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Review Article

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Review on application of nanotechnology in animal health and by product industry

Gizachew Fentahun Desta
Department of Animal Biotechnology, Injibara University, Injibara, Ethiopia.
*Correspondence author's: E-mail; *gizafentahun@gmail.com*

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Abstract

Nanotechnology is an exciting scientific and technological area that is considered as one of the hot topics of the 21st century. It has the potential to manipulate matter at the nano-meter scale, creating and assembling substances at a molecular level with new and interesting properties. This has offered opportunities for applications in different sectors. Recently, nanotechnology has received particular attention due to its promising to different applications, such as in disease diagnosis at molecular levels as well as at a single cell by using different nano-materials, drug delivery system and treatments, nano-vaccine and vaccine adjuvant, tumor therapy. The technology also have a crucial role in animal product industry, such as meat packaging, nano-milk production and nano-egg production with the goal of enhancing the performance of the product, prolonging the product shelf life and freshness, and improving the safety and quality of animal origin food. In the future it provide new products and new processes expected that the application of nano-materials in tumor therapy will greatly improve current methods of tumor-cell detection and tumor therapy, while reducing toxicity compared to traditional tumor treatments. On other hand, there are challenges and controversies in the field about the technology. Therefore; risk assessment should be done before field application and public awareness should be done about the effect of nano-particles and peoples exposed to the nanoparticles should use personal protective equipments.

1. Introduction

Nanotechnology is an exciting scientific and technological area that is considered as one of the hot topics of the 21st century. This emerging field is about the rational investigation and potential uses of the matter at the nanometer scale (Tiwari *et al*., 2011). Nanotechnology can be referred to as an area of science and technology focused on the manufacture of nano- sized materials (less than 100 nm in diameter at least one dimension) that possess unique and novel properties, although a globally accepted definition does not exist (Gruère, 2012). It also refers to the production, characterization, and manipulation of such materials.

The major differences between nano-materials and bulk materials are the changes in physicochemical (e.g., porosity), optical, mechanical and catalytic properties. Other differences are also observed in the strength, absorption, function, weight, and stabilization of materials (Cockburn *et al*., 2012). All of these properties make nanotechnology very promising, and have led to the development of many innovations in the area of improve diagnosis and treatment delivery systems , productivity such as in meat production, milk and egg production, processing and food packaging (Rahim *et al*., 2013).

However, when this generic technology is applied to foods, the changed properties of the nanomaterials may also affect the behavior and properties of the foods (Cockburn *et al*., 2012). Nonetheless, decreased use of certain food ingredients due to the improved bioavailability of functional compounds can be achieved through the use of nanomaterials. Thus, it is also likely that the amounts of salt, sugar and preservatives can be reduced through the use of nanomaterials, while improving color, flavor and texture and thereby enhancing the sensory acceptance. Furthermore, the delivery and absorption of active ingredients and nutrients can be significantly improved (Chaudhry and Castle, 2011). Other benefits include targeted delivery, enhanced stability and absorption of the bioactive compounds, along with improved antimicrobial effects against pathogens in food that may be resistant to chemical antimicrobials. As the technology an exciting scientific and technological hot topic area of this century, it is important to provide a highlight review about it. Therefore, the objective of this review to provide a highlight about application of nanotechnology in disease diagnosis and treatment approaches and animal product industry processing.

2. Application of nanotechnology in animal health

2.1. Disease Diagnosis and Treatment

Nanotechnology has the potential to provide cheaper, fast and precise diagnostic tools. These days, nanomaterials are playing a key role in imaging and monitoring and hence earlier detection of disease (Tripp *et al*., 2007). Better diagnosis has a positive effect in the cost of animal health care. Bio nanomaterial based research has emerged as a new exciting field of DNA, RNA and peptides are considered as important bio nanomaterials for the fundamental development in life sciences. The nanomaterial s such as quantum dots, nano shells, carbon nanotubes can be synthesized and functionalized which may couple with the imaging sources and accompany the molecule with ultrasound, magnetic resonance, X-rays techniques to diagnose the targeted organ effectively (Loukanov *et al*., 2012).

The effective delivery of therapeutic molecules has been a major barrier to obtain targeted response against the disease agent. Many drugs are effective in treating diseases but most of them also have certain limitations with regard to toxicity, poor aqueous solubility and cell impermeability. The drawbacks discussed above can be solved by nano-medicine. Nano-medicine has the potential to solve unique biological challenges. New drugs and new delivery systems both come under nano-medicine umbrella. Therapeutic and diagnostic agents are at the forefront projects of nano-medicine and research is focused on rational delivery and targeting of pharmaceuticals in animals (Desai *et al*., 2007).

Nano-pharmaceuticals, the most promising and productive area of nanotechnology application in animal treatment involves nanoparticles and hence they are available for broad range of biological targets owing to their small size and higher mobility. Nano-pharmaceuticals engross encapsulating the material to generate nanoparticle which thereby improves solubility, diffusion and degradation characteristics of the encapsulated material and, nanomaterials that can carry drugs to the targeted site (Si *et al*., 2007). Conventional synthetic and natural antimicrobial substances are being tested, and have shown excellent results against multi-resistant microorganisms and bacteria strains that are normally hard to eliminate by using the conventional treatment, like *Brucella abortus*, *Mycobacterium bovis*, *Staphylococcus aureus*, *Salmonella*, *Ehrlichia*, *Ana plasma*, *Rhodococcus equi* and others (Mcmillan *et al*., 2011).

2.2. Drug Delivery Systems

Considering the pharmacology area, nanotechnology allows the development of new products and also the possibility to rework conventional substances in order to obtain better efficacy results, by loading drugs into nanoparticles through physical encapsulation, adsorption, or chemical conjugation, that the pharmacokinetics and therapeutic index of the drugs can be significantly improved in contrast to the free drug counterparts. Drug-loaded nanoparticles can enter host cells through endocytosis and then release drug payloads to treat microbes-induced intracellular infections (Zhang *et al*., 2010).

Nanoparticle-based drug delivery provides many advantages, such as enhancing drug-therapeutic efficiency and pharmacological characteristics. The utility of nanoparticles in improving pharmacokinetics, reducing unwanted side effects, and improving delivery to disease sites has been demonstrated for a number of nano-drug delivery systems (Mcmillan *et al*., 2011). It also improve the solubility of poorly water-soluble drugs, modify pharmacokinetics, increase drug half-life by reducing immunogenicity, increase specificity towards the target cell or tissue, improve bioavailability, diminish drug metabolism and enable a more controllable release of therapeutic compounds and the delivery of two or more drugs simultaneously for combination therapy (Shabaruddin *et al*.,2013).

Generally, the practical consequences of a pharmaceutical nanostructure substance are providing a rational use of the active ingredient to the tissues and cells of interest and delivering multiple therapeutic agents to the same cells for combination therapy (Peer *et al*., 2007). Providing new perspectives of administration routes for medicines and vaccines and also reducing stress and toxicity for drug administration, collateral effects of conventional pharmaceutical actives (Zhag *et al*., 2008). Moreover, it provides the use of new molecules and actives in animal therapeutic and producing low or no residues in animal products, resulting in no withdrawal needed.

2.3. Nano-Vaccine and Vaccine Adjuvant

Vaccination is one of the important methods of prevention of disease in advance by developing antibody against the particular pathogen. Nano-particles used as vaccine carriers and adjuvants. Synthetic oligodeoxynucleotides and antigens in biodegradable nano-spheres used for immunization. These new perspectives for vaccines development are contributing with better efficacy and safety results, both in pets and livestock animals (Akagi *et al*., 2012). Liposomal vaccines can be made by associating microbes, soluble antigens, and cytokine. Liposomes as vaccine adjuvant, liposomes have been firmly established as immune-adjuvants (enhancers of the immunological response), potentiating both cell mediated and humoral immunity. Liposomal immune adjuvants act by slowly releasing encapsulated antigen on intramuscular injection and also by passively accumulating within regional lymph nodes (Loukanov *et al*., 2012).

Adjuvants are agents added to a vaccine to augment immune responses toward antigens. A number of studies describe the use of nanoparticles as adjuvant. Immunization of animals with both complete antigens and haptens (small molecules that can elicit an immune response only when attached to a large carrier such as a nanoparticle or a protein) conjugated to the surface of colloidal gold particles generated higher levels of specific antibodies than immunization of the same antigens with classical adjuvants (Andreev, 2010).

2.4. Tumor Therapy

To fight against tumors, patients have to be administered drugs that increase in dose over time, which is associated with considerable adverse effects, such as multidrug resistance and accumulative systemic toxicity. Chemotherapy also causes side effects in healthy tissues, which have negative impacts on the quality of life of the patients (Antonio *et al*., 2014). In addition, chemotherapy may concomitantly damage adjacent organs or tissues, and these adverse effects are difficult to avoid. In recent decades, the development of nanotechnology has provided an opportunity to overcome the aforementioned side effects. The integration of various nano-materials (NMs) with spectroscopic, biochemical, and optical methods has allowed the development of advanced methods for tumor therapy, which may revolutionize the treatment of tumors (Shabaruddin *et al*., 2013).

An emerging approach is to utilize nanotechnology and NMs to minimize toxicity to healthy tissues. Various NMs have performed attractively in various aspects of antitumor treatment and garnered intense research interest, and they have presented great potential for antitumor treatment by enhancing the effectiveness of treatments and reducing systemic side effects. scientific research shows that NM-based therapeutics have great potential in the treatment of tumors, diabetes, infection, neurodegenerative disease, and inflammation (Ibanez *et al*., 2015). The integration of tumor therapy with NMs is expected to bring about new breakthroughs for nanotechnology in the field of medicine (Liu *et al*., 2015).

3. Application of nanotechnology on animal by product industry

Nanotechnology is projected to impact the food industry mainly through the creation of nano-sized materials with novel properties, the development of novel processing methods, products and improvements in food safety and biosecurity. Strategies for the application of nanomaterials in food may be different from those employed in traditional nanotechnology (Weiss *et al*., 2010). Nevertheless, due to the novel properties exhibited by nanomaterials, significant beneficial changes are expected to be enabled in the production, packaging and distribution of many food products, including meat, milk and egg products (Gruère, 2012).

3.1. Nano Meat Technology

Areas of investigation in meat product include reformulation through minimizing and modifying the fat content, lowering the amount of sodium, phosphate and nitrate, and inclusion of probiotics, prebiotics and other materials. In addition, improvement of bioavailability, formation of compounds that can promote health and reduction of unhealthy compounds are possible areas of study including processing and storage of meat products (Olmedilla *et al.*, 2013). A wide variety of ingredients exist for potential application in meat processing (e.g., fat replacers such as citrus fiber, soy protein concentrate, oat fiber, carrageenan, and soya fiber and plasma protein) (Weiss *et al*., 2010). The potential benefit is obtained from the use of nanotechnology by the delivery of antioxidants and antimicrobials through nanomaterial in processed meats (Ozimek *et al*., 2010).

Since consumers demanding higher quality meat products at affordable prices and growing competition, the meat production sector has witnessed an exceptional change in not only the ingredients, but also the processing system (Weiss *et al*., 2010). The demand for sustainable production of meat products and emphasis on human health and wellness has further led to the growth of innovation in the meat product industry (Young *et al*., 2013). Thus, expectations have risen regarding the use of ingredients and additives with improved functionality to enhance the quality and image of muscle foods (Olmedilla *et al*., 2013). Growing health concerns has caused a shift in the focus towards the development of novel meat products with reduced amounts of saturated fats, sodium salts, color fixatives (e.g., nitrites), and cholesterols, along with increased use of ingredients which have positive effects on health. It is also expected that novel products developed with new ingredients and processing systems should possess similar gustatory, visual and aromatic effects as traditional meat products (Weiss *et al*., 2010).

A significant challenge in traditional meat products is the low bioavailability of bioactive components when included in meat products, have often led to unfavorable effects, such as poor organoleptic quality, lowered capacity to retain water and poor resistance to the growth of microbes (Weiss *et al*., 2010). Therefore, the meat industry needs to implement and support an innovation agenda to address such challenges and ultimately improve the quality experienced by consumers (Troy and Kerry, 2010). Thus, nanotechnology is one such process-based innovation that could have a significant impact on the food industry (Linton and Walsh, 2008).

The technology has opened the path to an unexplored science for studying individual nanoparticles and their unique application for meat industry ranging from meat design, achieving food security, meat safety, overcoming food allergies, meat packaging, restoring meat damage and sensory evaluation to processes such as filtration, separation and encapsulation with a goal of making meat products cost-effective with the natural properties (Singh *et al*., 2011).

Nanotechnology holds out enormous possibilities and although, so, far relatively little has been accomplished, tons of money is being poured into the research, suggesting as nothing else that it is taken seriously (Singh and Neelam, 2010). Interestingly, one of the first examples given of the speculative technology of nanotechnology was that of synthesized meat. The technology is ranging from the actual to the speculative promise a variety of ways to create real meat without killing animals (Cagri *et al.*, 2004). Moreover nanotechnology continues to advance at its current pace, we could expect that soon we will be able to create unlimited amount of meat by synthesis at the atomic level, which would eradicate hunger.

Although, still commercially infeasible at the moment or in some cases technically infeasible for several years to come, the point here is not to be unfocused by the fact that we cannot yet make exploit of these technologies but rather to choose whether we should support the development of these technologies. Some of the researchers in this field, for instance, are so committed to the development of cultured meat; largely out organizations to pursue the technology. For example, New Harvest is a non-profit research organization working to develop new meat substitutes, including cultured meat-meat produced in vitro , in a cell culture, rather than from an animal (Hopkins and Dacey, 2008).

3.2. Nanotechnology Based Meat Packaging

Increasing competition between suppliers and government regulations, have resulted in innovations in films that enhance products and package performance. Since consumer demands meat, to remain fresh for longer period, ease in handling, safe and healthy with environmental friendly packaging. Properties such as mechanical and heat resistance can be augmented by the use of nanotechnology (Singh and Neelam, 2010). Moreover, environment friendly, light weight-packaging materials can be made for use in army rations.

Nanotechnology provides food scientists with a quantity of ways to make novel laminate films suitable for use in the food industry. Nanolaminates can provide food scientists some advantages for the preparation of edible coatings and films over usual technologies thus, have a number of significant applications within the food industry (Cagri *et al*., 2004). These coatings or films could serve as moisture, lipid and gas barriers. Alternatively, they could improve the textural properties of foods or serve as carriers of functional agents such as colors, flavors, antioxidants, nutrients and antimicrobials.

3.3. Nano Milk Production

Nanotechnology is a new technological tool in modern raw milk production and pasteurization. An emerging technologies such as microarray technology and nanotechnology have the potential to advance nutrition and health science in many aspects of relevance for modern milk production. This implies both a better understanding of the aspects of importance for ensuring the establishment of the conditions for the whole cow and hereby the necessary public acceptance of an effective and industrialized milk production and the support of milk and dairy products as a natural part of a healthy diet (Womack, 2005).

Recent developments of nanotechnological tools like biosensors substantiate an intensified research in new solid on-line/at line methods, which can measure critical points throughout the milk production chain (e.g., feed, cow, raw milk, milk tank, throughout the processing chain, during storage and distribution with regard to pathogens, indicator organisms of contamination, antibiotics, toxins, chemical contaminants, and allergens). These support the development of hazard analysis critical control points (HACCP)-based quality management systems for quality management systems as well as shelf-life prediction systems in dairy products (Andersen, 2007).

3.4. Nano Egg Production

Role of nanotechnology in designer eggs production is now a well-known fact. In the future it is expected that, the market has to supply the cholesterol free eggs, yolkless or reduced yolk eggs which can be the high value protein source, immune eggs which can supply the predetermined antibodies and therapeutic eggs with supply the predetermined physiological factors for treatment purposes. The tools and techniques currently with us will not give the solution for these challenges. They can only be solved by an emerging nanotechnology, which deals not only merely at the molecular level but also at the atomic level (Kannaki and Verma, 2006).

Eggs are often the source food borne pathogens, like salmonella. Early detection of food borne pathogenic bacteria is critical to prevent disease outbreaks and safeguard public health. Numerous methods have been developed in order to detect this pathogen; however, the biggest challenges remain detection speed and sensitivity. Now, a novel nanotechnology-based biosensor is showing great potential for food borne pathogenic bacteria detection with high precision (Boulaiz *et al*., 2011).

4. Future perspectives and challenges

Over the last years, NMs have come to play a significant role in commercial development. Indeed, we might expect to produce many breakthroughs and new prospects for the world economy from advances in nanotechnology. With the potentially wide application of NMs in the future, NMs may be extensively used in various fields. In the upcoming years, nanotechnology research will reform the science and technology of animal health and will help to boost up the livestock production. Proponents of nanotechnology consider this technology as one of the most powerful tools in modern society; it has made a revolutionary impact on every aspect of human life. Looking at the speed of advancement of nanomedicine, particularly the utilization of various nanoparticles in the prevention, diagnosis, and treatment of a complex disease like cancer, one can predict that this cutting-edge technology will be on our doorstep soon (Niknamfar and Esmaeili, 2017).

In the future, it can be conceived that bacterial infections can be eliminated in the patient within a few minutes, instead of using treatment with antibiotics for weeks. With the advancement in technology, we can expect to generate the capability to perform surgery at a cellular level, thereby removing individual diseased cells and even repairing defective portions of the individual cells (Tatli *et al*., 2018). Several nanotechnology-based products are already in the market and many are under development or in experimental stages (Meena *et al*., 2018).

Although the benefits associated with the use of nanoparticulate systems in order to optimize the productive performance and treat diseases, it is largely accepted that some nanoparticles (like metal nanoparticles) can elicit toxic and deleterious side effects towards living organisms. As with all new technologies new risks might appear that we have not thought about yet, underlining the need for continuous and dynamic risk reviews (Love *et al*., 2012). There are different challenges related to nanotechnologies such as environmental risks due to release of nanoparticles into the environment, human (workers and consumers) may also suffer from safety risks and futuristic risks like human enhancement and self-replications of nanomachines, business risks involved with the marketing of nanotechnology-enabled products and risks related to the protection of intellectual property are identified (Boulaiz *et al*., 2011).

5. Conclusion and Recommendations

Nanotechnology has emerged as one of the most innovative technology and has potential to provide fast and precise drug delivery system, diagnostic nanomaterial tools and therapeutic nanoparticle and nanomedicine (Nano drug). These nanomaterials are playing a key role in diseases diagnosis and treatment, drug delivery and tumor therapy. The technology has numerous applications in livestock product industry, such as in meat milk and egg packaging and processing for values additions to animals product. Nano materials (NMs) have come to play a significant role in commercial development. Indeed, we might expect to produce many breakthroughs and new prospects for the world economy from advances in nanotechnology. With the potentially wide application of NMs in the future, NMs may be extensively used in various fields, especially for clinical diagnosis and tumor therapy, due to their size, biocompatibility, surface chemistry, relatively good stability, and adjustable toxicity in biological systems. Even though technology is interesting and promised a breakthroughs and new prospects, there are challenges and controversies in the field about the technology. Therefore; Risk assessment should be done before field application and public awareness should be done about the effect of nanoparticles. More advanced research should be conducted on nanoparticle, nanomaterial and nano-medicine to improve effective diagnosis and treatment of animal diseases and also Continuous research is need on nano by products in order to increase production of low fat and low cholesterol animal products.

6. References

Akagi, T., Baba, M., and Akashi, M. (2012). Biodegradable nanoparticles as vaccine adjuvant and delivery systems: regulation of immune responses by nanoparticle-based vaccine. *Adv. Polymer Sci*., 247: 31 64.

Andersen, H.J., 2007. The issue raw milk quality from the point of view of a major dairy industry. J. Anim. Feed Sci., 16: 240-254.

Andreev, S.M. (2010).An immunogenic and allergenic property of fullerene conjugates with amino acid and proteins. *Doklady Biochemistry*, 370: 4 7.

Antonio, D., Milano, C., Righini, A. et al. (2014). Pharmacogenomics in lung cancer chemotherapy: a review of what the oncologist should know. *Anticancer Res*., 34:5241 5250.

Boulaiz H, Alvarez PJ, Ramirez A, Marchal JA, Prados J, Rodrí- guez-Serrano, *et al*. (2011). Nanomedicine: Application areas and development prospects. *Int. J. Mol. Sci*., 12: 3303 3321.

Cagri, A., Z. Ustunol and E.T. Ryser, 2004. Antimicrobial edible films and coatings. *J. Food Prot*., 67: 833-848.

Chaudhry, Q., Castle L. (2011). Food applications of nanotechnologies: An overview of opportunities and challenges for developing countries. *Trends Food Sci. Technol*., 22:595 603.

Cockburn, A., Bradford, R., Buck, N., Constable, A., Edwards, G., Haber, B., Hepburn, P., Howlett, J., Kampers, F., Klein, C., Radomski, M., Stamm, H., Wijnhoven, S., Wildeman, T. (2012). Approaches to the safety assessment of engineered nanomaterials (ENM) in food. *Food Chem. Toxicol*., 50:2224 2242.

Desai, M.P., and Labhasetwar, V., Walter, E., Levy, R.J., and Amidon, G.L. (2007): The mechanism of uptake of biodegradable micro particles in Caco-2 cells is size dependent. *Pharmaceutical Research,* 14: 1568.

Gruère, GP., 2012. Implications of nanotechnology growth in food and agriculture in OECD countries. Food Policy 37:191 198.

Hopkins, P.D. and Dacey, A. (2008). Vegetarian meat: Could technology save animals and satisfy meat eaters. J. *Agric. Environ. Ethics*, 21: 579-596.

Ibanez, IL., Notcovich, C., Catalano, PN., Bellino ,MG., Duran, H. (2015). The redoxactive nanomaterial toolbox for cancer therapy. *Cancer Let*., 359:9 19.

Kannaki, T.R. and Verma, P.C. (2006). The challenges of 2020 and the role of nanotechnology in poultry research. Proceedings of the National Seminar on Poultry Research Priorities to 2020, November 2-3, 2006, Central Avian Research Institute, pp: 273-277.

Linton, JD., Walsh, ST. (2008). A theory of innovation for process-based innovations such as nanotechnology. *Technol. Forecast. Soc*., 75:583 594.

Liu, L., Lv, HY., Teng ZY., Wang, CY., Wang, GX. (2015). Glucose sensors based on core-shell magnetic nanomaterials and their application in diabetes management: a review. *Curr. Pharm. Des*., 21:5359 5368.

Loukanov, A.R., Emin, S., Tiwari A., Mishra, A. K., Kobayashi, H., and Turner A. (2012): In *Intelligent Nanomaterials*, Wiley-Scrivener publishing (2nd edition), LLC, USA, 649-664.

Love, SA. Maurer-Jones, MA., Thompson, JW., Lin,Y-S., Haynes, CL. (2012). Assessing nanoparticle toxicity. *Annu. Rev. Anal. Chem*., 5: 181-205.

Mcmillan, J., Batrakova, E., Gendelman, H.E. (2011. Cell Delivery of Therapeutic Nanoparticles. *Progress in Molecular Biol. Translational Sci*., 104:563-600.

Meena, NS., Sahni, YP., Thakur, D., Singh, RP. (2018). Applications of nanotechnology in veterinary therapeutics. J.Entomo. Zoolo. Studies, 6: 167-175.

Niknamfar, AH., Esmaeili, H. (2017). Reviewing on nanotechnology for creating antimicrobial for chicken feed: Max-min optimization approach. *Int. J. Res. Industrial Engineering*, 6: 312-327.

Olmedilla-Alonsoa, B., Jiménez-Colmeneroa, F., Sánchez-Muniz, FJ. (2013). Development and assessment of healthy properties of meat and meat products designed as functional foods. *Meat Sci*., 95:919 930.

Ozimek, L., Pospiech, E., Narine, S. (2010). Nanotechnology is food and meat processing. *Acta. Sci. Pol .Technol. Aliment*, 9:401 412.

Peer, D., Karp, J. M., Hong, S., Farokhzad, O. C., Margalit, R. and Langer, R. (2007): Nanocarriers as an emerging platform for cancer therapy. *Nature of Nanotechnology*, 2:751- 760

Rhim, JW, Park HM, Ha CS. 2013. Bio-nanocomposites for food packaging applications. Prog Polym Sci 38:1629 1652.

Shabaruddin, FH., Chen, LC., Elliott, RA., Payne, K. (2013). A systematic review of utility values for chemotherapy-related adverse events. *Pharmacoeconomics*, 31:277 288.

Si, D.Y., Liang, W., Sun, D.Y., Cheng, F.T., and Liu, C.X. (2007): Nanoscale devices for veterinary technology: Trends and future prospective. *Asian J. Pharmacodynam. Pharmacokint*., 7: 83.

Singh, M., Manikandan, S. and Kumaraguru, A.K. (2011). Nanoparticles: A new technology with wide applications. *Res. J. Nanosci. Nanotechnol*., 1: 1-11.

Singh, V.P. and Neelam, S. (2010). Nanotechnology: The new opportunities and threats to food. Indian Food Ind., 29: 46-49.

Tatli Seven, P., Seven, I., Gul Baykalir, B., Iflazoglu Mutlu, S., Salem, AZ. (2018). Nanotechnology and nano propolis in animal production and health: an overview. *Italian J. Anim. Sci*., 17: 921-930.

Tiwari, A., (2011): Advanced materials world congress, Sweden. *Advance materials letters*, ***2(6)***:377. DOI:10.5185/amlett.2011.1200.

Tripp, R.A., Alvarez, R., Andersqon, B., Jones, L., Weeks, C., and Chen, W. (2007). Bio conjugated nanoparticle detection of respiratory syncytial virus infection. *Int. J. Nanomed*., **2**: 117-124.

Weiss, J, Gibis, M., Schuh, V., Salminen, H. (2010). Advances in ingredient and processing systems for meat and meat products. *Meat Sci*., 86:196 213.

Womack, J.E. (2005). Advances in livestock genomics: Opening the barn door. *Genome Res*., 15: 1699-1705.

Young, JF., Therkildsen, M., Ekstrand, B., Che, BN., Larsen, MK., Oksbjerg, N., Stagsted, J. (2013). Novel aspects of health promoting compounds in meat. *Meat Sci*., 95:904 911.

Zhang, L., GU, F. X., Chan, J., M, Wang, A., Z, Langer, R., S, Farokhzad, O., C. (2008): Nanoparticles in medicine: therapeutic applications and developments. *Clinical PharmacololgyTherapeutics*. 83:761-769.

Zhang, L., Pornpattananangkul, D., and Hung, C.M. (2010): Development of Nanoparticles for Antimicrobial Drug Delivery. *Current Medicinal Chemistry,* 17: 585-594.

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