

# Study of Histopathological Changes of Ag Nps in Quail Kidney

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## Abstract

Nanotechnology is one of the most promising technologies of the twenty-first century, as silver nanoparticles have access to enter the body due to their small size, which are the skin, respiratory and digestive systems. This study was conducted to investigate the histological changes caused by silver nanoparticles on the kidney of Japanese quail. 100 birds were obtained from the College of Agriculture and division into five groups, where each group included 20 birds. The first and second groups were treated with a chronic treatment, which was dosed with silver nanoparticles for 30 days, as for the third and fourth groups, they were treated with the acute treatment and dosed for 3 days only with the AgNPs, as well as the control group, which was dosed for 30 days with distilled water. The results of the chronic treatment after 10 days of dosing showed Hemorrhage and degeneration of epithelial cells Renal tubules, while the acute treatment showed intercellular hemorrhage and degeneration and glomerular shrinkage, the results were more severe after 30 days of treatment, which showed swelling of the epithelial cells, hemorrhage between the tubules and inside the glomerulus, and obstruction of the renal tubules. We conclude from this study that taking AgNPs orally caused histopathological changes to the kidney, which were represented by hemorrhage between the tubules and inside the glomerulus, as well as degeneration of epithelial cells and shrinkage of the glomerulus, in addition to swelling of the epithelial cells with the presence of infiltrating cells between the tubules, and this explains that silver nanoparticles have toxic effects on the quail kidney.

**Keywords:** Silver nanoparticles, Coturnix coturnix, Kidney, Histopathology

## 1. Introduction

Nanomaterials are distinct class of advanced materials that can be produced with dimensions ranging from 1-100 nm (Khan et al., 2019). It is characterized by its high surface to volume ratio due to its extremely small size (Gahlawat et al., 2016). AgNPs are represent one of the most fascinating among many metallic NP due to their chemical and physical properties and play an important role in nanoscience and in medicine, as they consist of about 20 to 15.000 silver atoms (Chen and Schleusener, 2008). one of the areas in which nanotechnology has been used is environment as it has been used to reduce environmental damage, by solving major environmental problems such as solid waste, air pollution management, water scarcity, and this has led to an increase in the efficiency of clean energy production (Bilal,2015; Ahmadi et al., 2019; Babatunde et al., 2020). It has ability to penetrate the cell membrane due to their small size (Hondroulis et al., 2014). The benefits of this technique appeared since ancient times. Archaeologists found that the Mesopotamian civilization was the first to use this technigue by manufacturing and painting bright pottery (Palmberg et al., 2009). In this study, quail was used as a laboratory animal due to its small size, consumption of a small amount of feed, early sexual maturity in egg production, short life cycle, disease resistant and its tolerance to environmental conditions (Rahman et al., 2016; Islam et al., 2015; Wilkinson et al., 2016).

## 2. Materials and Working Methods

### The source and breeding of quail birds

100 birds were obtained from the College of Agriculture and Forestry, Department of Animal Resources, University of Mosul, and were 10 days old. They were distributed in wooden cages to five groups, each of which included 20 birds. The cages were spread with sawdust and provided with 24 hours for lighting, and the birds were left for five days for the purpose of Conditioning. The feeding was based on a starter feed from the Erbil Feed Company for Feed Industry in Iraq-Erbil, with a protein concentration of 17% (Leung et al., 2018).

### 3. Experiment Design

Silver NPs were used at a size of 100nm, and they were obtained from the Iraqi company Sigma-aldrich.com with a purity of 99.5, Pcod: 1001151786, concentrations (1and 2 ppm) were used, which were treated chronic and orally dosed for 30 days with nanosilver, as for the concentrations (5 snd 10 ppm) treated acutely and orally, as well as the control group, which was dosed 30 days with distilled water, the birds were orally dosed with 0.5 ml of AgNPs in the morning for a period of 30 days. The birds were sacrifice and the kidneys were taken and fixed with formalin at a concentration of 10% (Al-Hajj, 2015). The tissue sections were prepared and using hematoxylin and eosin stains based on (Luna, 1968).

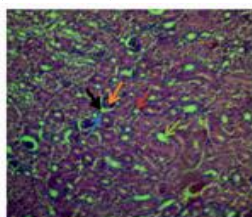
## 4. Results

### Histopathological changes after 10 days

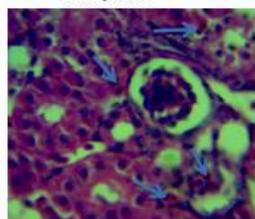
The results of the current study showed that the kidney tissue of the quail birds of the control group consisted of glomerulus, Bowman’s space, Bowman’s capsule, distal convoluted tubule and proximal convoluted tubule [picture \(1\)](#). When examining the tissue sections under the microscope of the groups dosed with nanoparticles treated with chronic treatment after 10 days of dosing, it was noted that there were obvious changes represented by the appearance of simple hemorrhage between the convoluted tubules at 1 ppm [picture \(2\)](#). Urinary tubule epithelial cell degeneration was also observed in [Picture-3](#). And simple hemorrhage between the urinary tubules [Picture \(4\)](#). [Picture \(5\)](#) also showed degeneration, hemorrhage and shrinkage of the glomerular, which led to an increase in Bowman's space.

### Histopathological changes after 30 days

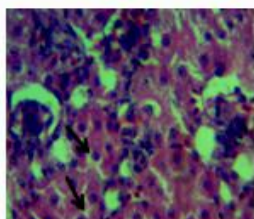
The results after 30 days of treatment showed the histological structure of the kidney of quail in the control group [picture \(6\)](#). As the treated groups they showed swelling of the cuboidal cells of the renal tubules, which led to obstruction and stenosis of the tubules at 1 ppm [picture \(7\)](#). Obstruction of the renal tubules, shrinkage of the glomerular duct and an increase in Bowman's space were also observed at 2.5 ppm in [Picture \(8\)](#). It showed the degeneration of the cuboidal epithelial cells lining the renal tubules with infiltrating cells between the tubules at 5 and 10 ppm in [Picture \(9 and 10\)](#).



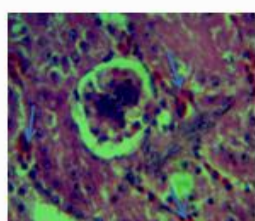
Photomicrography(1) cross section of at the kidney of the control group showed the glomerulus (→), distal convoluted tubule (→). Proximal convoluted tubule (→), Bowman's space (→) and Bowman's capsule (→), H&E, 100X.



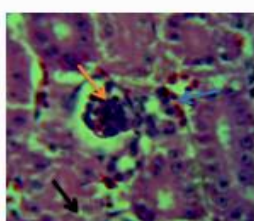
Photomicrography(2) cross section of at the kidney at a concentration of 1 ppm showed inter glomerular hemorrhage (→), H&E, 400X.



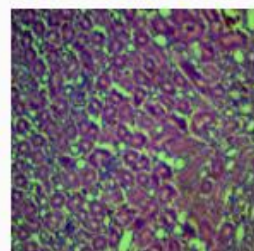
Photomicrography(3) cross section of at the kidney at a concentration of 2.5 ppm showed degeneration (→) of the epithelial cells of the urinary tubules H&E, 400X.



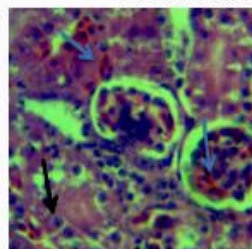
Photomicrography (4) cross section of at The kidney at a concentration of 5 ppm showed inter tubular hemorrhage (→), H&E, 400X.



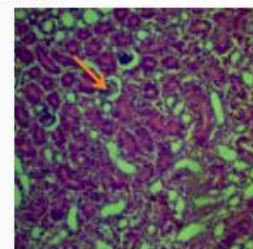
Photomicrography (5) cross section of at the kidney at 10 ppm showed degeneration (→), inter cellular hemorrhage (→) and glomerular shrinkage (→), H&E, 400X.



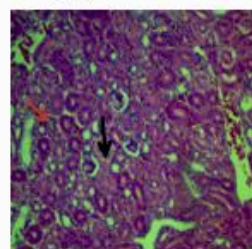
Photomicrography (6) cross section of at The histological structure of the kidney of quail for the control group was showed, H&E,100X.



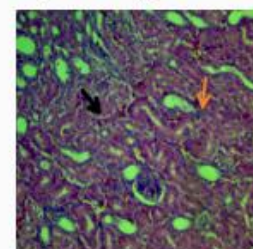
Photomicrography (7) cross section of at the kidney at 1 ppm showed swelling of the epithelial cells of the renal tubules (→) and hemorrhage (→), H&E, 400X.



Photomicrography(8) cross section of at the kidney at a concentration of 2.5 ppm showed obstruction of the renal tubules and shrinkage of the glomerular bulb (→), H&E,100X.



Photomicrography (9) cross section of at the kidney showed epithelial cell degeneration (→) with inter tubular infiltration cells (→) at 5 ppm, H&E, 100x.



Photomicrography (10) cross section of at the kidney showed epithelial cell degeneration (→) with inter tubular infiltration cells (→) at 10ppm, H&E, 100x.

## 5. Discussion

The results showed after 10 days that silver has pathological effects on the kidney of quail, which showed the occurrence of hemorrhage between the tubules, degeneration of epithelial cells and shrinkage of the glomerular. A study was conducted on mice, they were treated with silver NPs orally at 300 mg/kg, and the results showed hemorrhage between the tubules and this is consistent with our results (Hamad et al., 2022). And the study conducted by the researchers (Nabeh et al., 2020) indicated that the exposure of female albino rats to AgNPs at 15 µg / kg it led to the degeneration of epithelial cells and this result was in agreement with our current study. The study conducted by Salman (2014) in the kidneys of male rats treated with Nano silver at 0.6 mg/kg showed that hemorrhage occurred between the tubules in addition to the appearance of necrosis in the distal and proximal convoluted tubes. The researchers (Sarhan and Hussein, 2014) who evaluated the effects of silver NPs by inter membranaceous intravenous injection mice with a dose of 2,000 mg/kg, showed swelling of the glomerulus and led to a reduction in Bowman’s area in addition to the appearance of inflammatory cells between the tubules, and it was contrast to our results. The researchers (Sardari et al., 2012) showed through their study on male mice after there were treated with Ag nano orally at a dose of 70 nm for 30 days for adults that AgNPs showed

effects on renal tubules and increased glomerular pressure which caused atrophy of those glomeruli. After 30 days of treatment, silver nanoparticles led to clear histological changes, the researchers (Roda et al., 2017) found that the treatment of AgNPs in the kidney of mice led to a shrinkage of the epithelial cells, and this does not coincide the results of the current study. (Al-Mahmoud, 2006) explained that this swelling is caused by UN controlled cellular growth because the factors that control cell proliferation are not able to determine the mitotic activity of cells, so they grow into large clumps. The researchers (Sarhan and Hussein, 2014) found during their study on the kidney of white rats when treated with silver nanoparticles at 50 µg/L that it caused Hemorrhage between the tubules and inside the glomerulus and this is similar to the above result. (Abdelhalim and Jarrar, 2011) explained that the tissue changes caused by nanomaterials are evidence of injury to the renal tubules and the renal structure due to its toxicity, and thus the kidneys are unable to deal with the accumulated wastes that produce from metabolic disorders caused by nanomaterials. A study conducted by (Liu et al., 2013) indicated that exposure of mice intravenous injection at 50, 25, 10 mg/kg with AgNPs for 7 days led to toxic effects. There is a need for a future study on the effect of silver particles on other organs.

## 6. Conclusions

We conclude from this study that taking AgNPs orally caused histological changes to the kidneys, which were represented by inter-tubular and inter glomerular hemorrhage, epithelial cell degeneration, and glomerular shrinkage, in addition to swelling of the epithelial cells with infiltrating cells between the tubules this explains that Ag nano particles have toxic effects on the quail kidney.

## Acknowledgment

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