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# A review on the usage of nano technology in poultry industry

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**Abstract**
Nanotechnology deals with nano sized particles in atomic, molecular and supramolecular levels. This technology is used almost in all fields of life. The particular usage of nanotechnology in Agriculture, Animal Husbandry and food systems is important as it influences predominantly the Indian Economy. The usage of nanoparticles in poultry industry and the commonly used nanoparticles are silver, selenium, calcium phosphate, zinc, chromium, germanium, copper, gold and zirconium are reviewed in this article. The effect of nanoparticles on the performance of birds, egg production, gastro intestinal tract, blood parameters, organs, diseases, mineral contents in chicken, embryo development in chicken, use of disinfectant in hatchery and poultry processing plant and packaging materials used in poultry industry.

**Keywords:** Nanotechnology, poultry industry, production performance

## Introduction
Nanomaterials are used in the fields of biology (molecular and cellular), biotechnology, mineral nutrition, physiology, reproduction, pharmacology in both animal and human models (Swain *et al.* 2015) [33]. Nano-sized materials are having multifaceted use in agriculture and food systems. The applications of nanomaterials in agriculture and animal husbandry are of utmost importance as per Sindhura *et al.* 2014 [26] since the Indian economy is predominantly depending on agriculture.

Nanotechnology is concerned with materials whose structures exhibit significantly novel and improved physical, chemical, and biological properties due to their nano-scaled particle size. This can be defined as a research and development aimed at understanding and working with seeing, measuring, and manipulating matter at the atomic, molecular, and supramolecular levels.

National Nanotechnology Initiative (NNI) defined Nanotechnology as "utilization of structure with at least one dimension of nanometer (nm) size for the construction of materials, devices or systems with novel or significantly improved properties due to their nanosize" (Yadav *et al.* 2006) [39]. In simple terms, nano mineral particles refer to the particles having a particle size of the range of 1-100 nm. At this scale, the physical, chemical, and biological properties of materials differ fundamentally and often unexpectedly. The nano-sized particles are having higher potential than their conventional sources and thus reduce the quantity required Sindhura *et al.* 2014 [26].

**Table 1:** Effect of nanoparticles on the performance of birds

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver | Ahmadi and Kurdestani 2010[1] | No effect on weight gain of broilers |
| | Andi *et al.*, 2011 [6] | Significant improvement in the weight gain, feed intake and feed conversion ratio of broilers |
| | Ahmadi *et al.*, 2012 [2] and Ahmadi *et al.*,2013 [3, 4] | No significant effect on growth performance and decrease trend in feed efficiency in broilers |
| Ovo nano silver | Saki and Salary 2015 | No significant effect on growth rate and feed conversion ratio in broilers |
| Industrial chitosan and sodium-tripolyphosphate | Sundari*et al.*, 2013 and 2014 [31, 32] | Increased true metabolizable energy and nutrient digestibility in broiler feed additive |
| Selenium | Saleh 2014 [22] | Increase in body weight gain and breast muscle weight in broilers |
| Calcium phosphate | Vijayakumar and Balakrishnan 2014 [34] | Increased growth performance of broilers |
| Zinc | Sahoo *et al.*, 2016 [20] | Beneficial in broiler chicks |

**Table 2:** Effect of nanoparticles in egg production

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Chromium picolonate | Sirirat *et al.*, 2013 [28] | No significant effect on egg production improves egg quality, increaseschromium concentration in the yolk and calcium concentration in the eggshell |
| Germanium and Selenium | Khan *et al.*, 2015 [17] | Highest egg production and best feed conversion ratio in Japanese quails |
| Chromium | Malathi *et al.*, 2015 [15] | Increased egg weight linearly, albumen per cent, albumen index and Haugh unit score significantly increased |

**Table 3:** Effect of nanoparticles on the gastro intestinal tract

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver nitrate | Atiyeh *et al.*, 2007 [7] | Unstable, and can be toxic to tissues |
| Metallic silver | Choi *et al.*, 2008 [12] | Less toxic and exert a higher antimicrobial effect |
| Silver | Wadhera and Fung, 2005 [36] | Anti microbial |
| | Wright *et al.*, 1999; 2002 [38, 37] | Antifungal and antibacterial effect |
| | Cho *et al.*, 2005 [11] | Antibacterial effect |
| | Sawosz *et al.*, 2007 [23] | No effect on *E.faecium, E. coli* and other enterobacteriaceae |
| | Yoon *et al.*, 2007 [40] | Has effect on *B. subtilis* than on *E. coli* |
| | Singh *et al.*, 2015 [27] | Higher sensitivity to Gram negative bacteria |
| | Sawosz *et al.*, 2007 [23] | Significantly increased number of gram positive bacteria in Japanese quails |

**Table 4:** Effect of nanoparticles on blood parameters

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver | Ahmadi 2012 [2] | Significantly effected oxidative stress enzymes activity |
| | Saleh 2014 [22] | Decrease in saturated fatty acids and increase in unsaturated fatty acids |
| | Boostani *et al.*, 2015 [9] | Increase inheterophil: lymphocyte ratio |
| ovo nano silver | Saki and Salary 2015 [21] | Blood concentration of alkaline phosphatase significantly increased |

**Table 5:** Effect of nano particles on organ

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver | Ahmadi *et al.*, 2012 [2] and Ahmadi *et al.*,2013 [3, 4] | Reduction in bursal weight, increase weight in small intestine and liver |
| zinc oxide | Esfahani*et al.*, 2015 [13] | Improved carcass quality, increased crude protein and decreased crude fat in breast and thigh meat of broilers |
| | Mohammadi *et al.*, 2015 [16] | Increase in proventriculus and pancreas, no relative weight increase in lymphoid organs |
| Ovo Silver | Saki and Salary 2015 [21] | Recorded no significant effect on bursa and spleen and relative decrease in weight of the organs |

**Table 6:** Effect of nano particles on diseases

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver | Chauke and Siebrits 2012 [10] | Kills coccidia in broiler intestines |
| chitosan | Zhao *et al.*, 2012 [41] | Enhanced mucosal delivery of live New Castle disease vaccine |
| zinc oxide | Ahmadi *et al.*,2013 [3, 4] | Increased high density lipoprotein |
| | Fathi *et al.*, 2016 [14] | Controlled mortality due to ascites in broiler chicks |
| selenium | Najjari *et al.*, 2015 [18] | Increases immunity, inhibit the anamnestic response and infection |

**Table 7:** Effect of nanoparticles on minerals

| Nano particles | Authour | Salient Findings |
|---|---|---|
| In ovo silver | Saki and Salary 2015 [21] | Increase in ash, calcium and copper of bones |
| In ovo copper | Sosnowska *et al.*, 2014 [29] | Increase of copper in liver and spleen |

**Table 8:** Effect of nanoparticles on chicken embryos

| Nano particles | Authour | Salient Findings |
|---|---|---|
| In ovo silver | Sawosz *et al.*, 2009 [24] | No influence on mortality, growth and development of embryos |
| | Sikorska *et al.*, 2010 [25] | Tendency of increasing mineral content |
| | Studnicka *et al.*, 2009 [30] | Increase in alanine transaminase (ALT) which indicates liver damage |
| | Saki and Salary 2015 [21] | No significant effect on the lymphoid organ weights and growth rate but improved the bone mineral concentration and cell mediated immunity |
| Gold | Zielinska *et al.*, 2009 [42] | Increased mortality |
| ZrO2 | Ravikumar and Gokulakrishnan 2012 [19] | Showed maximum antibacterial activity against Salmonella and *E.coli* |
| Copper | Sosnowska *et al.*, 2014 [29] | Higher body weight, lower feed conversion ratio, mortality and higher percentage of breast and leg muscles |

**Effect of nanoparticles as disinfectant in hatchery and poultry processing plant**

The present research demonstrated that the nanosilver preparation disinfects eggs and hatchers. Nanoparticles reduces microbiological contamination and acts as bactericidal and fungicidal throughout the incubation. The level of contaminants in the air inside the incubator decontaminated with UV was 40% higher than in the incubator disinfected with nanosilver. As this study shows, nanosilver is not able to replace efficiently functioning ventilation but may be an element supporting the elimination of gaseous contaminants. (Banach *et al.* 2016) [8]

**Table 9:** Effect of nanoparticles in package material for eggs and meat

| Nano particles | Authour | Salient Findings |
|---|---|---|
| Silver doped egg trays | Viswanthan *et al.*, 2015 [35] | Increased storage performance in the eggs |
| zinc oxide packing materials | Akbar and Anal 2014 [5] | Active against *Salmonella typhimurium* and *Staphylococcus aureus* |

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