



Cytotoxicity and Antimicrobial Activity of Chromium Picolinate Mediated Zinc Oxide Nanoparticle

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Authors' contributions

This work was carried out in collaboration among all authors. Idea and study was conceptualized by authors LA and SR collection of the literature and drafting the manuscript was by authors MKS and LA. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To study the chromium picolinate mediated with zinc oxide nanoparticle and its cytotoxicity and antimicrobial activity

Introduction: Chromium can alleviate glucose intolerance and insulin resistance and it is involved in the metabolism of glucose, lipid, protein, and nucleic acid. Chromium picolinate [CrPic], also named as picolinic acid chromium and several studies have proved that CrPic, as the source of Chromium, can alleviate the high level of blood glucose, blood lipid, insulin, and cholesterol in the patients with metabolic syndrome and zinc oxide [ZnO] has also gained momentum due to their unique properties in the process of nanotechnology. Chromium picolinate works together with insulin that produced by the pancreas to metabolize carbohydrates. It's made by combining chromium with picolinic acid. The acid helps the body absorb chromium. Randomized controlled trials have failed to demonstrate a link between chromium supplementation and the prevention or treatment of type 2 diabetes or impaired glucose tolerance. Chromium supplementation of young men and women does not promote muscle accretion, fat loss, or gains in strength. Physically active

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individuals with concerns about meeting guidelines for nutrient intake should be counseled to select and consume foods with high nutrient densities rather than to rely on nutritional supplements.

Materials and Methods: Chromium picolinate mediated with ZnO nanoparticles were evaluated for its antibacterial activity and cytotoxicity potential using brine shrimp lethality assay.

Results: Chromium picolinate mediated zinc oxide nanoparticles show good results in antimicrobial activity as well as in cytotoxicity.

Conclusion: Chromium picolinate mediated Zn nanoparticles is an efficient antibacterial and a potential cytotoxicity agent.

Keywords: Chromium picolinate; cytotoxicity; anti-oxidant; brine shrimp; anti-microbial

1. INTRODUCTION

Chromium is a mineral that exists in several safe forms and is found naturally in many foods [1]. Chromium is known to enhance the action of insulin, a hormone critical to the metabolism and storage of carbohydrate, fat, and protein in the body. Although some researchers question whether this mineral is truly essential, it does serve several important functions in the body [2]. For example, it is part of a molecule called chromodulin, which helps the hormone insulin perform its actions in the body [3]. Chromium picolinate have several kinetic mechanisms for its utilization by the cells that require reduction of chromium center, a process that can lead potentially to an antioxidant effect [4]. Chromium, as an essential element, is directly related to the activity of glucose tolerance factor [5]. Cr can alleviate glucose intolerance and insulin resistance and it is involved in the metabolism of glucose, lipid, protein, and nucleic acid [6]. However, as supplementary drug, Cr could not be effectively used due to the poor absorption rate [dietary chromium: 0.4–2%; chromium chloride: 0.5–2% [7]. Chromium picolinate, also named as picolinic acid chromium, is a convenient form of chromium that is used more efficiently than some other forms of chromium [8]. The absorption rate of it is about 0.7–5.2%. Several studies have proved that CrPic, as the source of Cr, can alleviate the high level of blood glucose, blood lipid, insulin, and cholesterol in the patients with metabolic syndrome. Chromium picolinate is the mineral chromium attached to three molecules of picolinic acid [9]. Chromium is probably the only nutritional mineral that has a several hundred-fold difference between the acceptable daily intake level and the calculated reference dose [10].

Zinc oxide has gained momentum due to their unique properties for biomedical applications [11,12]. It has been used considerably for its

important applications in different areas viz. catalysts [13], sensors [14], optoelectron, highly functional, and effective photoelectron devices [15]. ZnO nanostructures have a great advantage to apply in medical and pharmaceutical applications due to their large surface area and high catalytic activity zinc oxide nanoparticles [ZnO-NPs] has received significant interest worldwide particularly by the implementation of nanotechnology to synthesis particles in the nanometer region [16]. Many microorganisms exist in the range from hundreds of nanometers to tens of micrometers. Zinc oxide thin films and nanoparticles have applications in luminescent devices, photocatalysis, photoelectrochemistry and nonlinear optical devices [17,18,19]. In the present study we have used chromium picolinate mediated Zinc oxide nanoparticles to evaluate its cytotoxic and antimicrobial potential.

Some of the previous study has been carried out on the chromium picolinate, chromium (Cr) supplementation has been studied as a co-adjuvant diabetes therapy, due to its role in glucose/insulin metabolism [20]. Chromium may enhance insulin sensitivity by activating intracellular signaling pathways involved in glucose transporter 4 (GLUT4) translocation, consequently increasing glucose and amino acids transport [21,22].

In the present study we have used chromium picolinate mediated Zinc oxide nanoparticles to evaluate its cytotoxic and antimicrobial potential.

2. MATERIALS AND METHODS

2.1 Chromium Picolinate Preparation

100 mg of Chromium picolinate is mixed and dissolved with 10 ml tween-20, further 3 mM of Zinc oxide was mixed along with prepared

chromium picolinate and then it was kept in theorbital shaker for 24- 72 hrs until the color change was observed, which is the indication of nanoparticle synthesized.

2.2 Evaluation of Antibacterial Activity

The agar well diffusion method was used to determine the antibacterial activity of Zinc oxide.Lactobacillus, streptococcus mutans and candida albicans.The fresh bacterial suspension was dispersed on the surface of Muller Hinton agar plates and the fresh fungal suspension was dispersed on the surface of Rose Bengal agar plates, Different concentration of nanoparticles [50, 100 & 150 μ L] was incorporated into the wells and the plates were incubated at 37°C for 24 h. The antibiotics were used as positive control. Zone of inhibition was recorded in each plate.

2.3 Evaluation of Cytotoxicity Activity

Brine shrimp eggs were obtained from the new aqua laboratory .Filtered ,artificial seawater was prepared, the shrimp eggs were added into the chamber while the lamp above the other side to attract the hatched shrimp ,two days were allowed for shrimp to mature ,after two days the shrimp is ready for the assay ,then it is placed in the well with each contain 10 brine shrimps accordingly the nanoparticle is added 5,10,15,20 micrometer and it was left for 24 hrs to assess the LD50 of the shrimps against the compound.

3. RESULTS AND DISCUSSION

3.1 Antimicrobial Activity

The test for antimicrobial activity was carried out using the Agar well diffusion method. Three agar plates for identifying the inhibitory effect over *Lactobacillus*, *S. mutans* and *C. albicans* respectively, were used. Each plate had four wells each with different nanoparticle concentrations being 50 μ L, 100 μ L and 100 μ L and 150 μ L, while the fourth was a standard. Against *Lactobacillus*, the diameter of the zone of inhibition of the nanoparticles at 50 μ L, 100 μ L and 150 μ L is observed to be 15 mm, 20 mm and 22 mm respectively. With *S. mutans*, the diameter of zone of inhibition of the nanoparticles at 50 μ L, 100 μ L and 150 μ L was obtained as 09 mm, 13 mm and 25 mm respectively. Against *C. albicans*, the diameter of the zone of inhibition at 50 μ L, 100 μ L and 150 μ L was observed as 09 mm, 13 mm and 23 mm respectively. Thus, maximum activity for all the three was observed at 150 μ L when compared with standard.

3.2 Cytotoxicity Activity

The test for cytotoxic properties was assessed using brine shrimps. Ten nauplii were placed in each of six wells with one standard and the remaining with nanoparticle concentrations 5 μ L, 10 μ L, 15 μ L, 20 μ L and 25 μ L. LD50 concentration was obtained to be 25 μ L, with half the population of nauplii in the respective well surviving, post incubation.

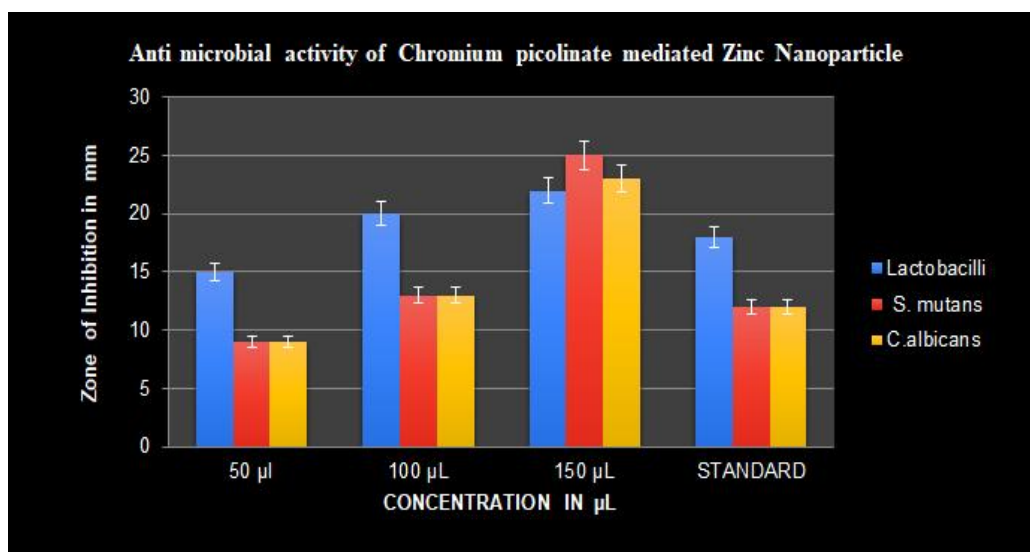


Fig. 1. Graph showing antimicrobial activity of Cr Pic-Zn NP against oral pathogen

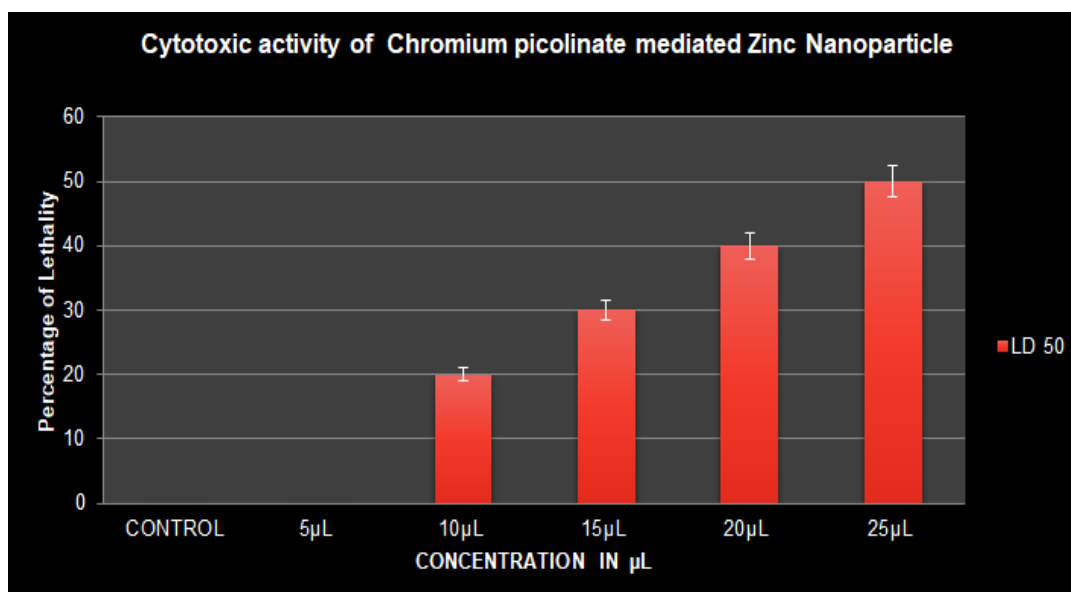


Fig. 2. Graph showing cytotoxicity activity of Cr Pic-Zn NP in brine shrimp lethality assay

4. CONCLUSION

In the present study, it is evident that the chromium picolinate mediated ZnO nanoparticles is an efficient antibacterial and a potential cytotoxicity agent. Since Chromium picolinate has been reported to have a potential ability to cytotoxic in previous studies, with a possible mechanism to have the capability to remove nascent ROS from the cell membrane which leads to destruction of cells and in this study it has established to have an potential antimicrobial and brine shrimp lethality at higher doses. Hence it can be used for further research and has an application in other biomedical applications.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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