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The Effect of Kombucha Tea on Oxidative Stress Parameters in Mice Treated with Silver Nanoparticles

Mahsa Alikarami [1,*]

[1] Personalized Medicine Research Center of AmitisGen, Tehran, Iran

* *Corresponding author: Mahsa Alikarami, Personalized Medicine Research Center of AmitisGen, Tehran, Iran. E-mail: mahsaalikarami1369@gmail.com*

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Abstract

The use of silver as an antibacterial goes back to ancient times. Adding a small number of silver nanoparticles to different surfaces can cause the antimicrobial coating. Use at high doses has toxic effects, which can alter cell morphology, increase oxidative stress, increase membrane permeability, decrease cell growth, and ultimately cause cell death through apoptosis or necrosis. In this study, we evaluated the antioxidant effect of kombucha beverage in mice treated with silver nanoparticles. The amount of SOD, CAT, MAD, and GST enzymes were evaluated in four groups include control groups, silver nanoparticles treated, Cambodian beverage treatment, and Nano + kombucha treated. The results showed an increase in oxidative stress after treatment with silver nanoparticles. It has also demonstrated that kombucha drinks can have a protective role and reduce the oxidative stress induced by silver nanoparticles. It is therefore suggested that it can be used as a potent antioxidant against silver nanoparticles.

INTRODUCTION

Nanoparticles are nanosized materials with specific properties (1). These features, along with their particular dimensions, have made them widely used in various medical fields include Drug delivery, vaccines, diagnostic methods, and medications (2). These substances have limitations in addition to being able to play a positive role in the medical field, for example, the amount of dose used and their toxicity to the cell. One of the nanoparticles widely used in various industries is silver nanoparticles. The use of silver as an antibacterial material goes back to ancient times, especially in the control of open wounds and burns (3). Today, the primary purpose of using silver nanoparticles is its antimicrobial property. Adding a small number of silver nanoparticles to different surfaces can cause the antimicrobial coating (4). Silver nanoparticles are antibacterial anti-fungal anti-virus material. Use at high doses has toxic effects, which can alter cell morphology, increase oxidative stress, increase membrane permeability, decrease cell growth, and ultimately cause cell death through apoptosis or necrosis (5). Because of their size, nanoparticles can quickly enter cells, one of the events caused by the accumulation of silver nanoparticles in the cells is the increase of free radicals in the cell producing ROS in the cell (6). The collection of ROSs in the battery activates the pathways of programmed cell death and necrosis that eventually lead to cell death. With the increasing use of silver nanoparticles in various industries and the increased likelihood of material entering the body, the risk of poisoning caused by these substances has increased (7). The use of antioxidant sources is one of the elements that can counteract the toxic effects of silver nanoparticles. These substances neutralize the impact of free radicals and thus prevent the adverse effects of these substances.

One of the rich sources of antioxidants is kombucha drinks (8). This drink is made from fermented green tea originating in China. Kombucha is rich in a variety of antioxidants, including vitamins E, C, beta-carotene, and other carotenoids (9). Studies have shown that the antioxidant activity of kombucha drinks is 100 times higher than vitamin C and 25 times higher than vitamin E. Therefore, it is expected to be very useful in the treatment of oxidative stress disorders (10). Numerous studies have been done in vivo and in vitro on the antioxidant effects of kombucha, which indicate that it can reduce the oxidative stress effects of various toxins (11). In this study, we evaluated the antioxidant effect of kombucha beverage in mice treated with silver nanoparticles.

MATERIALS AND METHODS

The study population in this study consisted of 20 adult male NMRI mice with an average weight of 13-15 grams. Animals were kept in the animal house at 25-23 °

C, 40-35% moisture content, and 12 hours of dark and 12 hours of light. In terms of nutrition, they had free access to water and animal feed. The mice were randomly divided into four groups of five each: control group, treatment group with silver nanoparticles 500mg / kg, treatment group with kombucha drink 5ml / kg, and treatment group with nanoparticle + kombucha. The oral treatment was performed by oral gavage for 40 days. At the end of the procedure, mice were anesthetized with chloroform and blood was collected from the heart. To evaluate the antioxidant properties of kombucha beverage, the levels of catalase, glutathione S transferase, MDA, and superoxide dismutase enzyme levels were assessed. Data were analyzed by SPSS v16 software. One-way ANOVA and Tukey tests were used to analyze the significant association between groups. Data were considered significant at $P \leq 0.05$.

RESULTS

As shown in Table 1 and Figure 1, mice treated with silver nanoparticles at levels of 500 mg/kg increased the serum levels of rat malondialdehyde. This indicates an increase in oxidative stress in the nanoparticle-treated group. This indicates an increase in oxidative stress in the nanoparticle-treated group. Treatment with kombucha beverage in the nanoparticle + treatment group significantly decreased serum malondialdehyde ($P = 0.001$). There was also a significant increase in superoxide dismutase ($P = 0.0001$) and catalase ($P = 0.001$). Glutathione S-transferase levels increase compared with the group treated with silver nanoparticles, but this increase was not statistically significant ($P = 0.045$).

Table 1. Antioxidant Enzyme Level

Group	MDA	SOD	CAT	GST
Control	3.26±0.15	6.17±1.27	6.82±0.26	4.52±0.46
Silver nano	6.42±0.59	3.29±0.41	2.64±0.31	1.25±0.33
Kombucha	2.94±0.84	5.81±0.31	4.61±0.42	3.11±0.44
Nano+kombucha	4.88±1.21	4.83±0.12	4.82±0.31	2.82±0.35

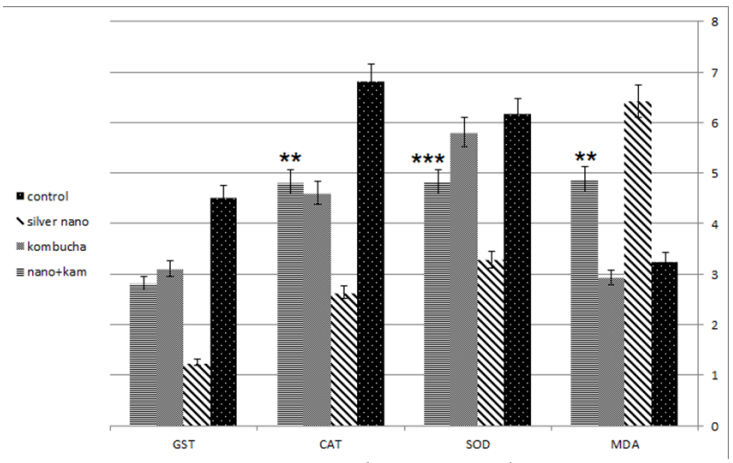

Figure 1. Antioxidant Enzyme Level

DISCUSSION

In the present study, the effect of kombucha beverage on oxidative stress parameters induced by silver nanoparticle treatment in NMRI mice was evaluated. Initial results showed that treatment with silver nanoparticles at the rate of 500 mg/kg at the end of the treatment period caused a significant change in oxidative stress parameters such as malondialdehyde, superoxide dismutase catalase and glutathione transferase in the nanoparticle treatment group. Another study conducted by Shariatzadeh et al., 2017 aimed at investigating the effect of Nigella sativa oil on the kidney structures of NMRI mice treated with silver nanoparticles showed that treatment with silver nanoparticles increased the oxidative stress in this group of mice (12). The use of silver nanoparticles as a disinfectant is growing in many industries today. It was further shown that kombucha beverage has a protective effect against oxidative stress induced by silver nanoparticles treatment, which normalizes the enzymatic level involved in oxidative stress. In this study, MDA enzyme activity was significantly increased by silver nanoparticle treatment, but in nanoparticles+ kombucha treated group, the operation of this enzyme was decreased as well as superoxide dismutase, catalase, and glutathione S transferase enzymes decreased by silver nanoparticle treatment. But the protective effect of kombucha has increased the levels of these enzymes. Setroki et al. (2013) investigated the impact of Kombucha beverage on the oxidative stress induced by diabetes, which showed that kombucha beverage regulated the enzymatic system associated with oxidative stress (13). In another study, they examined

the protective effect of kombucha beverage on oxidative stress induced by TCE, the group showing that kombucha beverage could have a remedial role in counteracting the oxidative stress induced by TCE. This will reduce the level of malondialdehyde and increase the glutathione S transferase level (14). Given the increasing use of silver nanoparticles in various industries and the adverse effects of this material on people's health, it is important to adopt strategies that protect people from the dangers of this substance. In this regard, this study showed that the use of kombucha as a beverage can act as a potent antioxidant against the negative effects of silver nanoparticles.

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