SPC

Journal of Medicinal and Chemical Sciences

Journal homepage: http://www.jmchemsci.com/

Original Article

The Role of Garlic Oil in Improving Disturbances in Blood Parameters Caused by Zinc Oxide Nanoparticles

Jalank Hameed Mahmoud[1], Ozdan Akram Ghareeb[1,*], Yawooz Hameed Mahmood[2]

[1]*Community Health Department, Kirkuk Technical Institutes, Northern Technical University*
[2]*Biology Department, College of Education, University of Samarra, Iraq*

ARTICLE INFO

Article history

Received: 2021-10-01
Received in revised: 2021-10-06
Accepted: 2021-10-26
Manuscript ID: JMCS-2110-1282
Checked for Plagiarism: **Yes**
Language Editor:
Dr. Behrouz Jamalvandi
Editor who approved publication:
Dr. Behrooz Maleki

DOI:10.26655/JMCHEMSCI.2022.1.9

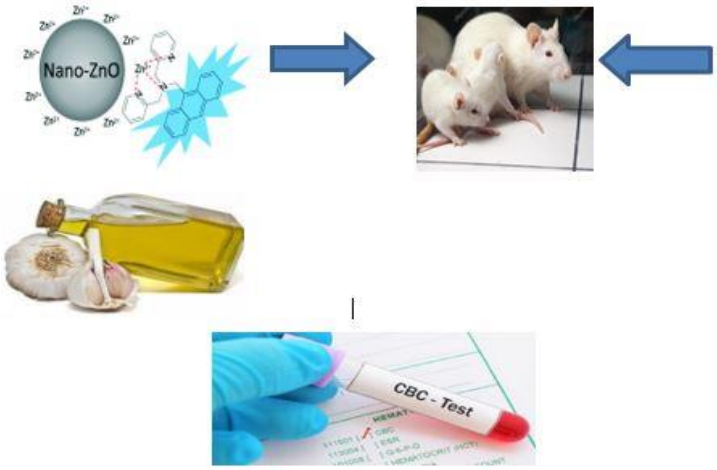
KEYWORDS

Blood Toxicity
Garlic Oil
Experiment

ABSTRACT

Industrial applications of zinc oxide nanoparticles (ZnO-NPs) are increasing because of their unique features, such as their widespread use in cosmetics as well as sun screens. The potential harmful effects of ZnO-NPs need to be investigated further. The purpose of this research is to examine the prophylactic effect of garlic oil on some hematological parameters altered by zinc oxide nanoparticles (ZnO-NPs) of adult male rats. This experiment was conducted on thirty-six male rats fall into 4 packs of six animals each. CON is the control group of healthy rats. ZnO-NPs group received 200 mg/kg zinc oxide nanoparticles, while the ZnO-NPs +GO group intoxicated rats received 100 ml/kg garlic oil, and GO group rats received only 100 ml/kg garlic oil. Study duration was 15 days. After the experimentation, rats were sacrificed and the levels of hematological parameters were evaluated, which included erythrocytes count, hemoglobin level, leukocytes count, and platelet count. The results of this study showed that zinc oxide led to significant changes in blood parameters, and when combined with garlic oil, hematological toxicity was improved. In conclusion, the hematological toxicity of ZnO-NPs was noticeable; however, the use of doses of garlic oil reduced this toxic effect.

GRAPHICAL ABSTRACT



* Corresponding author: Ozdan Akram Ghareeb
✉ E-mail: Email: naw_m@yahoo.com

Introduction

Zinc oxide nanoparticles (ZnO-NPs) are semi-conductor metal oxide nanoparticles widely used in biomedical fields, as well as in the cosmetics and skin care products. It is important to note that nano-composites have toxic properties determined by factors such as size, structure and main components, shape, physical and chemical properties, and method of synthesis, which affect health [1,2]. Toxicity that is mediated by nano particles consists of oxidative stress, infection, genetic harm, preventing cell division and cell loss [3,4]. The increasing growth of applications of nanoparticles evokes an increasing necessity to evaluate the potential toxicity of nanomaterial, which has not been fully identified to date. Thus, the study of its toxicity is necessary to prevent its harmful effects. Humans are exposed to ZnO-NPs out of the oral, inhaled and dermal route. These particles have the capability to travel throughout the body and penetrate into individual cells and their nuclei [5]. Many traditional plants have been used for many years in treatments and disease prevention as well as to improve the health of the body. Phytochemicals in plants work within molecular level to guard human cells from many pathogens [6]. Garlic (*Allium sativum* L.) belongs to the onion genus, from *Amaryllidacaea* family, monocotyledonous, perennial plant, native to central Asia and northern Iran [7]. Because garlic contains many vigorous chemical constituents, like amino acids, organic sulfates, vitamins and minerals, it has been proposed to be an auspicious candidate for preserving homeostasis [8]. In addition, it has several biological benefits, including stimulating immune function, promoting detoxification of foreign compounds, reactive oxygen species (ROS) - scavenger, encouragement DNA reform, anti-microbial effect, anti- inflammation, anti-diabetic, induction of apoptosis, and inhibition of angio genesis [9-11]. Blood parameters are one of the main signs in detecting the real physiological condition of the organism. Estimate of hematological parameters levels has a key role in determining the toxicity of nano particles in the body [12]. So, this experiment deals with the hematological parameters that diagnose blood disorders due to the harmful effect of zinc oxide and evaluate the positive role of garlic oil on ZnO-NPs induced hematotoxicity in laboratory animals.

Animals and Study Groups

Male albino rats (5-7 weeks old, 190-260 g) were obtained from animal laboratories center, and the rats were held at house in special plastic crates in a room of well ventilation kept at 25 °C ± 2 °C and 70% ± 10% of relative humidity, a twelve hours light/dark cycle; it has wide places to access for water and food. Rats were adapted to laboratory conditions for a week, and then the experiment was conducted on them. The rats were randomly separated into 4 packs, six in each group as shown in Table 1.

Table 1: Experimental design for twenty-four rats used in the study

Groups	Treatments and dosages
CON	Healthy rats
ZnO-NPs	Rats received zinc oxide nano particles at dose 300 mg/kg orally, for 14 days [13]
ZnO-NPs+ GO	ZnO-NPs intoxicated rats were orally treated with 100 ml/kg GO employing gastric gavage for 14 days [14]
GO	Rats were administrated only garlic oil at a dose 100 ml/kg for 14 days

Blood Parameters

Animals were injected by an anesthetizer and dissected at the end of the treatment course, and blood samples were taken in EDTA tubes through heart puncture and utilized promptly for hematological parameter measurement. An auto hematology analyzer was used to measure hemoglobin (HB), red blood cells (RBCs), white blood cells (WBCs), hematocrit (HCT), and platelets (PLTs).

Material and methods

Chemicals

The following chemicals were applied: Zinc oxide nanoparticles aqueous dispersion (suspension in water 20 wt%), white liquid appearance. ZnO purity=99.5, particle size= 30-40 nm, ph =8.9.

taken out of American Research Nanomaterials, Inc. Houston, Texas (USA), and garlic oil product obtained from La Tourangelle, INC. Artisan made.

Data Analysis

SPSS version 26 was used for statistical analysis. Variances among packs were analyzed by one-way ANOVA and Dawkins test, and statistics were presented as mean± standard deviation. A level difference of $p<0.05$ was taken into consideration as statistically significant.

Result and Discussion

As illustrated in Figure 1, no statistically significant changes ($P>0.05$) were observed in the blood profile between CON group and GO group. Nonetheless, a significant drop was observed in RBCs count, HB content, HCT percentage, and PLTs count, whilst WBCs count significantly augmented after ZnO-NPs treatment compared with the control group. Co-administration of garlic oil to exposed - ZnO nanoparticles rats restored RBCs, HB, HCT, and PLTs values approximately to control levels. Nevertheless, GO underestimated the rise in WBCs count in metal oxide -intoxicated rats. Systemic toxicity of chemicals counts upon the way of administration and place of exposure. Hematological parameters are the first to be affected by systemic toxicity. Therefore, evaluation of hematological parameters can be considered as a diagnosis of the harmful effects of foreign compounds on blood components in vivo [15,16]. To assess the advantageous impact of garlic oil towards ZnO-NPs prompted hematotoxicity, basic hematological parameters in rats were measured. ZnO-NPs poisoned rats revealed a substantial drop in mean values of RBC, Hb, HCT and PLT, but a substantial rise in WBC count happened when compared with control rats. Decreased red blood cells count is related to the progress of anemia. The toxin stimulates lipid peroxidation system leading to the production of lipid peroxides that hemolysate red blood cells [17]. Among the main pathological after effects of free radical-induced tissue lipid peroxidation are greater cellular distortion, decreased erythrocyte survival by augmented auto-necrosis, and augmented lipid fluidity that initiates a chain of inflammatory reactions that cause endothelial dysfunction [18,19]. Low levels of hemoglobin which is the main intracellular protein for RBCs is resulted from losing blood or rapid destruction of blood cells, leading to anemia [20]. Hematocrit is a key factor of blood viscidness. A decrease in the count of erythrocytes, a decreasing quantity of hemoglobin in every erythrocyte, or both may arise lower than normal hematocrit. Chemicals or toxins damage myeloid tissue by inhibiting the enzymes needed for hemopoiesis [21,22]. Circulating thrombocytopenia is due to decreased platelet production or increased platelet destruction [23]. The increased WBC level results from the triggering the physique's immunity to counteract the toxic influence of the metal. Leukocytosis can also be ascribed to the undeveloped WBC in the blood [24,25]. In the current work the beneficial special effects of Garlic oil on ZnONPs-hematotoxicity were observed in ZnO-NPs +GO rats. Garlic can be presented as a ubiquitous antidote or protective herb towards numerous harmful substances through controlled clinical trials. Our results are consistent with the evidence of many previous laboratory and animal experiments that studied the protecting effects of garlic for chemical toxicities, proving that garlic in addition to its own main constituents could reduce the toxicity of various factors in the blood and many organs of the body through a variety of mechanisms, such as radical sifting and antioxidant effect, lipid peroxidation reduction, anti-inflammatory agent, chelating agent, cell protection activities, increased protein synthesis in tissues that have been damaged, suppression of apoptosis [26-31]. Al-Sebaey *et al*. (2019) evaluated the effect of garlic extract on blood toxicity, immune-suppression, and hepatic oxidative stress induced by cyclophosphamide (CYP) in male rats. They found that garlic extract can be used to protect against these toxic effects, by modulating immunity as well as improving oxidative stress [32]. Nasr *et al*. (2017) investigated the effect of garlic on lead acetate-induced testicular toxicity in male rats. They concluded that garlic has a prophylactic effect against the possibility of unfavorable apoptosis caused by lead acetate

[33]. Consistent with the findings of those studies, the results of the current study manifest that garlic can play a role in modulating ZnONPs-induced hematological disorders.

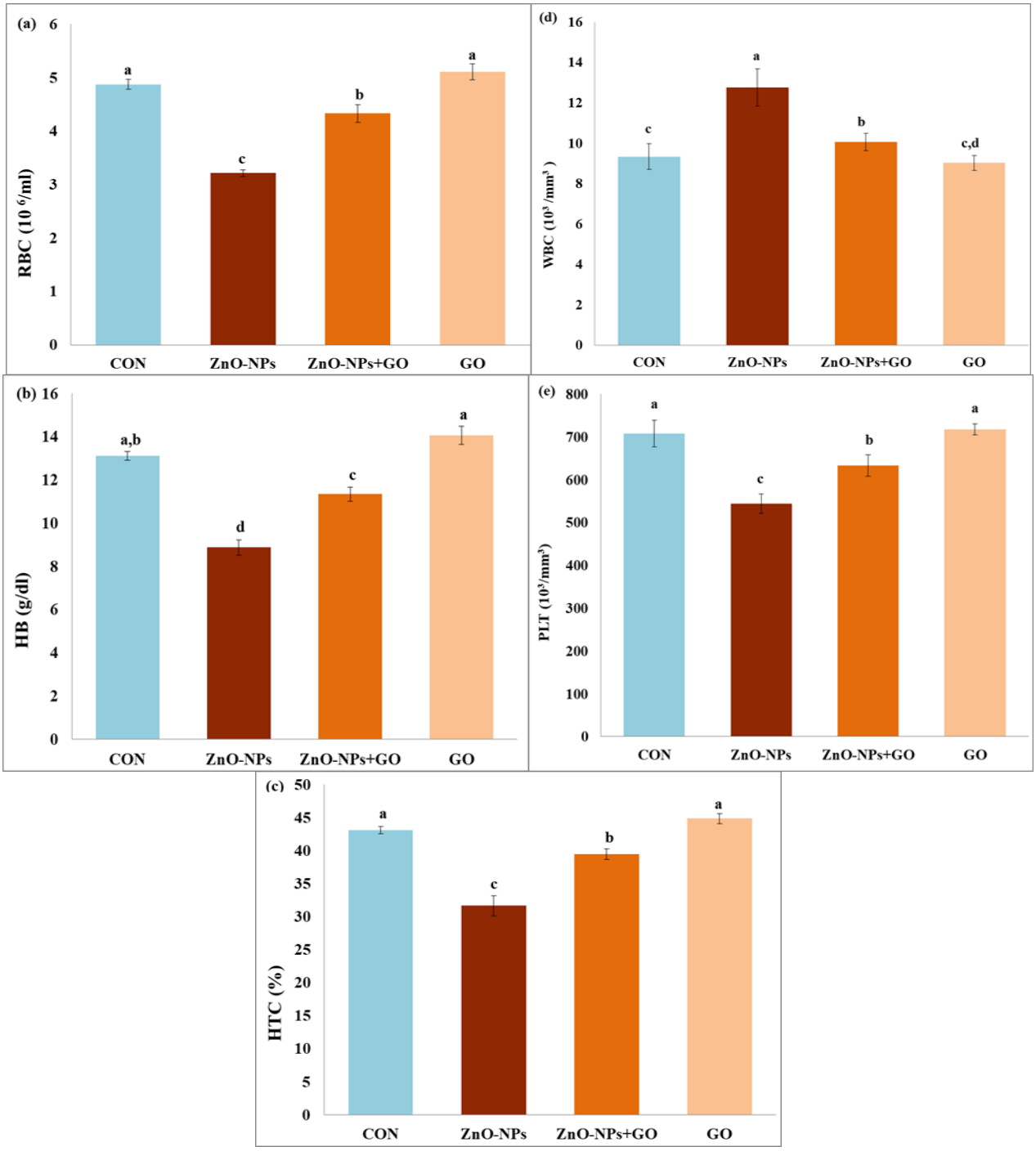


Figure 1: Effects of dosing rats with zinc oxide nanoparticles and co-dosing with garlic oil on the following blood markers: (a) RBCs, (b) HB, (c) HTC, (d)WBCs, and (e) PLTs. Data were represented as a mean ± SD, different letters denote significant variances within the column ($p < 0.05$), test = ANOVA, post hoc = Duncan

Conclusion

In this study, we reported that zinc nano particles have toxic effects on blood parameters. As garlic oil has an outstanding ability to reduce blood toxicity, its therapeutic properties can be exploited in therapeutic strategies in this field.

Funding

No funding.

Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Conflict of Interest
The authors declare that they have no competing interests.

Ethical considerations
The ethical issues (including plagiarism, data fabrication, double publications) were fully noted by the authors.

ORCID
Jalank Hameed Mahmoud
0000-0002-7128-3306
Ozdan Akram Ghareeb
0000-0002-7037-0643

References
[1]. Ghareeb O.A. *Indian J. Forensic Med. Toxicol.*, 2021, **15**:3213 [Crossref], [Google Scholar], [Publisher]
[2]. Pacheco I., Buzea C., *Nanomaterials and Nanocomposites for Energy and Environmental Applications*, 2021, 3 [Crossref], [Google Scholar], [Publisher]
[3]. Egbuna C., Parmar V.K., Jeevanandam J., Ezzat S.M., Patrick-Iwuanyanwu K.C., Adetunji C.O., Khan J., Onyeike E.N., Uche C.Z., Akram M., Ibrahim M.S., *J. Toxicol.*, 2021, 30:**2021** [Crossref], [Google Scholar], [Publisher]
[4]. Zhao X., Abulikemu A., Lv S., Qi Y., Duan J., Zhang J., Chen R., Guo C., Li Y., Sun Z., *Chemosphere*, 2021, **275**:129969 [Crossref], [Google Scholar], [Publisher]
[5]. Keerthana S., Kumar A., *Crit. Rev. Toxicol.*, 2020, **50**:47 [Crossref], [Google Scholar], [Publisher]
[6]. Al-Haidari K.A.A., Faiq T.N., Ghareeb O.A., *Pak. J. Med. Health Sci.*, 2021, **15** [Google Scholar], [Publisher]
[7]. Entezari A., Mehrvar M., Zakiaghl M., *Virus Disease*, 2021, **32**:595 [Crossref], [Google Scholar], [Publisher]
[8]. El-Saber Batiha G., Magdy Beshbishy A. G. Wasef L., Elewa Y.H., A Al-Sagan A., El-Hack A., Mohamed E., Taha A.E., M. Abd-Elhakim Y., Prasad Devkota H., *Nutrients*, 2020, **12**:872 [Crossref], [Google Scholar], [Publisher]
[9]. Moutia M., Habti N., Badou A., *Evid.-Based Complementary Altern, Med.,* 2018, **1**:10 [Crossref], [Google Scholar], [Publisher]
[10]. Farhat Z., Hershberger P.A., Freudenheim J.L., Mammen M.J., Blair R.H., Aga D.S., Mu L., *Eur. J. Nutr.*, 2021, **60**:3585 [Crossref], [Google Scholar], [Publisher]
[11]. Moosavian S.P., Paknahad Z., Habibagahi Z., *Int. J. Clin. Pract.*, 2020, **74**:e13498 [Crossref], [Google Scholar], [Publisher]
[12]. Ghareeb O.A., Sulaiman R.R., Ibrahim S.H. *Ann. Romanian Soc. Cell Biol.*, 2021, **19**:7448 [Google Scholar], [Publisher]
[13]. Sharma V., Singh P., Pandey A.K., Dhawan A., *Mutat. Res.*, 2012, **745**:84 [Crossref], [Google Scholar], [Publisher]
[14]. Abdel-Daim M.M., Abdel-Rahman H.G., Dessouki A.A., Ali H., Khodeer D.M., Bin-Jumah M., Alhader M.S., Alkahtani S., Aleya L., *Sci. Total Environ.*, 2020, **710**:136338 [Crossref], [Google Scholar], [Publisher]
[15]. Arika W.M., Nyamai D.W., Musila M.N., Ngugi M.P., Njagi E.N., *J. Hemat Thromboembolic Dis.*, 2016 [Crossref], [Google Scholar], [Publisher]
[16]. Ghareeb O.A., *Ann. Romanian Soc. Cell Biol.*, 2021, **3**:13796 [Google Scholar], [Publisher]
[17]. Kaestner L, Bianchi P., *Front. physiol.*, 2020, **11**:387 [Crossref], [Google Scholar], [Publisher]
[18]. Fujii J., Homma T., Kobayashi S., Warang P., Madkaikar M., Mukherjee M.B., 2021, **55**:562 [Crossref], [Google Scholar], [Publisher]
[19]. Gwozdzinski K., Pieniazek A., Gwozdzinski L. *Oxid. Med. Cell.*, 2021, **2021** [Crossref], [Google Scholar], [Publisher]
[20]. Kosmachevskaya O.V., Novikova N.N., Topunov A.F., *Antioxidants*, 2021, **10**:253 [Crossref], [Google Scholar], [Publisher]
[21]. Corrons J.L., Casafont L.B., Frasnedo E.F., *Ann. Hematol.*, 2021, **1**:9 [Crossref], [Google Scholar], [Publisher]
[22]. Kucukal E., Man Y., Hill A., Liu S., Bode A., An R., Kadambi J., Little J.A., Gurkan U.A., *Am. J. Hematol.*, 2020, **95**:1246 [Crossref], [Google Scholar], [Publisher]
[23]. Kishimoto S, Maruhashi T, Kajikawa M, Matsui S, Hashimoto H, Takaeko Y, Harada T, Yamaji T, Han Y, Kihara Y, Chayama K., *Sci. Rep.*,

2020, **10**:1 [Crossref], [Google Scholar], [Publisher]
[24]. Ewere E.G., Okolie N.P., Ndem J.I., Oyebadejo S.A., *GSC biol. pharm. sci.*, 2021, **15**:027 [Crossref], [Google Scholar], [Publisher]
[25]. Miranda R.N., Wang S.A., *Diagnosis of Blood and Bone Marrow Disorders.* Springer, Cham., 2018, 171 [Crossref], [Google Scholar], [Publisher]
[26]. Dorrigiv M., Zareiyan A., Hosseinzadeh H., *Phytother. Res.*, 2020, **34**:1770 [Crossref], [Google Scholar], [Publisher]
[27]. Vijaya P., Kaur H., Garg N., Sharma S., *J. Basic Appl. Zool.*, 2020, **81**:23 [Crossref], [Google Scholar], [Publisher]
[28]. Ramadhan S.A., Ghareeb O.A., *Ann. Romanian Soc.*, 2021, **25**:597 [Google Scholar], [Publisher]
[29]. Zwolak I., *Oxid. Med. Cell.*, 2020, **2020**:14 [Crossref], [Google Scholar], [Publisher]
[30]. Dutta A., Dahiya A., Prakash A., Agrawala P.K., *Phytomedicine Plus*, 2021, **1**:100084 [Crossref], [Google Scholar], [Publisher]
[31]. Mondal A., Banerjee S., Bose S., Mazumder S., Haber R.A., Farzaei M.H., Bishayee A., *Pharmacol. Res.*, 2021, **24**:105837 [Crossref], [Google Scholar], [Publisher]
[32]. El-Sebaey A.M., Abdelhamid F.M., Abdalla O.A., *Environ. Sci. Pollut. Res.*, 2019, **26**:15559 [Crossref], [Google Scholar], [Publisher]
[33]. Nasr N.E., Elmadawy M.A., Almadaly E.A., Abdo W., Zamel M.M., *Alex. J. Vet. Sci.*, 2017, **54**:70 [Crossref], [Google Scholar], [Publisher]

HOW TO CITE THIS ARTICLE
Jalank Hameed Mahmoud, Ozdan Akram Ghareeb, Yawooz Hameed Mahmood. The Role of Garlic Oil in Improving Disturbances in Blood Parameters Caused by Zinc Oxide Nanoparticles, *J. Med. Chem. Sci.*, 2022, 5(1) 76-81
DOI: 10.26655/JMCHEMSCI.2022.1.9
URL: http://www.jmchemsci.com/article_139302.html