

Review Article**SELENIUM AND VITAMIN E DEFICIENCY IN ANIMALS****Deepak Sapkota**B.V.Sc and A.H, Agriculture and Forestry University
E-mail: sapkotadeepak2113@gmail.com**Abstract**

This review article deals with the brief description of vitamin E and Selenium along with their deficiency syndrome. Selenium is a trace element that plays an important role in the health and production of animals. Selenium, a potent biological catalyst, functions synergistically with vitamin E in the maintenance of the body's antioxidant status. Vitamin E has also found to be essential for the integrity and optimum function of reproductive, muscular, circulatory, nervous, immune systems; and also involved in arachidonic and prostaglandin metabolism. In cattle, economically significant impacts such as reduced fertility, placental retentions, and the incidence of mastitis and metritis have been noted in selenium deficiency. For the beef cattle 100µg/kg DM (dry matter) and at 300µg/kg DM for dairy cows is the estimated daily nutritional requirements of selenium. The selenium requirement for calves is 100µg/kg DM per day. In adult cattle, NRC recommends 15 to 60 international units (IU) of Vitamin E as the daily nutritional need while in nursing calves it is 40–60 IU. It has been found that, diets rich in carbohydrates, nitrates, sulfates, calcium or hydrogen cyanide (clover, flax seeds) influenced negatively to the organism for the use of selenium in cattle.

Keywords: Vitamin E, Selenium, Antioxidant, Deficiency**Introduction**

Vitamin E and Selenium are essential nutrients for animals and human. Since the discovery of Vitamin E in the last 50 years, and recognition of the nutritional essentiality of selenium for the last 20 years, many nutritionally significant interrelationships between these nutrients have been demonstrated in several laboratories.

History of selenium

Illness of workers of plant were attributed to exposure to high levels of selenium while Jons Jakob Berzelius was isolating selenium from red deposits in the lead chambers of the sulfuric acid plant (Oldfield, 1999). However, selenium toxicity problems in livestock had been recorded for hundreds of years previously although the cause was unknown. During the 13th century, Marco Polo reported a hoof disease in horses during his travel in China. In Colombia in 1560 similar problems were noted where the syndrome was called alkali disease (Fordyce, 2005). In the early years of this century, selenium was identified as the active principal forages that caused livestock poisoning in South Dakota. This discovery led to investigations of natural sources of selenium, in the course of which the existence of a peculiar group of

plants having the ability to accumulate quantities of selenium up to several thousand parts per million when grown on seleniferous soil were noted. Such plants include members of the genera Astragalus, Haplopappas, Machaeantheia, and Stanleya, which are called "selenium accumulators" or "selenium indicators".

Selenium (Se) is a trace element that plays an important role in the performance and health of animals, being dependent on the amount of selenium taken up by plants as bioavailable selenium. In cattle, economically significant impacts such as reduced fertility, placental retentions, and the incidence of mastitis and metritis have been noted in selenium deficiency (Hefnawy et al, 2010; Spears et al, 2008). In the perinatal period, selenium deficiency leads to disorders altering milk quality in cows (Horky et al., 2015; Ran et al., 2010). Selenium plays a role in the formation and the activity of cytotoxic, helper T and Natural killer (NK) cells in the immune system (Petrie et al, 1989).

History of Vitamin E

Vitamin E, first described in 1922 by Evans and Bishop as a dietary factor, is composed of eight fat-soluble compounds (α -, β -, γ -, δ -tocopherol, and α -, β -

, γ -, δ -tocotrienol) obtained from plant (edible oils, seeds) organisms (Galli et al., 2017). Vitamin E acts synergistically with selenium which is known for its antioxidant feature (Liu et al., 2014). After being absorbed through the lymphatic pathway, it is transported into systemic circulation along with the chylomicrons and finally stored chiefly in the liver (Rengaraj & Hong, 2015). Vitamin E has been also found to be essential for the integrity and optimum function of reproductive, muscular, circulatory, nervous, immune systems; and also involved in arachidonic and prostaglandin metabolism (Graham, 1991).

Sources of Vitamin E

Vitamin E is naturally present in the various plant lipids. Human diets such as salad oils, dressings, shortenings, and margarine made from soybean, cottonseed, peanut, corn, and sunflower oils are the major sources of vitamin E while the Alfalfa, corn, and soybean meals are the major sources of the vitamin in animal feeds.

Nutritional requirements of Selenium and Vitamin E

For the beef cattle 100 μ g/kg DM (dry matter) and at 300 μ g/kg DM for dairy cows is the estimated daily nutritional requirements of selenium. The selenium requirement for calves is 100 μ g/kg DM per day (Mehdi and Dusfranse, 2016; Jobling, 2012) but for the hyper muscular cattle races, this intake of 100 μ g/kg DM of selenium per day does not seem to cover all the requirements. Intake of 300 μ g/kg DM per day has been advocated by Guyot and Rollin for the Belgian blue bulls. Dietary selenium consumption is also influenced by Vitamin E (Jobling, 2012). The amount of selenium is increased when a diet low in vitamin E is consumed which is necessary for the prevention of certain anomalies (Jobling, 2012). In adult cattle, NRC (Jobling, 2012) recommends 15 to 60 international units (IU) of Vitamin E as the daily nutritional need while the daily requirements for nursing calves are 40–60 IU. However, vitamin E and selenium are involved in similar functions. Therefore, Vitamin E deficiency could be partially compensated by an adequate intake of Selenium and vice versa.

Interaction with other elements

According to Kessler et al. (1993) it has been found that diets rich in carbohydrates, nitrates, sulfates, calcium or hydrogen cyanide (clover, flax seeds etc.) influenced negatively on the use of selenium in cattle. At a concentration of over 2.4 gm/kg DM, sulfur (S) could decrease the absorption of selenium by the steric competitiveness. Similarly, the rate of absorption of selenium is also decreased by Fe³⁺. In dairy cows, in late pregnancy, calcium level of 0.8% DM in the feed allows the absorption of selenium at an optimal level (Harrison and Conrad, 1984). Besides, with the high concentration of lead in the diet of the calf, serum levels of selenium and its content in all tissues were found to be decreased (Neathery et al, 1987). Selenium deficiency is exacerbated by Iodine deficiency. The raw materials rich in cellulose and crude protein have a positive impact on the selenium use by the assimilations rates (Kessler, 1993).

Deficiency symptoms

Deficiency signs of Selenium include exudative diathesis, poor immunogenic response, embryonic mortality, pancreatic fibrosis in birds and white muscle disease (nutritional muscular dystrophy) in ruminants and other species (Khanal & Knight, 2010). Vitamin E deficiency leads to similar signs and more effects are seen in immunity and reproductive performance: follicular and ovarian activity is highly susceptible in females; sperms are susceptible to oxidative damage in males (Liu et al., 2014).

Diagnosis of Vitamin E and Selenium deficiency

Diagnosis of vitamin E and selenium deficiency can be made through the history of diets, lesions in muscles, the selenium content of the soil, clinical findings, estimation of selenium level of blood and tissues, elevation of the liver and muscle-specific enzymes (C.P.K, S.G.O.T., S.G.P.T) and reduction of glutathione peroxidase in blood and tissue in white muscles. Ante mortem and post mortem diagnosis of both selenium deficiency and toxicity are best measured by blood and liver samples (Tiwary et al., 2006). Best and sensitive indicator of selenium status can be measured by whole blood selenium concentration than hair selenium or glutathione peroxidase activities (Deore et al., 2003).

Vitamin E and Selenium deficiency in animals

Diseases	Animal affected	Tissue affected
REPRODUCTIVE FAILURE <ul style="list-style-type: none"> Fetal death, reabsorption Testicular degeneration 	<ul style="list-style-type: none"> Rat, cow, ewe Rooster, rat, rabbit, dog, pig, monkey 	<ul style="list-style-type: none"> Embryonic vascular system Germinal epithelium
NUTRITIONAL MYOPATHIES <ul style="list-style-type: none"> Nutritional muscular dystrophy Mulberry heart disease Gizzard Myopathy Stiff lamb disease 	<ul style="list-style-type: none"> Sheep, goat, calf, rat, guinea pig Pig Turkey, duck, New born lamb 	<ul style="list-style-type: none"> Striated muscle Cardiac muscles Gizzard muscle Striated muscle
<ul style="list-style-type: none"> Erythrocyte hemolysis 	<ul style="list-style-type: none"> Chick, rat, rabbit 	<ul style="list-style-type: none"> Erythrocyte
<ul style="list-style-type: none"> Incisor depigmentation 	<ul style="list-style-type: none"> Rat 	<ul style="list-style-type: none"> Incisor enamel
SYSTEMIC DISORDER <ul style="list-style-type: none"> Liver necrosis Membrane lipid Peroxidation Accumulation of ceroid Kidney degeneration Anaemia 	<ul style="list-style-type: none"> Rat, mouse, pig Chick, rat Rat, mink, calf, lamb, dog, chick, turkey Mouse, rat, pig Monkey, pig 	<ul style="list-style-type: none"> Liver Hepatic mitochondria and microsomes Adipose Renal tubule contorti Bone
ENCEPHOLOMACIA	<ul style="list-style-type: none"> Chick 	<ul style="list-style-type: none"> Cerebellum
EXUDATIVE DIATHESIS	<ul style="list-style-type: none"> Chick 	<ul style="list-style-type: none"> Capillary walls
PANCREATIC FIBROSIS	<ul style="list-style-type: none"> Chick 	<ul style="list-style-type: none"> Pancreas

Prevention and Treatment

In animals, selenium deficiencies can be corrected by giving injections, dietary supplements, salt licks and drenches. The concentration of selenium in tissue, serum, and whole blood was found to be higher by the administration of organic selenium such as selenium methionine than by the administration of equivalent doses of selenite (Tiwary et al., 2006). Vitamin E status and species of host determines the level of dietary selenium needed to prevent deficiency. Assuming normal vitamin E status of the animal, concentrations of 0.04 - 0.1 mg/kg (dry weight) of selenium in feedstuffs are generally adequate for most animals with a range of 0.15-0.20 mg/kg for poultry and 0.03-0.05 mg/kg for ruminants and pigs (WHO, 1987). The international standard for Se requirements for cattle is 0.1 to 0.8 mg/kg dry matter. However there is a variation with the recommended level for cattle in different parts of the world. The concentration of 0.1 mg/kg of selenium and 10-20mg/kg DM of Vitamin E in feedstuffs is required to maintain immunity status in sheep (Liu et al., 2014). 3mg of selenium as sodium selenite along with 150 IU alpha-tocopherol acetate mixture @20mg/lb body weight through the intramuscular route has also been recommended. Tocopherol acetate can be given up to 300 to 2000mg/day in calf, 100 to 500mg/day in lamb, 500mg/day in pig, and 30 to 100mg/day in dog.

Conclusion

Selenium and Vitamin E play an important role in the health and production of cattle. The availability of selenium and Vitamin E in sufficient quantities in the diet ensures the proper functioning of the immune and reproduction systems. This biological function of selenium is accomplished through the selenoproteins, such as the Glutathione peroxidase family (GPx) in which selenium is a structural component. Deficiency of Vitamin E and Selenium has direct or indirect effect on the health, production and growth of different animal species. Large number of diseases in animals can be prevented by intake of Vitamin E and Selenium which are interrelated to each other. However, excessive selenium supplementation can lead to toxicity. The speciation of selenium in food and yeasts, as well as our understanding of their metabolism and absorption should be investigated on further studies.

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