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Original Research Article

Histopathological Study of Kidney and Liver of Rats after Induction of Poisoning by Nitrate

Heba Saleh Shaheed[1*]
[1]Department of Pathology and Poultry Diseases, Collage of Veterinary Medicine, Al-Qasim Green University, Babylon 51013, Iraq

***Corresponding Author:** Heba Saleh Shaheed
Department of Pathology and Poultry Diseases, Collage of Veterinary Medicine, Al-Qasim Green University, Babylon 51013, Iraq

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Abstract: The purpose of this research is to investigate the effects of nitrate as a calcium appearance on the hepatic and renal histology. Iraqi fertilizer firm in supplied the calcium nitrate tetrahydrate was used in this study. Twenty-four male albino wistar rats weighing 220 ± 25 g were kept under conditions of natural photoperiod, humidity 50±10%, and temperature 25±2° C. These were divided into 3 groups: G1 control group, G2 received 200 mg/kg, G3 received 400 mg/kg. Rats were administered calcium nitrates orally for thirty days after the salts were dissolved in mineral water. Animals were then sacrificed by being beheaded in the neck region. Organs such as the kidneys and liver were taken for histological analysis. Liver and kidney samples were taken from rats that were given varying amounts of calcium nitrate for a duration of 30 days. The liver sections showed regular histological architecture with hexagonal lobules and visible capillary sinusoids. The livers of the 200 mg/kg group showed mild histological damage, while the 400 mg/kg doses showed significant vascular dilatation, congestion, hepatocyte degeneration, bleeding, and lipid vacuolation. The kidneys showed severe histopathological changes, including glomerular atrophy, intra-glomerular hemorrhage, and vascular congestion, compared to the G2 which showed mild renal lesions. In conclusion, nitrate induced significant alterations in the kidneys and liver architecture that were dose-dependent. Finally, greater dosages of calcium nitrate used excessively might be harmful to humans and other mammals.

Keywords: Liver, Kidney, Histopathology, Nitrate.

INTRODUCTION

The use of synthetic fertilizers is prevalent in agriculture due to their affordability and the fact that they quickly and easily deliver plant nutrients. However, there are concerns about the potential negative effects on human and environmental health caused by contamination of soil, air, and water [1]. The control of plant growth and development is one of several biological activities that rely on calcium, an important macronutrient [2]. An increase in fruit calcium content is possible with the most common forms of calcium fertilisers, as stated in [3]. These include calcium nitrate as well as calcium chloride.

According to [4], crops that are experiencing fast development, those with a high calcium need, and those in fertigation systems may be supplied with calcium nitrate rapidly. If plants are unable to absorb nitrates, a result of nitrogen fertilisation, the chemicals might be washed into water streams. Notably, the nitrate content is higher in green, leafy vegetables like lettuce. Agricultural soil management practices are associated with 60% of total nitrous oxide emissions [5].

Methemoglobinemia, GIT, liver as well as lungs cancers [6], and non-Hodgkin's lymphoma are among the health problems that can develop in humans after consuming nitrates or nitrite in water and food. Moreover, nitrate reductase enzymes are produced by the bacterial flora of the mouth. As a result, about 25% of the nitrate that is consumed might be converted to NO 2 in the mouth. Based on the gastric content and redox environment, nitrous acid may be converted into other nitrogen oxides, such as nitrogen dioxide (NO 2 -2) and dinitrogen trioxide (N2O3), due to the acidic pH of the stomach.

After absorption in the colon, nitrate undergoes enterosalivary circulation, where it is converted to nitrite in the mouth and then the cycle resumes [7]. Notably, nitrate is formed when the body metabolizes nitrosamine and nitric oxide; this compound is known to be a highly carcinogenic agent that may cause cancers of the stomach, liver, and esophagus [8]. Animals have been the subject of several investigations on the impact of nitrate-induced changes on biochemical markers of the liver and kidney [9]. Consequently, the purpose of this research is to investigate the effects of nitrate as a calcium appearance on the hepatic and renal histology.

MATERIALS AND METHODS

Chemical Material: Iraqi fertilizer firm in supplied the calcium nitrate was used in this study.

Animals:

In plastic cages, twenty-four male albino wistar rats weighing 220 ± 25 g were kept under conditions of natural photoperiod, humidity 50±10%, and temperature 25±2° C. The animals were given pellets and water from the faucet on an as-needed basis. These were divided into 3 groups: G1 control group, G2 received 200 mg/kg, G3 received 400 mg/kg.

Rats were administered calcium nitrates orally for thirty days after the salts were dissolved in mineral water. Animals were then sacrificed by being beheaded in the neck region. Organs such as the kidneys and liver were taken for histological analysis.

The experimental rats' liver and kidney were taken out, cleaned with PBS, then fixed in a Bouin's solution for a whole day, and then embedded in paraffin wax. After that, the tissue sections were divided into 5 µm-thick slices using a rotary microtome, and they were stained with hematoxylin and eosin [10]. After being dried, the preparations were examined under an optical microscope.

RESULTS

Sections of the liver and kidneys of rats that were given dosages of 200, 400, and mg/kg of calcium carbonate for 30 days showed clear histological changes. There were clear capillary sinusoids and hexagonal lobules in the liver's normal histological architecture, as seen in the section (Figs. 1).

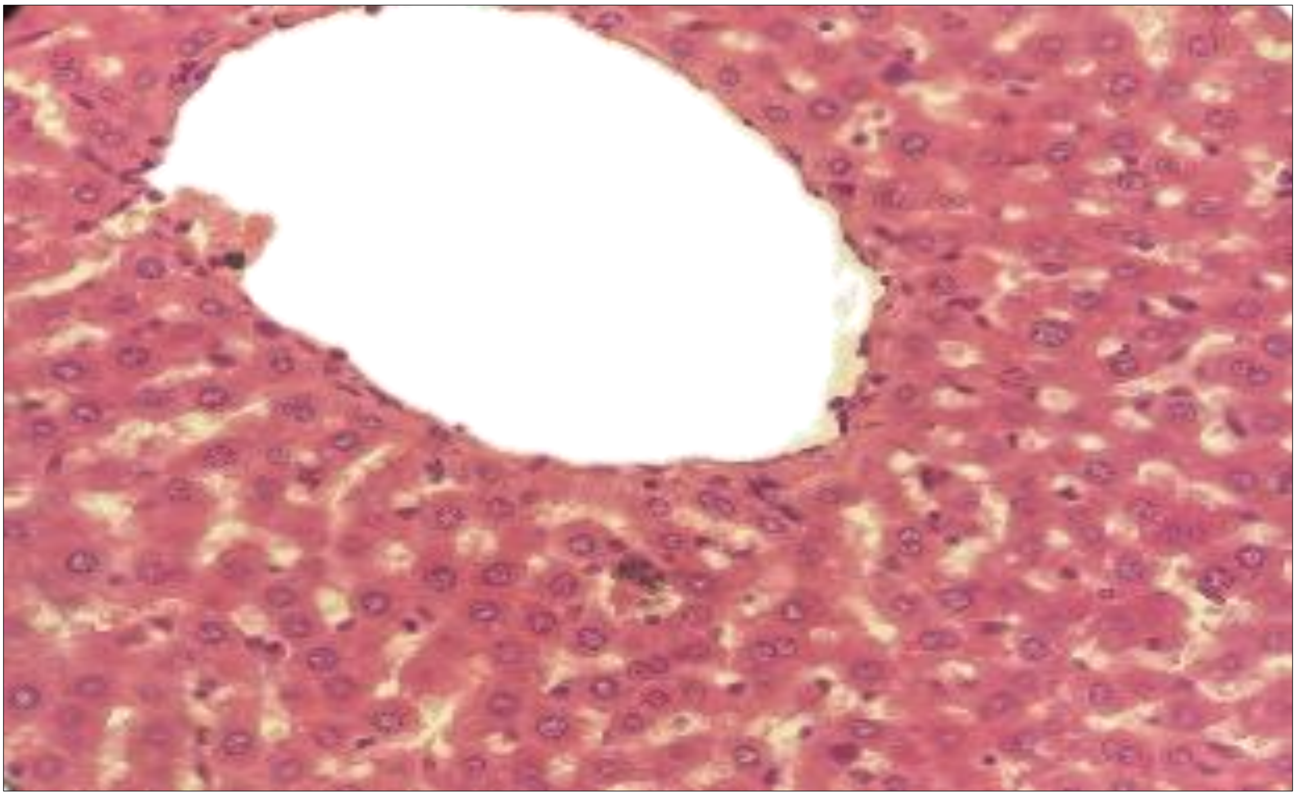

Figure 1: Photomicrograph of liver from rat of control group shows normal tissue architecture. H&E, X10.

When comparing the livers of the G2 to the control group, mild histological damage was discovered (Fig. 2). However, the 400 mg/kg higher doses (G3) showed mild inflammations, hepatocyte degradation, haemorrhage, vascular dilatation and congestion, and lipid vacuolation in comparison to the control group (Fig. 3).

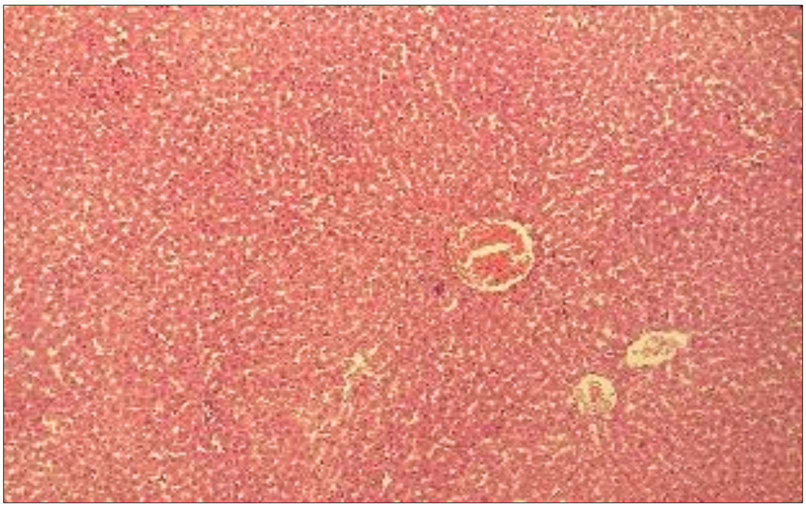

Figure 2: Photomicrograph of liver from rat of 200 mg/kg shows mild blood vessels congestion, fatty changes and inflammatory cells infiltrating. H&E, X10.

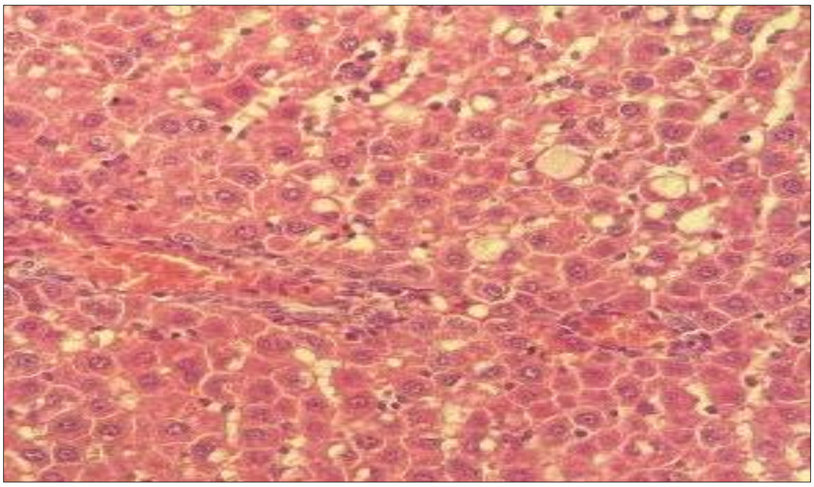

Figure 3: Photomicrograph of liver from rat of 400 mg/kg shows blood vessels congestion, fatty changes and inflammatory cells infiltrating (red arrow). H&E, X40.

Moreover, microscopic examinations of the renal tissues in rats treated with nitrate revealed severe histopathological alterations, such as glomerular atrophy, Bowman's space dilation, haemorrhage of intra-glomerulari, as well as vascular congestion (Fig. 6), in contrast to G2, which showed mild lesions (Fig. 5). This was in contrast to the kidneys of control rats, which showed normal renal parenchyma with clearly defined renal glomeruli and tubules (Fig. 4).

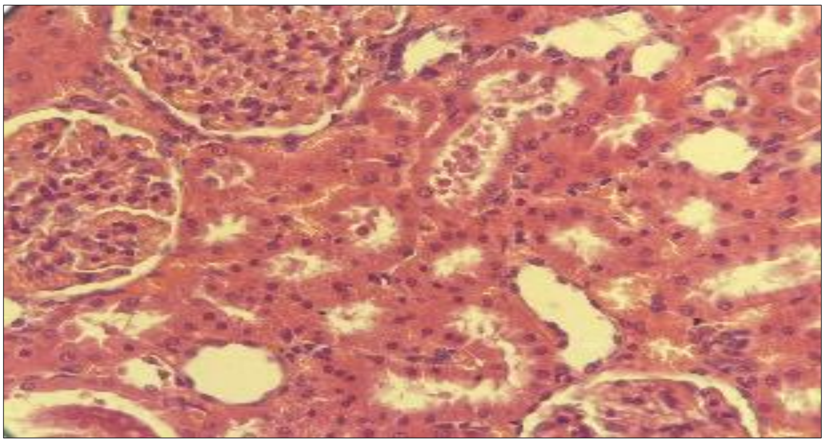

Figure 4: Photomicrograph of kidney from rat of control group shows normal tissue architecture. H&E, BX40.

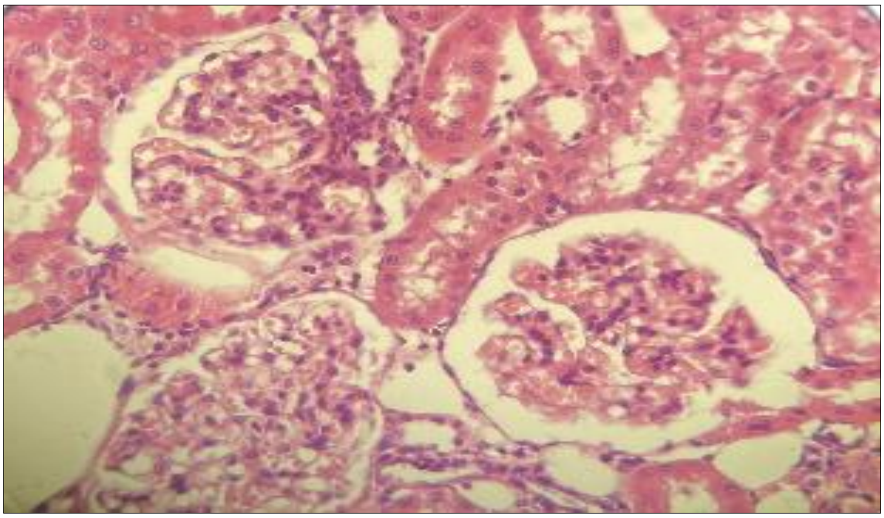

Figure 5: Photomicrograph of kidney from rat G2 shows mild glomerular atrophy and vacuolation. H&E, X40.

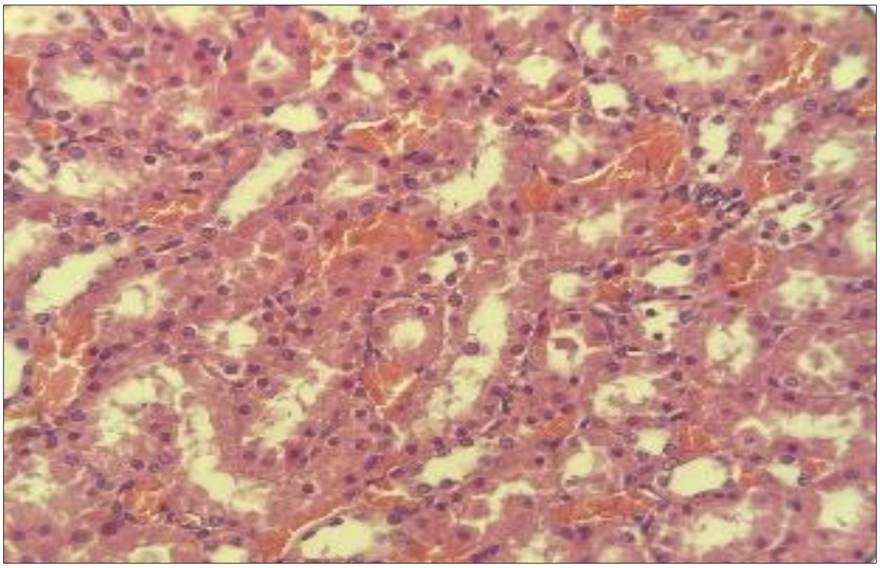

Figure 6: Photomicrograph of kidney from rat of toxin group shows blood vessels congestion and hemorrhage (black arrow) Mesangial cell hyperplasia and inflammatory cells infiltrating (red arrow). H&E, X40.

DISCUSSION

Numerous health issues for people are caused by the increased use of synthetic fertilisers, particularly nitrate fertilisers [11]. The processes of food absorption, digestion, and metabolic utilisation can all be impacted by the chemical makeup of fertilisers [12]. Groundwater may get polluted with nitrates from fertilisers used on soil or animal dung, which can harm people and other animals [13].

Ca nitrate induces histological alterations in the liver, as shown by the present research. These alterations include hepatocyte cytoplasmic vacuolation, mononuclear cell infiltration, venous congestion, and fatty degeneration. Similar histological changes were documented in a few earlier studies [14-16]. The administration of calcium nitrate treatment caused the renal tubules to dilate, the glomeruli to atrophy, and leukocytes to infiltrate. Anwar and Mohamed [17], observed that rats given 500 mg/L NaNO3 for different periods (3, 4 and 6 weeks) experienced renal blood vessel congestion and glomerular shrinkage in their kidneys.

Rats given NaNO3 showed a necrosis of the cells and mononuclear cell infiltration in the portal canals, especially in the lobules of the liver. These alterations may be the consequence of nitrate-induced changes in membrane dispersion. The earlier research by Ogur *et al*., [18], revealed comparable alterations in the adult rats' liver tissue. Indeed, hepatic degeneration and cell necrosis, ranging from increased intercellular space to hydropic degeneration, were seen in the livers of rats treated with nitrate.

Furthermore, glomerular tuft atrophy and renal blood vessel congestion were seen upon microscopic inspection of renal tissue in the group treated with nitrate (Anwar and Mohamed, 2015).

CONCLUSION

Nitrate induced significant alterations in the kidneys and liver architecture that were dose-dependent. Finally, greater dosages of calcium nitrate used excessively might be harmful to humans and other mammals.

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