arora S.P. and Kaur Harjit., 2010, Das A., 2013) [1, 3]. Vitamin E deficiency symptoms in growing calves have been characterized as dystrophic lesions in the muscle known as "white muscle disease". A deficiency of vitamin E may result in cystic ovaries, increased incidence of retained placenta, and possibly increased risk of mastitis (Dass R. S., 2013) [2].

### Vitamin K

Vitamin K synthesizes prothrombin in the live so as to maintain its normal level in blood. Prothrombin after conversion to thrombin is responsible for clotting of blood. The normal time of clotting of blood is 3minutes. In surgical operation its administration is essential to prevent extensive bleeding.

In vitamin K defiance, coagulation time of the blood increases to more than 3minutes as a result of low levels of prothrombin. The animals are prone to this problem whenever the diets are defiant in vitamin K or when certain bacteriostatic drugs such as antibiotics or sulphonamides are prescribed for treatment of some other disease. Neonatal are likely to suffer from vitamin K deficiency at birth; however colostrum and milk when given in sufficient quantity will help them to overcome this problem (Arora S.P. and Kaur Harjit., 2010, Garg, A.K., 2004) [1, 5].

### Thiamin (Vitamin B<sub>1</sub>)

Vitamin B<sub>1</sub> is one of the first water soluble factors, which was identified as antineuritic for the prevention of Beriberi in man and polyneuritis in birds. It is classified under vitamin B-complex group and is a dietary requirement for all monogastrics. In ruminants all vitamins of B-complex group are synthesized in the rumen by microbes and therefore, they are not classified under dietary requirements for this category (Arora S.P. and Kaur Harjit., 2010) [1].

Early symptoms of thiamin deficiency in most species include loss of appetite, emaciation, muscular weakness, and progressive dysfunction of the nervous system. Chicks reared on thiamin deficient diet have poor appetites and consequently emaciated. After 10 about 10 days they develop polyneuritis, which is characterized by nerve degeneration and paralysis. Since in ruminants bacteria can synthesize thiamin, its deficiency does not occur. (Dass R. S., 2013) [2].

### Riboflavin (Vitamin B<sub>2</sub>)

Riboflavin is the second water soluble vitamin designated as B<sub>2</sub> characterized in the B-complex group of vitamin. It is involved in two main coenzymes such as flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD) which function in each and every animal cell and even in plant cells. Ruminants do not require this vitamin owing to its synthesis in the rumen whereas poultry require it essentially in the diet.

Riboflavin deficiency caused decrease in growth rate, lowers the hatchability of eggs and egg production decreases. Recovery of sick births is possible if treated early. Riboflavin deficiency in humans is characterized by dermatitis of face and photophobia. In new born calves the symptoms of deficiency are loss of hair and soreness in the corners of mouth (Arora S.P. and Kaur Harjit., 2010) [1].

### Pyridoxine (Vitamin B<sub>6</sub>)

Vitamin B<sub>6</sub> is a group of three active compounds which are functional in body metabolism. They are pyridoxol (alcohol

type), pyridosal (aldehyde type) and pyridoxamine (amine type). They all act as components of several enzymes, particularly the ones involved in amino acid metabolism. Feed and fodders are good sources of this vitamin and can meet the requirements of different species of livestock except under certain situations.

Characteristic symptoms of Vitamin B<sub>6</sub> deficiency are dermatitis, epileptic type convulsions and anemia. Vitamin B<sub>6</sub> deficiency creates neurological disorders because its coenzymes have a role to play in the processes of neurogenesis and neuron longevity. For this purpose apoenzymes are glutamate decarboxylase and  $\gamma$ -aminobutyric acid transaminase. Thus, in its deficiency symptoms of convulsions may appear (Arora S.P. and Kaur Harjit., 2010, Garg, A.K., 2004) <sup>[1,5]</sup>.

### **Niacin**

The importance of niacin was established when it was found that niacin was essential to prevent pellagra in humans and black tongue in dogs. Later it was considered dietary essential for all monogastrics. Corn eating people are prone to pellagra disease because this cereal is deficient both in niacin and tryptophan.

Pellagra recorded in human beings is a niacin deficiency disease of skin leading to dermatitis. Earlier there was considerable mortality amongst the low income group eating corn as their staple diet in USA, which is now extinct. The symptoms of deficiency are dermatitis which appears on face, neck, chest, hands, legs and feet. Mouth lesions show nervous and glossitis with tongue showing red patches. Certain patients may also show nervous disorder. In india, pellagra has been reported to be endemic amongst the low income group (Arora S.P. and Kaur Harjit., 2010) <sup>[1]</sup>.

### **Biotin**

Biotin is a dietary essential for monogastrics but since rumen microbes synthesize this vitamin in the rumen, it is therefore, not a requirement for ruminants. Problems of its deficiency are encountered when raw eggs containing avidin, a biotin binding protein, is consumed by humans. Avidin is a heat labile protein and its potency to bind biotin is lost on heating (Arora S.P. and Kaur Harjit., 2010, Garg, A.K., 2004) <sup>[1,5]</sup>.

### **Choline**

Choline is widely distributed and can be synthesized by the plants and in the liver of animals. Its requirements are quite high for animals; therefore, it needs to be supplied in the diet in additional quantity particularly in chicken and swine. Choline differs from the nomenclature of vitamins because it is a structural component of tissues rather a metabolic catalyst.

Choline deficiency in rats, swine and chicken results in fatty liver because lecithin which contains choline is not enough and lipotropic effect is more predominant. Its deficiency can also cause perosis in chicken and spraddled-leg in piglets. Its inadequacy can result in a pathological condition, namely haemorrhagic kidney in certain species of animals, e, g., swine and rats (Arora S.P. and Kaur Harjit., 2010) <sup>[1]</sup>.

### **Folic Acid**

Folic Acid is described under the generic name folacin which covers folic acid and some other related compounds. Its importance was realized based on folic acid deficiency recorded in pregnant women. In animals, deficiency problem is rare because rumen and intestinal syntheses is adequate to

meet the necessary requirements (Arora S.P. and Kaur Harjit., 2010) <sup>[1]</sup>.

### **Vitamin B<sub>12</sub>**

The discovery of Vitamin B<sub>12</sub> was attributed to its deficiency in pernicious anaemia in humans and its relationship with Co as the cause of wasting disease in ruminants. Neither animals nor plants can synthesize Vitamin B<sub>12</sub>. It is therefore, a dietary essential for all monogastrics. This vitamin is synthesized only by microbes.

### **Pantothenic acid**

Pantothenic acid was discovered as a vitamin from yeast and liver. In it is a component of coenzyme- A and acyl carrier protein and both of these acts in various reactions of animal metabolism.

coenzyme- A plays a role in many ways in all tissue cells and therefore, its deficiency can lead to variety of deficient symptoms e.g. effect on growth, reproduction, skin and nervous system. In pantothenic acid sufficiency, swine suffer from clinical symptoms showing nervous disorders of hind quarters and as a result, the legs show locomotor incoordination (Arora S.P. and Kaur Harjit., 2010) <sup>[1]</sup>.

Pantothenic acid deficiency in the chick growth is retarded and dermatitis occurs. In mature birds, hatchability is reduced. In farm animals no deficiency symptoms have been produced as it can be synthesized by the rumen microbes and this synthesized pantothenic acid meet the requirement of the animals (Dass R. S., 2013) <sup>[2]</sup>.

### **Ascorbic acid (Vitamin C)**

This vitamin is synthesized by plants as well as by all species of livestock except primates. Humans, guinea pigs, and fish are not able to synthesize it, therefore, it as a dietary essential for them. Its chemical nature was elucidated from its isolation from orange juice and thereafter it was synthesized and termed as hexuronic acid as ascorbic acid.

Scurvy is the disease known since long in humans in certain countries where green vegetables or fresh fruits are not available during certain months or it may occur in persons on long sea voyages. It takes about 3 months for deficiency symptoms to appear in humans and 3 weeks in guinea pig. Scurvy is characterized in humans by multiple haemorrhages, gingivitis and weakening of collagenous structure of cartilage and teeth, bleeding gums with loss of teeth, skin lesions and haemorrhages in the body which is characteristic of capillary fragility.

Adult ruminants normally do not suffer from vitamin C deficiency but calves at an early age up to 3 weeks may suffer from vitamin C deficiency because the rate of synthesis is insufficient to meet the requirements (Arora S.P. and Kaur Harjit., 2010, Garg, A.K., 2004) <sup>[1,5]</sup>.

### **Vitamin in reproduction**

Vitamins also play significant role in the reproduction and fertility of the animals. Role of vitamin A in reproductive health is well known. Similarly, role of vitamin E has been demonstrated to be very vital, particularly, in preventing retained placenta (Dubey S. C, Mishra N. and Shinde A. K., 2012) <sup>[4]</sup>.

Vitamin A is essential for normal reproduction and optimum milk production and vitamin D play a significant role for normal transfer of Ca and P quantity in to the milk in the mammary gland, vitamin D regulates Ca and P levels which seem to be a genetically parameter. Adequate quantity of

vitamin D in milk is also necessary for neonates (Arora S.P. and Kaur Harjit., 2010) <sup>[1]</sup>.

### **Conclusion**

Vitamins are organic compounds that are essential to life. The requirements of vitamins depend up on the physiological status of animals and man. The needs are likely to vary according to nutritional status, age, health and functions. High producing cows have higher vitamin requirements because of higher rate of metabolic activity than the low yielding or dry cows. Likewise breeder hens need higher requirements of vitamins for optimum hatchability in sheep vitamin A is more important and its deficiency can cause various kinds of blindness.

Thus, the above discussion indicates that vitamins are very important for the proper functioning of the body metabolism. Through new knowledge is being added every day, lot more needs to be done in this field.

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