

Review Article

The Role of B Vitamins in Livestock Nutrition

Kennady Vijayalakshmy^{1*}, Meenakshi Virmani², Rakesh Malik³,
K Rajalakshmi⁴ and Kasthuri S⁵

¹Department of Veterinary Physiology, LalaLajpatRai University of Veterinary and Animal Sciences, India

²Department of Veterinary Physiology, LalaLajpatRai University of Veterinary and Animal Sciences, India

³Department of Veterinary Physiology, LalaLajpatRai University of Veterinary and Animal Sciences, India

⁴Department of Veterinary Anatomy, Rajiv Gandhi Institute of Veterinary Education and Research

⁵Department of Livestock Products Technology, Rajiv Gandhi Institute of Veterinary Education and Research

*Corresponding author

Kennady Vijayalakshmy, Research Scholar, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India-125004, Tel: +91 9894207217; E-mail: drviji_vet6115@yahoo.com

Submitted: 29 November 2018

Accepted: 09 December 2018

Published: 10 December 2018

ISSN: 2379-948X

Copyright

© 2018 Vijayalakshmy et al.

OPEN ACCESS

Keywords

• B-Vitamins; Deficiency Symptoms; Interactions; Role of Vitamins; Side Effects

Abstract

Vitamins are one of the key essential nutrients that help in maintaining the normal health status of the animals. The dietary supplementation of vitamins are highly necessary for the normal functioning of the animals. Deficiency of vitamins in the diets can have various deleterious effects on the animal health and also in reproduction. Vitamin B or B-group vitamins also have various potential role in maintaining the normal well being of animals. The present review reveals the role of different B-vitamins and the deficiency symptoms associated with the B-vitamins.

INTRODUCTION

Vitamins are essential organic nutrients, required in small amounts. The body cannot synthesise them and they must be obtained by outside sources like diet, rumen bacteria and sun. They also act as key factors that are required for growth, maintenance, reproduction and lactation. Different classes of vitamins include fat-soluble vitamins that are stored in tissues (A, D, E and K); water-soluble vitamins are the one that are not stored in tissues and there should be a constant supply (B Complex vitamins and C). Vitamin B group include Vitamin B₁ (Thiamine), Vitamin B₂ (Riboflavin), Vitamin B₃ (Niacin), Vitamin B₅ (Pantothenic acid), Vitamin B₆ (Pyridoxine), Vitamin B₇ (Biotin), Vitamin B₉ (Folic acid) and Vitamin B₁₂ (Cyanocobalamin) [1-3]. Vitamins have certain principal role in various metabolic and reproductive activities. Deficiency of these vitamins may have detrimental effect in their reproductive and performance activities. At the same time, over-dosage or toxicity may also have serious deleterious effects on all the activities. The present review gives emphasise on the role, toxicity and deficiency symptoms of different B group vitamins in livestock.

Vitamin B₁ (Thiamine) is composed of a substituted pyridine and thiazole ring. Thiamine (vitamin B₁) was the first of the water-soluble B-vitamin family to be discovered. Thiamines are destroyed by prolonged heat and avoid sulfite preservatives as it breaks Vitamin B₁. Vitamin B₁ is stable in acid, unstable in aqueous solutions of PH more than 5. It is readily oxidised by exposure to the atmospheric oxygen or by oxidising agents to thiochrome [1]. Thiamine has got various roles that

include it is a Co-factor for carbohydrates metabolism (Kreb's Cycle). This role enables conversion of blood sugar (glucose) into biological energy. It is important for providing energy to the brain, improve transmission of nerve impulses through the nerves by providing them with energy, proper function of the heart muscles, healthy mucus membrane, maintenance of smooth and skeletal muscles and formation of RBC's [5,8]. Deficiency of this particular vitamin causes Beriberi - the syndrome typically causes poor appetite, abdominal pain, heart enlargement [4,5], constipation, weakness, swelling of limbs and muscle spasms (all can be reversed on treatment), loss of appetite, muscular weakness, severe nervous disorders, general weakness [1]. Large doses of thiamine may cause rashes, itching, or swelling. These reactions are more common with intravenous injections than oral supplements [6]. Oral antibiotics, sulfa drugs, and certain types of diuretics may lower thiamine levels in the body. Taking this vitamin may also intensify the effects of neuromuscular blocking agents that are used during some surgical procedures. B vitamins are best absorbed as a complex, and magnesium also promotes the absorption of thiamine [7].

Vitamin B₂ (Riboflavin) chemically has a three rings structure (iso-alloxazine) linked to ribitol moiety. It is soluble in water (1:3000 to 1:20000) due to internal crystalline structure, urea or niacinamide are used to solubilise riboflavin when high concentrated solution is needed. Vitamin B₂ is unstable to light in both acidic and basic medium. Under acidic conditions, light produces lumichrome and in alkaline PH light produce lumiflavin and they both are biologically inactive. Riboflavin is absorbed in the proximal intestine and it is mainly stored in the liver, kidney and heart [2,8]. The Active forms work as co-enzymes for many

150 oxidation-reduction reactions involved in carbohydrate, Proteins and fat metabolism; activation of vitamin B₁₂ and folate and protection of erythrocytes and other cells from oxidative stress [2,6,9]. Poor reproduction characterised by small litters and deformed young (cleft palate and club-footedness) curly toe paralysis in chicks, digestive disturbances, general weakness, eye abnormalities and reproductive impairment [4].

Vitamin B₅ (Pantothenic acid) is a peptide substance composed of Pantoic acid and b-Alanine. It can be present as the Calcium salt or the Alcohol "Pantothanol". Role of Vitamin B₅ as a part of Co-enzyme A that assists the following reactions, formation of Sterols (Cholesterol and 7-Dehydrocholesterol), formation of fatty acids and formation of keto acids such as pyruvic acid [1, 6]. The deficiency symptom in ruminants especially in calves, there is scaly dermatitis around the eyes and muzzle. In swine, it causes locomotor disorder (especially of hindquarters) – goose-stepping gait is noticed. In poultry, severe dermatitis, crusty scab, rough and frizzled feathers are noticed. In dogs and cats, there will be loss of appetite, lowered antibody response and reduced rates of growth.

Vitamin B₆ (Pyridoxine) is needed for more than 100 enzymes involved in protein metabolism. It is also essential for red blood cell metabolism and haemoglobin formation. The nervous and immune systems need vitamin B₆ to function efficiently and it is also needed for the conversion of Tryptophan (an amino acid) to Niacin (Vitamin B₃). Vitamin B₆ also helps maintain blood glucose within a normal range. When caloric intake is low, vitamin B₆ helps to convert stored carbohydrate or other nutrients to glucose to maintain normal blood sugar levels [1,9]. Deficiency symptoms in case of ruminants include demyelination of peripheral nerves and haemorrhages in the epicardium are noticed. In swine, it causes poor appetite, slow growth, microcytic hypochromic anaemia and convulsions. In poultry, perosis or slipped tendon is noticed. In dogs and cats, deficiency is characterised by ataxia, cardiac dilatation and hypertrophy [9].

Vitamin B₇ (Biotin) acts as a co-enzyme for several carboxylation reactions and it is important for carbon dioxide fixation, Carbohydrates and Fats metabolism and also acts as a Co-factor for Pyruvate carboxylase [1,6]. Deficiency of Biotin causes hindquarter paralysis in ruminants, transverse cracking of soles and top of the hooves in swine and ulcerative foot pad dermatitis in poultry.

Vitamin B₉ (Folic acid) acts as a co-enzyme for leucopoiesis (production of leukocytes), erythropoiesis (production of erythrocytes) and nucleoprotein synthesis [1,6,9]. Deficiency leads to diarrhoea and pneumonia in ruminants, mild normochromic and normocytic anaemia in swine, cervical paralysis and feather depigmentation in poultry. Deficiency has sometimes been associated with perosis or slipped tendon [2,9].

Vitamin B₁₂ is the most chemically complex of all the vitamins. The structure of B₁₂ is based on a Corrin ring, similar to the Porphyrin ring found in Heme, Chlorophyll, and Cytochrome. The central metal ion is Co (cobalt) [6,9-11]. Role of Vitamin B₁₂ is essential for the maturation of erythrocytes, protects against pernicious anaemia, cell growth and reproduction and for the formation of myelin and nucleoproteins [13]. Deficiency symptoms include Pernicious Anaemia that is a type of

megaloblastic anaemia characterised by decreased number of enlarged red blood cells. Deficiency also causes demyelination and irreversible nerve cell death. It also causes anaemia, gizzard erosion and fattiness of heart, liver, kidney in poultry. Rough hair coat and dermatitis in swine is also noticed [8, 12-13].

CONCLUSIONS

Provision of proper animal nutrition is a key factor to attain successful livestock production. Animals have to be fed diets that are nutritionally balanced. If the desired ration is not formulated, then there will be possibilities of reduced growth, poor reproduction, reduced milk yield and they may possibly die. Vitamins aid an animal by helping to regulate body functions, keeping the body healthy, and promoting resistance to diseases. Vitamins are organic nutrients that are needed in small quantities to perform specific functions. Hence, proper dietary management of vitamins in animals has to be taken into consideration so as to avoid further complications.

REFERENCES

1. Albert CM, Cook NR, Gaziano JM, Zaharris E, MacFadyen J, Danielson E, et al. Effect of folic acid and B vitamins on risk of cardiovascular events and total mortality among women at high risk for cardiovascular disease: a randomized trial. *J. Am. Vet. Med. Assoc.* 2008; 299: 2027-2036.
2. Food and Nutrition Board, authors; National Research Council, editor. Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B₆, folate, vitamin B₁₂, pantothenic acid, biotin and choline. National Academy Press; Washington, DC, USA: 1998. Institute of Medicine, Vitamin B₁₂; pp. 306-356.
3. Lonn E, Yusuf S, Arnold MJ, Sheridan P, Pogue J, Micks M, et al. Homocysteine lowering with folic acid and B vitamins in vascular disease. *N. Engl. J. Med.* 2006; 354: 1567-1577.
4. Morris MS, Jacques PF, Selhub J. Relation between homocysteine and B-vitamin status indicators and bone mineral density in older Americans. *Bone.* 2005; 37: 234-242.
5. Bona KH, Njolstad I, Ueland PM, Schirmer H, Tverdal A, Steigen T, et al. Homocysteine lowering and cardiovascular events after acute myocardial infarction. *N. Engl. J. Med.* 2006; 354: 1578-1588.
6. Den Elzen WP, Groeneveld Y, De Ruijter V, Souverein JH, Le Cessie S, Assendelft WJ, et al. Long-term use of proton pump inhibitors and vitamin B₁₂ status in elderly individuals. *Aliment. Pharmacol. Ther.* 2008; 27: 491-497.
7. Herrmann M, Umanskaya N, Traber L, Schmidt-Gayk H, Menke W, Lanzer G, Lenhart M, et al. The effect of B-vitamins on biochemical bone turnover markers and bone mineral density in osteoporotic patients: a 1-year double blind placebo controlled trial. *Clin. Chem. Lab. Med.* 2007; 45: 1785-1792.
8. Toole JF, Malinow MR, Chambless LE, Spence JD, Pettigrew LC, Howard VJ, et al. Lowering homocysteine in patients with ischemic stroke to prevent recurrent stroke, myocardial infarction, and death: the Vitamin Intervention for Stroke Prevention (VISP) randomized controlled trial. *J. Am. Vet. Med. Assoc.* 2004; 291: 565-575.
9. Herrmann M, Peter Schmidt J, Umanskaya N, Wagner A, Taban-Shomal O, Widmann T, et al. The role of hyperhomocysteinemia as well as folate, vitamin B(6) and B(12) deficiencies in osteoporosis: a systematic review. *Clin. Chem. Lab. Med.* 2007; 45: 1621-1632.
10. Scott JM. Bioavailability of vitamin B₁₂. *Eur. J. Clin. Nutr.* 1997; 51: S49-53.

11. Watanabe F. Vitamin B12 sources and bioavailability. *Exp. Biol. Med.* 2007; 232: 1266-1274.
12. Allen LH. How common is vitamin B-12 deficiency? *Am. J. Clin. Nutr.* 2009; 89: 693-696.
13. Valuck RJ, Ruscini JM. A case-control study on adverse effects: H2 blocker or proton pump inhibitor use and risk of vitamin B12 deficiency in older adults. *J. Clin. Epidemiol.* 2004; 57: 422-428.

Cite this article

Vijayalakshmy K, Virmani M, Malik R, Rajalakshmi K, Kasthuri S (2018) *The Role of B Vitamins in Livestock Nutrition. J Vet Med Res* 5(10): 1162.