

Nanotechnology and its Role in Veterinary Medicine

Thokchom Shitarjit Singh^{1*} and Laishram Sunitibala Devi²

¹Assistant Professor, Department of Veterinary Anatomy, Sanskaram College of Veterinary and Animal Sciences, Patauda, Jhajjar, Haryana -124108, India.

²Scientist, Livestock Production Management, Indian Council of Agricultural Research-National Research Centre on Mithun, Medziphema, Nagaland -797106, India.

ARTICLE ID: 43

Abstract

Nanotechnology refers to the discipline and technology of small and specific things, range of 1–100 nm in size. Nanotechnology plays a vital role in every aspect of life. Recently, various applications of nanotechnology started to find their way in the field of veterinary sector. They increasingly invade the animal therapeutics, diagnostics, vaccines production, farm disinfectants, for animal breeding and reproduction, and even in the field of animal nutrition. Replacement of widely used antibiotics has a direct impact on public health. By doing this, they lessen the issue of drug resistance in both human and veterinary medicine as well as the issue of drug residues in milk and meat. While nanotechnology is regarded as one of the most foremost scientific technologies already applied in diverse subjects, its application in veterinary science is still in its infancy stages when compared to other disciplines.

Keywords: Nanotechnology, Veterinary medicine, Nanoparticles, Disease

Introduction

Nanotechnology refers to the material processing on the atomic or molecular level that has ability to calculate, function, and organize the matter. The term nanoscale is usually used to describe materials which have one or more of their three dimensions measuring the matter in the size range of 1–100nm (El-Sayed and Kamel, 2020). The term “Nano-technology” was first used by Norio Taniguchi in the year in 1974 (Taniguchi, 1974). Nanotechnology provides us with revolutionary solutions for traditional veterinary problems in the field of veterinary medicine and animal health. It enhanced the systems of diagnosis and treatment, provide new gears for molecular and cellular breeding, animal nutrition scenarios ranging from nutrient uptake and use, animal waste adjustment as expelled from livestock, pathogen detection, and much more (Woldeamanuel *et al.*, 2021).

Characteristics of Nanoparticles (NPs)

Nanoparticles can be classified into the following sets: polymers, nanocrystals, dendrimers, metal oxides, silica oxides, carbon, quantum dots and lipids have been developed over the last few decades on based on various components, along with an increasing variety of newly developed materials.

Applications of Nanotechnology

Nanotechnology in the field of animal production and veterinary medicine are extremely versatile and has a direct impact on human health. Below is an overview of some of the key nanotechnology methods used in veterinary research.

1. **Nanovaccines and nanoadjuvants:** The NPs are increasingly used in vaccine preparation. They perform essential immunomodulatory tasks that enhance the immune responses. They increase the cross presentation of peptides and activate the antigen presenting cells and act as adjuvants to slow down the release of the antigens which enhancing the effectiveness of the vaccine (Awate *et al.*, 2013).
2. **Animal breeding and reproduction:** The goals of such nanotechnology-based animal reproduction investigations are to build nano-bio sensors for physiological or altered detection of the reproductive status, develop metal nanoparticles for fertility control applications, develop nanodevices for secure cryopreservation of gametes and embryos and develop sustained release systems of molecules, including hormones, vitamins, antibiotics, antioxidants, nucleic acids, among others for diagnosis and treatment of reproductive disorders (Wang *et al.* 2014; Weibel *et al.*, 2014).
3. **Animal health and nutrition:** Nanominerals production provides various advantages for animal feed industry. They are cheaper and have growth promoting and immune stimulating effects. It also helps to control pathogens present in the feed and regulates the rumen fermentation process (Swain *et al.*, 2015).
4. **Nanopharmacuetics:** Compared to other fields in veterinary care, pharmacology and nanopharmaceuticals are at the forefront of what nanotechnology can develop. It enables the production of new drugs and the possibility of reworking traditional substances to achieve better results in efficacy (Chen and Conti, 2010). Liposomes have been reported to enhance drug solubility and boost their pharmacokinetic properties, accelerated synthesis and reduction of adverse side effects (Dos Santos *et al.*, 2011).

5. **Disease diagnostics:** Use of nanotechnology instruments for the examination of animal diseases or as animal simulations for the diagnosis of human diseases is remarkable. Application of NPs replaced the surgical interference in the treatment of cancer, reduce doses which are thousand time less than chemotherapy and has no side effects on healthy tissues (Troncarelli *et al.*, 2013). Recent studies suggest using quantum dots for in vivo imaging in small animal models.

Conclusion

Nanotechnology is a fascinating and quickly evolving aspect of engineering that enables us to interact at the radioactive and molecular levels, enable to explore, managed and apply nanometer-dimensional. It provided revolutionary advances in all aspect of veterinary medicine such as diagnosis, treatment, vaccination, animal production and reproduction, feeding, and hygiene. Although nanotechnology is still in the early stages of its development and nanoprodukt's safety is a worldwide concern, but we can say that's years from today nanotechnology will bring revolution in the field of veterinary & human medicine.

References

- Awate, S., Babiuk, L. A. and Mutwiri, G. (2013). Mechanisms of action of adjuvants. *Frontiers in immunology*, 4, 114.
- Chen, K. and Conti, P. (2010). Target-specific delivery of peptide-based probes for PET imaging. *Adv Drug Deliv Rev* 62: 1005– 1022.
- Dos Santos, G.C., de Oliveira, R.E., Ribeiro, R.T., Leite, E.A., Lacerda, R.G., et al. (2011). Study of the pilot production process of long-circulating and pHsensitive liposomes containing cisplatin. *J. Liposome Res.* 21: 60–69.
- El-Sayed, A. and Kamel, M. (2020). Advanced applications of nanotechnology in veterinary medicine. *Environmental Science and Pollution Research*, 27, 19073-19086.
- Taniguchi, N. (1974). "On the Basic Concept of 'Nano-Technology'," *Proc. Intl. Conf. Prod. Eng.* Tokyo, Part II, Japan Society of Precision Engineering.
- Troncarelli, M.Z., Brandão, H.M., Gern, J.C., Guimarães, A.S. and Langoni, H. (2013). Nanotechnology and antimicrobials in veterinary medicine Badajoz, Spain.
- Wang, T., Zhao, G., Liang, X., Xu, Y., Li, Y., et al. (2014). Numerical simulation of the effect of superparamagnetic nanoparticles on microwave rewarming of cryopreserved tissues. *Cryobiology*. 68: 234-243.



Weibel, M., Badano, J. and Rintoul, I. (2014). Technological evolution of hormone delivery systems for estrous synchronization in cattle. *Int. J. Livest. Res.* 4: 20-40.

Woldeamanuel, K. M., Kurra, F. A. and Roba, Y. T. (2021). A review on nanotechnology and its application in modern veterinary science. *International Journal of Nanomaterials, Nanotechnology and Nanomedicine.* 7(1), 026-031.

