

Evaluation of risk and the beneficial effects of synthesized nano silver-based disinfectant on poultry mortality and health

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Abstract

This study was evaluated for the potential use of nanosilver (nAg) as a disinfectant and antimicrobial growth promoter supplement for the poultry. The experiments were conducted in the Kangsabati river basin region, in West Medinipur district, West Bengal, India for six months. Two poultry farms were adopted for the experiment. The rural economy of this region from Jhargram to Barkola is heavily dependent on contract poultry farming. The water samples were collected from the water source of poultry farm which has been used for poultry drinking purpose. The bacteriological analysis of water sample revealed that the total bacterial count (total coliform and *E. coli*) were higher than the acceptable standards. The bacterial loads badly affected the growth performance and health of the poultry. For disinfection, a number of chemical compounds (like formaldehyde, calcium hypochloride, sodium hypochloride, and sodium bicarbonate) have been used in typical commercial formulations. However, the effects of all these chemical compounds have not been significant over time. As a part of our research-to-market initiative, we used nanosilver (nAg) formulation as a disinfectant. The nAg formulation was synthesized by hydrothermal technique and characterized by UV-visible, TEM, SEM, and EDX. The obtained results revealed that the mortality rate of poultry was reduced due to nAg formulation compared to the mortality rate of the negative control. Moreover, the income of the farmer family was increased by 10-20% due to less mortality and better health of the poultry.

Keywords: Farm water, nanosilver, field application, and poultry performance.

1. Introduction

In the poultry industry, water is the most important nutrient for the poultry but the importance of water quality is often neglected by the farmers and these could affect poultry health and performance. Major water quality parameter such as bacteria, viruses, total dissolved solids, pH level, nitrate, hardness, chloride, and sodium can affect the growth of the poultry. The entries of pathogenic bacteria through drinking water affect the health of the poultry and are likely to cause death. Therefore, the killing of such pathogenic bacteria is needed to improve the health of the poultry and are likely

to reduce the mortality rate of the poultry. Silver has been known from the century for its antibacterial properties. The reduction of the size of silver metal into nanoscale (<100 nm) increases the antibacterial property (Borm et al., 2006; Luoma, 2008). The nAg could directly target the structure of the cell and fully inhibit or damage the DNA of the cell (Rai et al., 2009). The earlier studies showed that the nAg act as a growth promoter which helps to increase the body weight due to the growth of muscle (Sawosz et al., 2012; Sawosz et al., 2013). Therefore, the objective of this study was to investigate the effects of nAg formulation in poultry farm drinking water quality on pathogenic bacteria and simultaneously checked the growth performance like food intake (FI) capacity, body weight (BW), food conversion ratio (FCR), and mortality rate of the poultry as well as the economic worth of the farmers.

Table 1. The water quality parameters of the study area

Sl. No.	Parameters	Value
1	pH	7.9
2	TDS (mg/L)	367
3	Alkalinity (mg/L)	217
4	Hardness (mg/L)	285
5	Chloride (mg/L)	95.7
6	Calcium (mg/L)	92.5
7	Total coliform (MPN/100 mL)	2400
8	<i>E. coli</i> (CFU/mL)	1.6×10^5

2. Materials and Methods

Two commercial broiler farms (farm A and farm B) were selected for the study over a period of 6 weeks (37 days). Where the farm A and farm B were selected for experimental and control study respectively. The water samples were collected from both farms (A and B) in a 1000 mL sterilized HDPE bottles and used for physicochemical and bacteriological analysis. The nAg was synthesized by the hydrothermal method where silver nitrate (AgNO_3) used as a precursor, sodium borohydride (NaBH_4) as a reducing agent, and polyvinylpyrrolidone (PVP) as a stabilizer. The farm A was received disinfected water through nano silver formulation while farm B received direct groundwater through the tap. The

data were collected from farms at the end of the week for productivity measure like BW, FI, % mortality, FCR, and temperature for 37 days.

3. Results and Discussion

The analysis of ground water results showed (Table-1) that the physicochemical water quality parameters of different farm were within the permissible range while bacteriological water quality parameter (indicator pathogen) exceeded the permissible range. The growth of *E. coli* was completely inhibited at 50 mg/L concentration of nAg and that concentration was taken as the MIC against *E. coli*. The characterization of synthesized nAg was done by UV-visible, SEM, TEM, and EDX as shown in Fig. 1. The characterized images of nAg showed that the average size of nanoparticles was 25 nm. The effects of treated and untreated drinking water quality were studied on the poultry growth performance like mortality rate, BW, FI, and FCR. The effects of all variable parameters on the growth performance (% mortality, FI, BW, and FCR) during the experiment period (1-37 days) are shown in Fig. 2 in the form of stem-and-leaf plots. The percentage mortality in the case group was 5.16% while the mortality in the control group was 17%. The

average final weight of the chickens / birds in the case group was 1.92 kg, compared to that of 1.77 kg in the control group. The authors observed that the main reasons of the poultry death in the control group were white diarrhoea, respiratory distress, and poor feed intake which could all be influenced by the bacterial effects. The economic analysis of case and control group was done for the total number of chicks started with in both the groups as well as final (remained) poultry at the end of 37 days. The case group farmer could get substantially more profit, primarily because of two reasons: lesser mortality and better health contributing to higher body weight.

4. Conclusion

50 ppm dosed nAg was considered for application in the farm water as a disinfectant. At the end of a 37 day case and control study, the percentage mortality in the case group was 5.16% while the mortality in the control group was 17%. Lesser mortality and better health contributing to higher body weight was the reason for better case farmer profit.

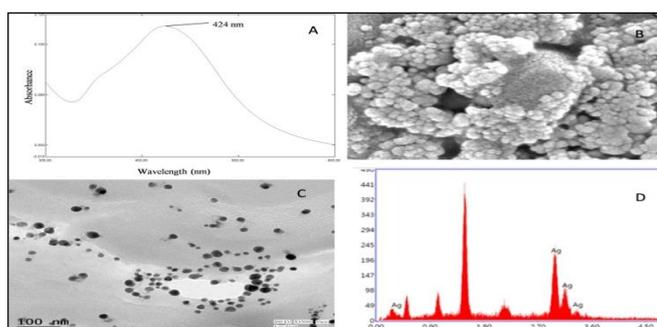


Figure 1. (A) UV-visible, (B) SEM, (C) TEM, and (D) EDX image of nAg

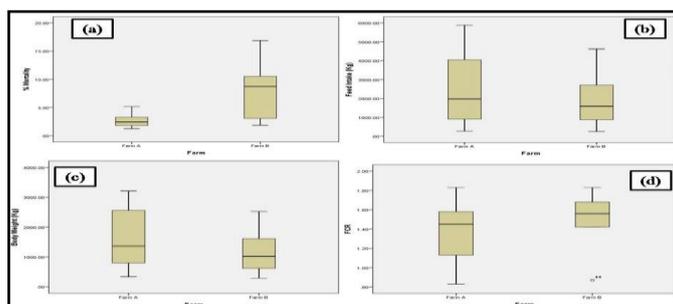


Figure 2. (a) % mortality, (b) FI, (c) BW, and (d) FCR of poultry of both farm.

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