

Essential Nutrients for Optimal Animal Health

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Description

Chitosan (CHT) is a natural substance widely used in veterinary medicine. However, the application of chitosan in animal production has severe shortcomings. This is because it is insoluble in pH ≥ 7 due to its very stable crystalline nature. This has stimulated its derivatization and de polymerization to low molecular weight chitosan. Low molecular weight chitosan (LWMCHT) has unique characteristics such as antibacterial activity and biodegradability, which make it sound for its use in animal nutrition, husbandry, and health. This review has provided sufficient evidence to demonstrate the usefulness of LWMCHT in animal nutrition, husbandry, and health. The review has also shown the benefit of LWMCHT in chemotherapy delivery. Further, the review has demonstrated the potential of LWMCHT as an alternative antibiotic in animal nutrition.

Animal Nutrition

Livestock is a substantial asset with a global market value of at least \$1.4 trillion. As a component of the extensive market chains, livestock industry employs up to 1.3 billion people globally, while 600 million poor smallholder farmers in developing nations directly depend on livestock especially, cattle. In addition to generating milk, meat, and manure, ruminants perform several other tasks, which include draught force. Animal protein makes up a significant portion of the typical person's diet. Thirty-three percent (33%) of the daily protein requirement worldwide is met by dairy, meat, and eggs from animals. The demand for livestock products is increasing daily due to population expansion and urbanisation. For rural households in developing nations, livestock species perform essential economic, social, and cultural services to boost farm revenue and households' well-being. Livestock is beneficial for a variety of reasons, including food production, family nutrition, family income, asset preservation, and soil productivity. Others include transportation, agricultural traction, agricultural diversification, sustainable agricultural production, family and community employment, ritual purposes, and social status. In many Sub-Saharan African (SSA) countries, livestock production accounts for about 35% of the agricultural GDP and employs approximately 70% of the population, especially in rural areas. According to Giller et al. livestock in this region meets up to 18% of the population's dietary protein needs with high-quality

animal protein, which helps to balance the people's high-carbohydrate diets.

Feeding is critical in producing livestock. However, the sector has to deal with inadequate feed resources especially, during the dry season, which results in weight loss of animals and lower market value. Further, due to the high price and limited supply of conventional feedstuffs, like soybean meal, which is a significant source of protein for the preparation of animal concentrates, feeding livestock with agricultural and industrial feed, has dramatically improved in recent years. The ever-increasing prices of cereals and protein concentrates have increased the cost of producing livestock. These problems necessitated the intensive study of less expensive non-traditional feed ingredients. Also, the rising global cost of energy, purchased feeds, equipment, and pharmaceutical drugs have led to a sharp drop in poultry production and the exit of many poultry farms has placed the industry's survival in jeopardy.

Feed Additives in Animal Nutrition

Feed additives in animal nutrition increase immunity and metabolic function and promote livestock growth in general. Antibiotics have been used for decades to treat diseases and boost agriculture development. The prolonged application of conventional antibiotics could result in microbial resistance and the residual effect on animal products. As a result, several non-conventional antibiotics have been developed. Chitosan is an alternative antibiotic and feed additive currently being used to formulate an animal's diet.

Chitosan is created by alkali-deacetylation of chitin. D-glucosamine and N-acetyl-D-glucosamine are two monosaccharides randomly arranged to form the linear polysaccharide called chitosan. Chitosan has uses in various industries, including the agricultural sector and more cutting-edge biotechnology and nanotechnology disciplines. Oral, nasal, and other routes deliver different medications into the body. Various chitosan-based films are used in food coating as an antimicrobial agent and a flocculating and adsorbing agent. Jayakumar et al. asserted that, chitosan could aim in delivering different genes utilised in siRNA technology, cancer, and gene therapy.

Further, chitosan has been used in 3D networks and micro-electrochemical systems are created using tungsten carbide

chitin whiskers, graphitic carbon nanocapsules, and other materials, which are used in heart regeneration therapy, corneal and bone regeneration, including brain and skin regeneration. According to Yamazaki, combining chitosan and sulphuric acid can potentially discharge high voltage for electrolyte application. Chitosan can remove effluents which include suspended particles from various processing plants, such as whey, dairy, poultry, and seafood.

Chitosan is also used to produce filter papers, biodegradable packaging, and water-resistant papers which are used as a fixative for colour photography and making colour films. Chitosan is used as a wood adhesive, fungicide, quality enhancer, and preservative. Chitosan, as an ingredient is employed in various cosmetic products due to its fungicidal properties, UV absorption capacity, and biocompatibility. In plants, for example, chitosan's antibacterial properties have made it beneficial for suppressing some plant diseases. Additionally, it increases the germination potential, root length

and activity and auxin concentration. It also increases seedling height and urea release in the soil. Further, chitosan by products provide animals with additional protein. Chitosan is effective to remove organic and inorganic contaminants from the environment. Chitosan and its derivatives are permeation enhancers that can be employed in drug-delivery systems because they can increase the permeability of intestinal, nasal, and buccal epithelial cells. Chitosan is a material that could create solid-state batteries. This is because it provides ionic conductivity in an acetic acid solution. The use of chitosan beads makes it possible to immobilise cells like *E. coli*. The two main criteria used to assess the physical, biological, and chemical characteristics of chitosan (CHT) are its molecular weight (Mw) and degree of deacetylation (DD). The most common commercial chitosan available is those with DD and kDa of 70-90% and 50 and 2000, respectively, derived from crustacean shells.