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ORIGINAL ARTICLE

Toxicity of AgNPs upon Liver Function and Positive Role of Tinospora Cordifolia: In Vivo

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ABSTRACT

This experiment was premeditated to probe the toxic impact of Silver Nanoparticles (AgNPs) upon liver function parameters in male rats, as well as to demonstrate the protective effect of Tinospora cordifolia (T.C) against liver function disorders caused by AgNPs. Twenty-four rats were classified into four packs, six ones for every pack. Rats were included by control animals without treatment, while the AgNPs group included rats treated with 50µl/kg / day AgNPs. In the AgNPs + T.C group, rats were co-administered of AgNPs at a dose of 50µl/kg with T.C at a dose of 400 mg/kg. Whereas, animals of the T.C pack were treated with 400 mg/kg of T.C. The duration of the experiment was 28 days. After blood samples were taken at the conclusion of the experiment. The levels of biochemical parameters (liver enzymes) such as alanine aminotransferase, aspartate aminotransferase, and alkaline phosphatase were evaluated to detect liver function abnormalities. The results showed that AgNPs induced a significant increase in the activity of serum liver enzymes in comparison to the control group ($p < 0.05$).While T. cordifolia co-treatment significantly reduced the levels of activities of those enzymes. Therefore, it can be considered that T. cordifolia effectively contributes to the protection against liver dysfunction caused by AgNPs in rats.

Keywords : Silver Nanoparticles**,** liver dysfunction**,** biochemical parameters**.**

INTRODUCTION

Nanotechnology and its application in medicine have revolutionized healthcare [(1)]. It has the ability to improve some medical diagnosis as well as treat and prevent some diseases [(2,3)]. Among the metallic nanoparticles, silver nanoparticles (AgNPs) have antimicrobial, catalytic and other properties, which make it possible to be applied in medicine and pharmaceutical industry [(4-6)]. On the other hand, many studies have revealed the presence of toxic effects of nanoparticles in vivo [(7)]. There is a special modern scientific branch that aims to study the potential negative effects of nanoparticles and related parameters affecting the cytotoxicity of nanomaterial's called nanotoxicology [(8,9)] . To this day, herbs are mainly used as treatment in many developing countries for primary health care due to their acceptability in the human body as well as their fewer side effects [(10,11)]. Tinospora cordifolia, which belongs to the Menispermaceae family, is a herbal plant that is used in many traditional medicinal fields to treat various diseases. Botanical components rich in bioactivity make this plant a vital role in expressing a wide range of beneficial effects in metabolic disorders [(12,13)] . The present paper aims at confirming the toxic influence of silver nanoparticles upon the biochemical parameters of the liver and at evaluating the potential protective role of T. cordifolia against these harmful effects.

METHODS

Chemicals: Silver (Ag) Nanoparticle Water Dispersion was supplied by US Research Nano-material, Inc. (Houston, TX, USA).Product No.: US 7140. Average particle size (APS): 15 nm, Ag concentration: 1000 ppm. Particle Purity: 99.9%, Crystal Type: Spherical. As for T.Cordifolia (plant supplement),it was obtained from Guduchi/Giloy Pure Extract Capsules, (Nature's Velvet Life Care, India).

Animals & Experimental Design: This experiment was conducted on (24) adult male rats, their ages ranged between 5-6 months, and their weights were 195-225 g. Animals were supplied from the laboratory animal centers, and housed in plastic cages and under typical conditions at 25 ± 2 °C and 12 h light-dark cycles. They are permissible for accessing feed and water. These rats were haphazardly classified into 4 packs, and in every single pack 6 rats were as follows:

- Controlling group (CON): Healthy rats, which did not receive any treatments.
- Group (AgNPs): Rats were given silver nanoparticles at a dose of 50µl/kg / day intraperitoneally [(14)] .
- Group (AgNPs + T.C): rats were co-administered of silver nanoparticles (50µl/kg/day IP) with T.Cordifolia at 400 mg/kg dose [(15)] orally by gavage tube .
- Group IV (T.C): T.Cordifolia was taken at 400 mg/kg dose alone.

After the experiment period (28 days), the rats were euthanized then sacrificed, and a heart puncture was used to draw blood. Tubes were used to collect blood samples that did not contain anticoagulants for biochemical testing.

Biochemical Analyzes: Roche diagnostic kits were used to calculate serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) in an automated system.

Statistic Assay: The statistics for this study were stated as the standard deviation (±) SD (n = 6). All variance parameters amongst groups were investigated employing one-way assay of variance (ANOVA) trailed by Duncan. A significant difference was considered at < 0.05 P value.

RESULTS

Fig. (1) illustrates the results of the experimental groups for the current study. Rats that took AgNPs showed higher levels of liver enzymes ALT, ALP and AST in comparison to those within the controlling group. The results also revealed no noteworthy change in all three liver biochemical parameters in animals with co-administration

of T. Cordifolia extract when compared with AgNPs treated mice ($P < 0.05$). This indicates that the liver could be slightly damaged with AgNPs administration, and that liver function was affected by AgNPs. But there was no obvious damage when the rats were dosed with T. Cordifolia.

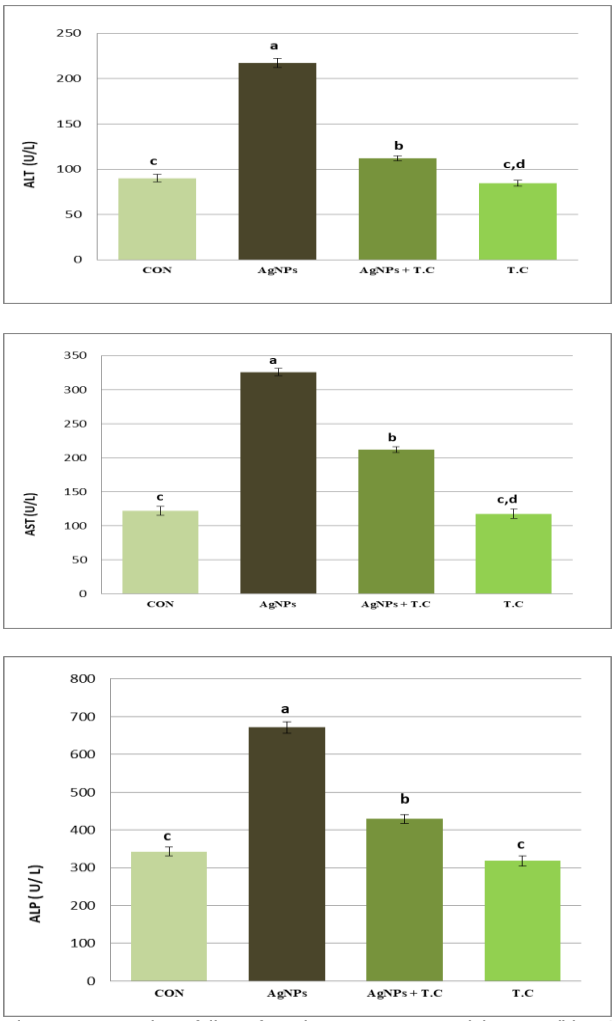

Figure 1: Results of liver function parameters: (a) ALT, (b) AST, and (c) ALP for the study groups. The data were expressed as mean ± SD. [a–d] Different superscripts indicate significant intra-column differences ($p < 0.05$).

DISCUSSION

Investigation of the nano-toxic effects of AgNPs is important for many areas of its use such as pharmaceutical applications and food packaging processes, which makes it a desirable material for humanity [16, 17]. The toxicity of NPs is due to special chemical and physical properties such as size, surface chemical modification and ion release [18] .Previous in vivo studies indicated that different types of nanoparticles tend to settle down in the liver with different toxic effects. The liver is the primary organ responsible for removing toxins from the body [19,20]. In this study, clinical biochemical analysis of body fluids was carried out for detecting the toxic impacts of these nanoparticles on liver function [21]. In this experimental study, it was found that AgNPs negatively affected the enzymatic parameters of liver function, which was consistent with previous studies [22-24]. Where disturbances in the levels of biochemical parameters in the serum indicate the unhealthy and pathological state of the liver. Elevated levels of serum of AST, ALT, and ALP, produced by damaged hepatocytes in the circulation, are associated with serious liver dysfunction [25,26]. These hepatic parameters showed moderation in the AgNPs + T.cordifolia group when compared to the AgNPs group. This can be attributed to the phytochemical components of the extract because it contains alkaloids, glycosides, sesquiterpenoids, lactones, and steroids[27-29]. On the other hand, it was found that T. cordifolia extract had a good liver protective effect on male rats against the toxicity caused by gold nanoparticles. Where doses of this plant extract were given orally and prevented damage to hepatocytes [30].

CONCLUSIONS

Silver nanoparticles, according to the results of the current study, have a detrimental effect on liver function. While T. cordifolia significantly reduced the high levels of serum enzymes associated with the liver.

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