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Effects of Nanoparticles on Zinc Oxide/Green Tea Complex on Rats' Lipid Profile and Liver Functions Following Treatment with Monosodium Glutamate

Reham Z. Hamza [1,2], [2]Fawziah A. Al-Salmi and Nahla S. El-Shenawy [3].

1. Department of Zoology, Faculty of Science, Zagazig University, Zagazig, Egypt
2. Department of Biology, Faculty of Science, Taif University, Taif, Saudi Arabia
3. Department of Zoology, Faculty of Science, Suez Canal University, 41522, Ismailia, Egypt

***Corresponding author**

Reham Z. Hamza,
Department of Zoology, Faculty of Science, Zagazig University, Zagazig, Egypt.

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ABSTRACT

Background and Goals : There is ongoing debate on the possible advantages of zinc oxide nanoparticles (ZnO NPs) made by green synthesis. The current study set out to clarify how green tea leaf extract (GTE)/ZnO NPs complexes counter monosodium glutamate (MSG)-induced hyperlipidemia. Supplies and Procedures: There were eight distinct groups of male rats used: Group I served as the reference point. Groups IV and V received MSG in two different doses (6.0 and 17.5 mg kgG1), Group VI received ZnO NPs/GTE complex, Group VII and VIII received ZnO NPs/GTE complex with MSG in different doses, while Group II received GTE (1 mg mLG1). Group III received ZnO NPs (10 mg kgG1). ZnO NPs/GTE complex's protective efficacy against MSG toxicity through research ZnO NPs/GTE complex's protective effect against MSG toxicity has been reported, based on an analysis of changes in lipid profiles and liver function enzyme activity (alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), alkaline phosphatase (ALK), and γ-glutamyl transferase (γ-GT). The rats that received MSG only experienced substantial alterations in lipid metabolism and a highly significant rise in liver enzymes. Results: By enhancing both the lipid profile and liver enzyme activity, the group VII and VIII results provide insight into the effectiveness of ZnO NPs/GTE complex as a hepatoprotectant when taken alone with MSG.Serum γ-GT, ALP, LDH, ALT, and AST activity were all markedly decreased. In summary, ZnO NPs/GTE complex has demonstrated potential hepatoprotective properties by drastically reducing the MSG-induced hepatotoxicity via the reduction of hyperlipidemia.

Keywords : ZnO NPs/Green tea complex, lipid profile, liver biomarker enzymes

INTRODUCTION

Zinc oxide nanoparticles, or ZnO NPs, are thought to be one of the best metals with antibacterial and optical qualities that are utilized in many various applications.1.Aloe barbadensis has the potential to be a nano antibiotic or a drug carrier for delivering medication to the target cancer cell because it has been utilized to create green ZnO NPs and has demonstrated notable antibacterial and antibiofilm qualities.2.As a typical ligature agent, camellia sinensis was suitably benefitted to generate green ZnO NPs. TEM indicated the crystallinity of the NPs, confirming the significance of Camellia extract in the production of ZnO NPs. Based on TEM analysis3, the size of the particles was found to be 200 nm. ZnO NP production is of great interest due to its antibacterial qualities and potential uses in biomedicine.4,5Moreover, numerous researchers have examined ZnO NPs with green tea extract5,6. Their discovery that green tea contains catechin and polyphenolic components piqued interest.of attention because of their potential as antioxidants and advantages to human health. The complex is effective against a number of pathophysiological diseases, including cancer, dementia, cardiovascular disease, and hypertension.7, 8. Green tea extract (GTE) offers the benefits previously discussed because it contains potent phenolic antioxidants for cutting-edge biomedical applications5,9,10. By lowering oxidative stress, anti-inflammatory biomarkers (C-reactive protein, "-tumor necrosis, and interleukin-6), and raising antioxidants like superoxide dismutase, catalase, glutathione peroxidase, and glutathione, ZnO NPs/GTE

complex provides partial hepatic protection against monosodium glutamate.5. They discovered that the GTE/ZnO NPs compound enhanced the Histological examination and transmission perspective of rat liver parenchyma following monosodium glutamate (MSG) treatment. ZnO NPs/GTE improved the ultrastructural changes in the form of normal nuclei with little irregular boundaries of nuclei and mid-size mitochondria, as well as the restoration of most hepatic structures, including normal nuclei without pyknosis and normal mitochondria.

MATERIALS AND METHODS

The highly pure green tea plant was purchased from the Al-Taif City, Saudi Arabia, local market. The 200 nm diameter, 150 nm length, and variety of sizes of ZnO NPsWe purchased 40–150 nm from Sigma-Aldrich Company. ZnO NPs have 99.5% purity according to Sigma Aldrich. Markets provided 99% pure monosodium glutamate (MSG) (Ajinomoto Co. Inc., Tokyo, Japan).Green tea extract (GTE) preparation: After giving the entire plant a thorough wash in double-distilled water, it was dried. 100 mL of ethanol 95E in 35EC was combined with 10 g of dried and powdered green tea. At 27EC14, the combined solution was continuously stirred with a magnetic device for a whole day. Filtered, the extract was kept at 4EC for additional study.ZnO NP characterization and GTE/ZnO NPs compound preparation: ZnO NPs have a specific surface area of 50 m2.gG1. For the synthesis of ZnO NPs/green tea complex5, approximately 0.001 M water solutions of ZnO NPs were created by dispersion using ultrasonic vibration (130 W, 20 kHz) for 30 min.In order to create the GTE/ZnO NPs solution, 5 mL of green tea extract (GTE) was added to 120 mL of an aqueous solution containing 0.001 M ZnO NPs. The mixture was then allowed to sit at room temperature for an hour in order to facilitate the reduction of Zn ions. The green tea extract/ZnO NPs complex (GTE/ZnO NPs complex, 1 mg mLG1) was finally produced.

Design of experimental animals and ethical considerations

The Wistar rats were acquired from the University of Zagzig's Faculty of Pharmacy's animal house. sixty-four male adultsBefore being used in an experiment, rats weighing 200–250 g were housed for two weeks at room temperature (25±2EC) with aeration. Food and water were provided to the animals for the duration of the 30-day trial, which began in March 2018.The rats were selected as the most suitable species of animals. In order to get accurate results, the sample size of animals was estimated using fewer animals. All procedures were carried out under anesthesia in order to save the animals from any potential pain. The Taif University Research Animal Ethics Committee authorized the guidelines for animal.

Blood sample collection

Prior to drawing blood via the retro-orbital plexus vein using capillary tubes (Micro Hematocrit Capillaries, Mucaps), all rats were starved for the whole night.

moderate anesthesia with ether. After being moved to centrifuge tubes, blood samples were given 30 minutes to clot before being centrifuged for 15 minutes at 3,000 rpm. The serum was divided and kept frozen at -20°C until the biochemical assessment was made.Evaluation of liver functions: Using the UV kinetics approach of the commercial diagnostic kit (Stanbio Co., Spain), the serum enzyme activities of lactate dehydrogenase (LDH), alanine aminotransferase (ALT), and an additional aminotransferase (AST) were determined. Human Diagnostic Worldwide, Germany was used to assess the γ-glutamyl transferase (γ-GT) activity. The information was presented in terms of international units per gram (IU gG1). The estimated amounts of proteins were as follows:Lipid profile assessment: Using Carr et al.'s approach, the serum's triglycerides (TG) and total cholesterol (TC) were maintained.The Warnick et al. procedures were used to evaluate the high-density lipoprotein-cholesterol (HDL-C). The serum level of low-density lipoprotein-cholesterol (LDL-C) was determined using the Friedewald et al. formula.LDL-C equals 0.7 Total cholesterol: (Concentration of Triglycerides / 5) - Content of HDL-C. Very low-density lipoprotein cholesterol (VLDL-c) was measured using Friedewald et al.'s methodology. Analytical statistics: The information is displayed as Mean±SE (n = 8/group). One-way analysis of variance (ANOVA) was utilized in the statistical analysis to evaluate any significant differences between the treatment groups, and the post hoc Tukey's test was employed for comparisons. Set at $p<0.05$, the statistical significance was maintained. Every analysis was carried out utilizing SPSS version.

RESULTS

Rats' serum lipid profiles were examined, and the results indicated that the MSG-LD and MSG-HD treatment groups had significantly higher levels of TC, TG, LDL-C, and VLDL-C than the GTE control group.and animals exposed to ZnO NPs in a dose-dependent way (Table 1).In contrast to the control, GTE, and ZnO NP groups, the HDL-C content in the MSG groups shown a substantial ($p<0.05$) drop. All of the lipid profile parameters were considerably reduced in the animals treated with GTE/ZnO NPs complex in combination with MSG-LD or MSG-HD, with the exception of HDL-C, which increased in comparison to its relative of MSG alone.Comparing the sera of the MSG-LD and MSG-HD groups to those of the control rats, there are notable variations in the activities of AST, ALT,

ALP, and LDH (Table 2). Information revealed that there were statistically significant increases in the levels of AST, ALT, ALP, and LDH activities in the sera of animals treated with MSG-HD as opposed to MSG-LD. In contrast to animals given MSG alone, treated rats with GTE/ZnO NPs plus MSG exhibited a substantial decrease in all enzyme activity. All enzymes experienced dose-dependent changes in their proportion of leakage.

DISCUSSION

Every piece of information found in the literature focuses on how vitamins C, E, quercetin, and diltiazem can prevent the harmful alterations brought on by MSG. Therapy utilizing Prior to the MSG, vitamin C restored the antioxidant's effectiveness and shown a protective function against MSG-induced oxidative stress20. Utilizing the GTE/ZnO NPs complex to guard against MSG-induced lipid metabolism disorders and enzyme leakage is a novel approach.Both natural materials and medicinal pharmaceuticals can be used to treat hyperlipidemia. The results of this study showed that all lipid profile measures showed a significant increase due to hyperlipidemia brought on by MSG treatment, with the exception of HDL-C, which showed a reduction. Additionally, the disruption of the lipid profile was secondary to increased liver function indicators, such as in both histological alternation and the current investigation. Serum liver enzyme levels rise when there is liver damage because the hepatocytes are disrupted.The current study found that the MSG groups' serum levels of LDL-C and VLDL-C were higher than the control rats'. Furthermore, the increase in TC could beattributed to the suppression of the hepatic cholesterol-7-alpha-hydroxylase enzyme, which synthesizes cholesterol from bile acid, or to the decrease in the TC-catabolic rate23. Furthermore, the improvement in TC seen in this study may be linked to an increase in HMG-CoA reductase activity in the hepatocytes of animals given MSG treatment and a decrease in the rate at which LDL-clearance from the circulatory system occurs as a result of insufficient LDL-C receptors linked to the build-up of TC level 24.Moreover, the decrease in lipase activity, an insulin-dependent enzyme involved in the removal of TG from plasma, may be linked to the increase in TG levels.TG lipolysis is approximated as glycerol and free fatty acids25. These days, a wide range of medications are utilized to reduce heart disease and blood vessel impairment as well as regulate blood lipid levels. According to the current study, in MSG-treated mice, the use of GTE/ZnO NPs significantly reduced the risk of disorders with high blood cholesterol levels.Increasing the hepatocyte enzyme leakage in serum was consistent with the findings of Egbuonu et al. 26 who reported that MSG administration led to an increase in ALT and AST enzyme activity as well as liver atrophic.

CONCLUSION

As per the findings of this study, the anti-hyperlipidemia impact of GTE/ZnO NPs was amplified by the reduction in TC, TG, and LDL-C levels as well as raised the HDL-C. Furthermore, the hepatocytes' integrity was enhanced, as evidenced by the enzymes' decreased activity. The current investigation demonstrates that GTE conjugated with ZnO NPs is a potentially effective anti-hyperlipidemic drug for treating MSG-induced hyperlipidemia diseases.

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