ISSN: 2583-8288
Popular Article
Published on: 30.09.2024

Vitamin E Deficiency in Animals and Birds: Clinical importance and preventive approaches

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DOI: 10.5281/Vettoday.13888479

Vitamin E is an essential nutrient for animals and birds, playing a crucial role in maintaining cellular health, immunity, and reproductive functions. It is a fat-soluble antioxidant that protects cell membranes from oxidative damage. When animals or birds are deprived of sufficient vitamin E in their diet, it can lead to a range of health issues, collectively referred to as "vitamin E deficiency diseases." These disorders are often more pronounced in young, growing animals and can lead to substantial economic losses for farmers.

Why is Vitamin E Important?

Vitamin E works in conjunction with selenium to protect cells from oxidative stress. It helps in maintaining the integrity of cell membranes, ensuring proper muscle function, reproductive health, and boosting the immune system. In the absence of adequate vitamin E, cells can be damaged, leading to various conditions such as muscle degeneration, reproductive failure, and increased susceptibility to diseases. Vitamin E is an essential nutrient that plays multiple roles in the health and productivity of animals and birds. Its primary function is as a fat-soluble antioxidant, which protects cell membranes from oxidative damage.

Sources and Supplementation

Vitamin E is primarily obtained from green leafy forages, grains, and oilseeds. However, supplementation is often necessary in high-production systems, particularly where oxidative stress is prevalent or when animals are fed high-fat diets. Incorporating vitamin E into the diet of livestock, along with proper management, enhances overall animal health, productivity, and product quality, making it an indispensable component of animal nutrition.

Source Type	Examples	Vitamin E Content	Key Considerations
Natural Feed Sources	Fresh green forages (alfalfa, clover, grasses)	High in α-tocopherol, the most active form	Best for grazing animals; content decreases with maturity and storage
	Oilseeds (soybean, sunflower, canola)	Rich in Vitamin E and unsaturated fats	Can be added to mixed rations for supplemental feeding
	Whole grains (corn, wheat, oats)	Moderate amounts of Vitamin E	Heat and processing can reduce Vitamin E content
	Vegetable oils (wheat germ oil, sunflower oil)	High in α-tocopherol and γ-tocopherol	Use in moderation to avoid fat imbalances in rations
Vitamin E Supplements	α-Tocopherol acetate	500 - 1,000 IU/g depending on formulation	Stable and commonly used in commercial feed supplements
	Synthetic all-rac α-tocopheryl acetate	~1.36 times more IU than natural forms	Less bioavailable but cost-effective for large-scale usage
Commercial Premixes	Vitamin E + Selenium premix	Varies (based on formulation)	Provides synergistic benefits, especially for immune and reproductive health
	Vitamin E + A + D premix	Varies	Useful for multiple deficiencies; easy to mix into rations
Other Sources	Brewer's yeast	Moderate levels of natural Vitamin E	Can be used as a protein and Vitamin E source in rations
	Fish oils	Low Vitamin E, but often	Often used in conjunction with

Source Type	Examples	Vitamin E Content	Key Considerations
		combined with Vitamin E	Vitamin E to prevent oxidation
Silage & Hay	Legume hay (alfalfa, clover)	Low-to-moderate (depends on harvest and storage)	Vitamin E content decreases significantly during drying and storage
	Ensiled forages	Varies (lower than fresh forage)	Proper storage is crucial to preserve Vitamin E levels

Key functions of Vitamin E in the animals

1. Antioxidant Properties

- **Prevents Lipid Peroxidation**: Vitamin E protects unsaturated fatty acids in cellular and subcellular membranes from oxidative damage caused by free radicals.
- **Works Synergistically with Selenium**: It enhances the antioxidant properties of selenium, another essential nutrient. Together, they protect cells from oxidative stress, minimizing tissue damage.

2. Immune Function

- Vitamin E boosts immune responses in both mammals and birds. It enhances the activity of phagocytic cells, stimulates the production of antibodies, and increases the overall disease resistance.
- In poultry, it has been linked to improved immune responses, particularly under heat stress conditions.

3. Reproductive Health

- **Mammals**: Vitamin E is essential for maintaining reproductive health. It supports the integrity of the reproductive system, reduces oxidative stress in the ovaries, and maintains the health of sperm cells.
- **Birds**: It prevents reproductive disorders like "white muscle disease" and reduces the incidence of early embryo mortality.

4. Muscle Health and Prevention of Myopathies

- Deficiency in vitamin E can lead to muscle degeneration and conditions such as nutritional muscular dystrophy, which is characterized by muscle weakness and stiffness. This is particularly common in young calves, lambs, and kids. In pigs and poultry, vitamin E prevents conditions such as exudative diathesis and muscular dystrophy.

5. Growth and Performance

- Adequate vitamin E levels are essential for optimal growth and production in livestock. Deficiency can result in poor growth rates, reduced feed efficiency, and compromised meat quality.

6. Skin and Coat Health

- Vitamin E supports the health of skin and hair by protecting cells from oxidative stress. In livestock, it promotes a shiny coat and healthy skin, making it especially important for show animals.

7. Egg and Meat Quality in Poultry

- In poultry, vitamin E improves egg production, shell quality, and fertility. It also enhances meat quality by preventing lipid oxidation, which helps maintain the flavor, color, and shelf-life of poultry products.

8. Role in Stress Mitigation

- During periods of environmental, nutritional, or physiological stress, vitamin E requirements increase. Supplementation helps reduce the adverse effects of stress on health and productivity, making it a crucial nutrient during vaccination, heat stress, and transportation in birds and livestock.

9. Neurological Functions

- It maintains the health of the nervous system by protecting neural cells from oxidative damage, thus reducing the risk of degenerative diseases.

Vitamin E Deficiency Diseases in different species of animals and birds

S.No.	Species	Deficiency disease
1.	**Ruminants (Cattle, Sheep, Goats)**	• **Muscular dystrophy (White muscle disease)**: Stiffness, weakness, and muscle degeneration, particularly in young calves and lambs. • **Retained placenta**: Increased incidence in dairy cows. • **Sudden death**: Due to heart muscle damage. • **Reduced immunity**: Increased susceptibility to infections and poor vaccination response
	Horses	• **Equine Motor Neuron Disease (EMND)**: Muscle atrophy, weight loss, and weakness. • **Poor exercise tolerance**: Reluctance to work, muscle fasciculations. • **Recurrent tying-up**: Muscle pain and stiffness after exercise

	Swine	• **Mulberry heart disease**: Sudden death in piglets due to heart failure. • **Hepatosis dietetica**: Liver degeneration and hemorrhage • **White muscle disease**: Weakness and stiffness • **Exudative diathesis**: Generalized edema due to capillary fragility
	Poultry	• **Encephalomalacia ("Crazy Chick Disease")**: Incoordination, ataxia, head retraction. • **Exudative diathesis**: Edema in the subcutaneous tissues, particularly in the breast and abdomen • **Muscular dystrophy**: Weakness and poor feathering • **Decreased egg production and hatchability**: Due to poor embryo development
	Dogs & Cats	• **Steatitis (Yellow Fat Disease)**: Painful inflammation of body fat, reluctance to move, and sensitivity to touch • **Muscle weakness**: Ataxia and difficulty in standing • **Reproductive issues**: Poor fertility and small litter size in bitches
	Birds	• **Muscular dystrophy**: Weakness and inability to fly **Encephalomalacia**: Tremors and uncoordinated movement. • **Poor feather quality**: Brittle or easily broken feathers • **Reproductive issues**: Reduced egg fertility and hatchability

Vitamin E Deficiency Diseases and it's symptoms and prevention

1. **Nutritional Muscular Dystrophy (White Muscle Disease)**
   - **Species Affected**: Cattle, sheep, goats, pigs, and horses.
   - **Symptoms**: Stiffness, muscle weakness, inability to stand, and difficulty in breathing. The muscles appear pale and white due to degeneration, hence the name "white muscle disease."
   - **Prevention**: Adequate dietary supplementation with vitamin E and selenium. Injecting vitamin E and

selenium during critical growth periods can help prevent this condition.

White Muscle Disease in cattle
lamb suffering with White Muscle Disease

2. **Encephalomalacia (Crazy Chick Disease)**
   - **Species Affected**: Chickens and other poultry species.
   - **Symptoms**: Loss of coordination, head retraction, and in severe cases, twisting of the neck (opisthotonos). This disease primarily affects young chicks and results in degeneration of the brain.
   - **Prevention**: Ensure balanced vitamin E in feed, especially during the early growth stages of chicks.

Crazy Chick Disease in birds

3. **Exudative Diathesis**
    - **Species Affected**: Poultry (mainly broilers).
    - **Symptoms**: Swollen, edematous areas on the breast and thighs, and accumulation of fluid under the skin. This condition is often associated with a deficiency of both vitamin E and selenium.
    - **Prevention**: Supplement poultry diets with adequate levels of vitamin E and selenium.

Swollen joints in broilers

4. **Reproductive Failures**
    - **Species Affected**: Cattle, sheep, goats, and poultry.
    - **Symptoms**: Reduced fertility, poor conception rates, early embryonic death, and lower hatchability of eggs in birds. In severe cases, there may be abortion or stillbirths.
    - **Prevention**: Proper supplementation with vitamin E, especially in breeding animals and layers.
5. **Mulberry Heart Disease**
    - **Species Affected**: Pigs.
    - **Symptoms**: Sudden death due to cardiac failure, typically seen in piglets. The heart appears enlarged and hemorrhagic, resembling a mulberry.
    - **Prevention**: Ensure sows and piglets receive adequate vitamin E during gestation and early life.

Strategies to ensure optimal health in animals and birds:

- **Balanced Diet**: Provide a diet rich in vitamin E and selenium. Natural sources of vitamin E include green forages, vegetable oils, and whole grains.
- **Supplementation**: In areas where the soil is deficient in selenium or the diet is low in vitamin E, supplementation is crucial. Oral or injectable forms of vitamin E and selenium are available.
- **Management Practices**: Monitor feed quality and storage conditions, as vitamin E can be degraded by exposure to light, oxygen, and rancid fats.
- **Regular Health Checks**: Early detection and intervention can prevent
- severe outcomes. Regularly check for signs of muscle weakness, reproductive issues, and poor growth.

Conclusion

Vitamin E deficiency can lead to a wide range of health issues in animals and birds, significantly impacting productivity and welfare. By providing a balanced diet and supplementing as necessary, farmers and pet owners can ensure the well-being of their livestock and poultry.

Recommended dosage of Vitamin E for animals and birds

Animal Type	Recommended Dosage	Method of Administration	Key Considerations
Cattle (Beef & Dairy)	Maintenance: 500 - 1,000 IU/day Lactating/Pregnant: 1,000 - 3,000 IU/day	Oral supplements (feed or water)	Increased requirements during pregnancy and lactation. Supplement especially during high-stress periods.
Sheep and Goats	150 - 300 IU/day	Oral drenching or feed supplementation	Essential during late pregnancy and lactation. Important for lamb and kid muscle health.
Pigs	Piglets: 50 - 100 IU/day Adults: 300 - 500 IU/day	Oral supplements in feed	Required during periods of rapid growth. Increases immune function and muscle quality.
Poultry (Chickens)	10 - 20 IU per kg of feed Broilers: 50 - 100 IU per kg of feed	Feed fortification with vitamin E premixes	Vital for reproductive health and reducing oxidative stress

Animal Type	Recommended Dosage	Method of Administration	Key Considerations
			in broilers and laying hens.
Horses	Maintenance: 500 - 1,000 IU/day Performance/Pregnant: 1,000 - 2,000 IU/day	Oral supplements (feed or water)	Higher doses required for pregnant mares and performance horses. Crucial for muscle health.
Dogs	2 - 10 IU/kg of body weight/day	Oral supplements (tablets or capsules)	Requirements vary with age and activity levels. Antioxidant properties protect against aging.
Cats	2 - 8 IU/kg of body weight/day	Oral supplements (tablets or capsules)	Cats on high-fat diets may require more vitamin E to prevent lipid peroxidation.