# The action potential Of Zinc Oxide Nanoparticles on DNA of *Streptococcus Mutants* species



# The action potential Of Zinc Oxide Nanoparticles on DNA of *Streptococcus*

*Mutants* species

Hassanain jwad abid al Hussein
Collage of Dentistry, Kerbela university.
Ohood Salman Jawad
College of Applied Medical Sciences
Eman Ibrahim Awad
College of Applied Medical Sciences

**Abstract**

In order to clarify the fundamental benefit between the relationship between the use of nanoparticles and the creation of DNA-sensing devices, using nanoparticles of zinc oxide. These particles are used in functional devices in the field of nanotechnologies in modern science, catalysts, materials used in dyes, as well as materials used in optical fields and many other high-tech applications. In this study, the effect of nanoparticles on a nuclear material and thus DNA damage is found to be deficient in the DNA and therefore the fundamental properties of the genetic material belonging to *Streptococcus Mutants* species.This study shows how the effect of the action of nanoparticles on nanotubes on DNA is altered and changed. When the acid density is relatively high, the non-saturation is clear and distinct. This effect is dependent on the length of the DNA and the control of dsDNA By controlling the absorption obtained by zinc oxide nanoparticles.

## 1.Introduction

Zinc nanoparticles can be used in many fields, including electrochemical specifically, which used in chemical and biological sensing. As well as in the field of catalysts including photovoltaic [1], [2], [3], phosphorus etc. [4], as well as thin film technology fields, as well as in solar cell technologies and dye-sensitive techniques [5], [6]. There are other uses which are very clear in the cosmetics industry, including the manufacture of sunscreen and cream, as well as the cream that treats acne, and also contributes to the treatment of wounds and dressing and other products used to prevent germs. It has become clear recently that the use of zinc oxide in order to accelerate the

healing of all wounds, in particular chronic and severe, as well as its effectiveness as an antimicrobial and anti-inflammatory material all [7].The properties of metal oxides make them more attractive in the applications of applied science in the field of stimulation, sensing, the ability to be a reservoir of energy, as well as in the field of optics, devices used in the field of electronics, memory matrices, scientific and technical applications in the field of medicine [8], [9] and devices used in sound and radio waves [10].In the field of medicine, the use of nanomaterials for metals is due to the susceptibility of their molecules to the killing of germs that cause many diseases [11], [12] and [13]. These nanoparticles are used in the synthesis of the basic component of the tooth [14], [15], including ZnO, CuO, and Ag, which act to prevent tooth decay caused by bacteria. This has been known through experiments on S.mutans bacteria on the widest scale at present [16], [17]. After the researchers identified a number of genes associated with this Characteristics [18], [19] and Meds cases, studied by researchers in a comprehensive and extensive, Vetoqathm as paving the way for many of the experimental research on the distinctive varieties of some genera of bacteria including S.mutans. The aim of this study is to determine the strength of the effect of the zinc nanoparticles on the genetic material of the bacteria.

## 2. Materials and methods:

ZnO Nps was synthesized by a standard method (Padmavathy & Vijayaraghavan, 2008Padmavathy N, Vijayaraghavan R. (2008). Enhanced bioactivity of ZnO nanoparticles – an antimicrobial study.

### *2.1.Collection of Samples.*

Twenty samples swab of dental carries taken from patiants Apollo Hospital, and then put them in sterile test tubes containing (3ml) normal saline and (1.5%) yeast that stored at least 12hrs. Then transport the samples to the laboratory in order to examination processes.

### 2.2.Bacterial Isolation.

Place 1 ml of each sample in the ,mitis-salivarius (MS) agar by using test-prepared dishes. All samples are then incubated in a 48-hour incubator at a temperature of 37 °

C. More than 90 colonies per milliliter (cell\ml) were obtained, which means that the mechanism for isolating samples was positive [20].

### *2.3. Identification of Isolates*

The bacterial colonies that appeared on the plant medium in the dishes incubated in the anaerobic way and for two days. This process has been repeated several times in order to obtain pure isolates that conform to the specifications of S.mutants [21] in terms of general morphology, as well as in terms of microscopy, and other characteristics. These isolates were identified by the use of the biochemical system for testing, which adopted the test system resulting from dextran [22].After isolating the anaerobic bacteria in the incubator in 24 hours and under thermal conditions of 37 ° C, then the incubation under air conditions at the normal temperature. The samples are then sprayed with mannitol 10% under air conditions for 3 hours at a temperature of 37 m. The samples are then sprayed with 4% tributyl chloridetri chloride chloride solution, and then incubated for one hour at 37 ° C. Thus, the color change to dark pink is evidence of the presence of mutant streptococcus while the other streptococcus colonies remain blue [23] .

### *2.4.Preparation and examination of nanoparticles of zinc oxide.*

There are many ways to synthesis zinc nanoparticles. One of these methods is sedimentation, the way in which directly synthesize these molecules, [24]This method involves the use of zinc nitrate and KOH. In this mode of operation, the water solution of zinc nitrate (Zn (NO3) 2.6H2O) was prepared by 0.2 ml, and 0.4 ml of KOH was diluted with deionized water. The KOH solution was then slowly added to the zinc nitrate solution at a normal temperature with continuous and vigorous stirring. The result of this reaction was the formation of a white suspension. And then placed the white suspension in the centrifuge in 5000 cycles fixed every minute and this process in 20 minutes. And then wash three times with distilled water and with absolute alcohol. This product is then calcined at 500 ° C in normal weather conditions for 3 hours, this is general method of ZnO nanoparticles of almost numbers of researches.

***2.5.Coupling the nanoparticles of zinc oxide with the genetic material of the bacteria.***

This solution was prepared and associated with high concentration DNA (0.04 - 24 μm). DNA (26 and 50 bp) was added to the solution containing the nanotubes of zinc nanoparticles to ~0.19 μm. The process of the adjustment was done using a solution known as phosphine as shown in Figure 1. And the addition of sodium chloride salt at a concentration of 50 mM. In addition to the incubation of the mixture for two hours of time and at the normal temperature with constant flipping and before using the agarose gel (2) and then dilute the gel, and then check the gel using a specialized device (FFA-5100, FUJI) Somewhat radioactive.The DNA oligomers were labeled at 5 'end with 32P through the use of the enzyme known as 4 polynucleotide kinase and 32 P---ATP. And the hybridization of the single-genomic DNA with the complementary threads of 1: 1.1 of thiolated to-non thiolated sequentially, in order to ensure that all thiolated threads were hybridized and that the process of incubation of these DNA was carried out at 80 ° C in 10 minutes .

***2.6.Agarose gels of ZnO nanoparticles***.

Screen imaging using the phosphor imager (FLA-5100, FUJI) DNA scanner that was associated with ZnO nano particle was measured using radioactive signals. The DNA percentage was measured (for the total DNA concentration of the total DNA ratio that is in the corridor).The running distance here was defined and calculated by dividing the DNA resistance by the run off of the irregular DNA. This calculation normalizes the migration resistance and allows for comparison between the different gels. The number of DNA molecules in nanoparticles is calculated by determining the total number of DNA molecules that are linked (as calculated by radioactive signals in gel). This is calculated by calculating the number of particles added to this interaction between the two sides .

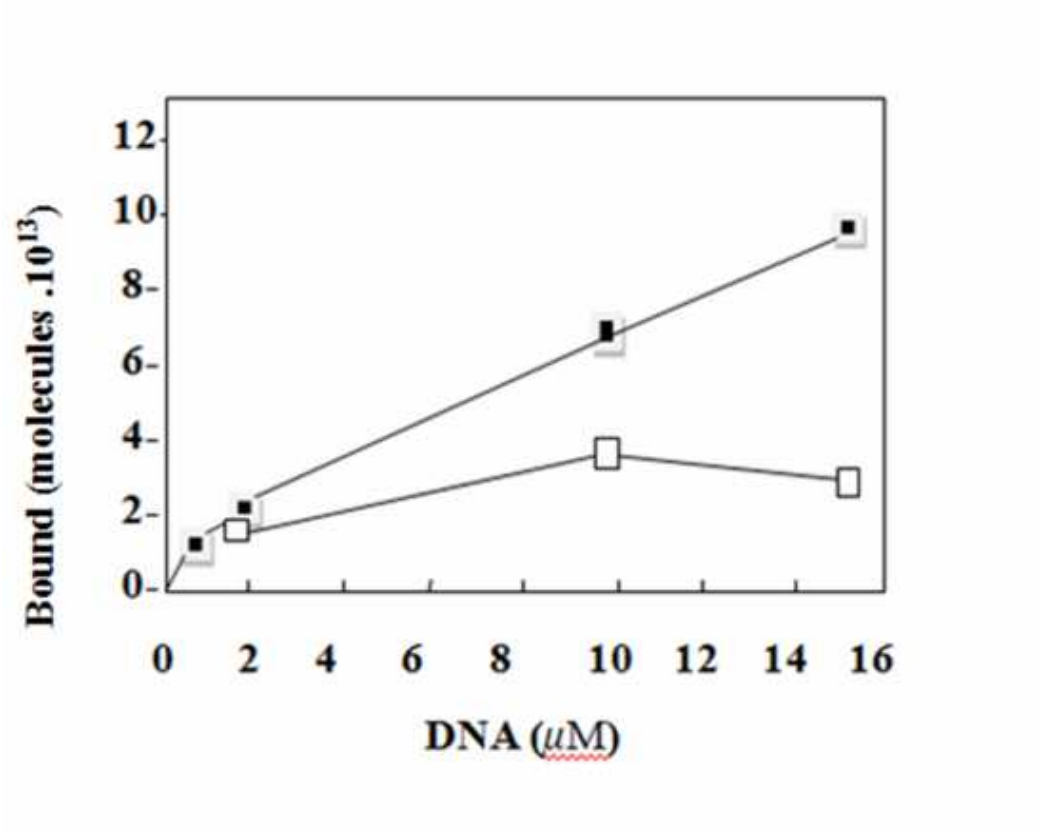


Figure (1):- Schematic representation shows the effect of ZnO-nanoparticles on the concentration of DNA, as compared to the original dsDNA.

**3.Results and Discussion**

The contrivance of nanoscale (<100 nm) NPs and their applications in industrial and biomedical area are increasing rapidly due to their high surface area and larger catalytic property [25],[26]. Additionally, their biocompatible nature makes valuable materials for the broad biomedical applications such as drug delivery, cytotoxicity, cell, DNA and as an antibiotic against bacterial population damage etc [27]. The dsDNA filaments were studied and also long nucleotides were identified) with their complementary strands and then suspended at increasing concentrations to a fixed amount of coated nanoparticles. And the analytical detection of ZnO-DNA solutions nano particles which was carried out by electroplating which obtained an agarose gel for retarded DNA associated with zinc particles, was resolved by the DNA. These nanoparticles of DNA / ZnO have been shown to be isolated

from each other. This band represents a separate number of DNA molecules that have one molecule of the zinc oxide nanotube. On this basis, this medium-distance migration of DNA / ZnO in the gel is a clear indication of the DNA density associated with the GNPs. Also, the mean migration distance decreased the amount of DNA that was added to the increase in the number of ZnO nano particles.

To directly investigate this distortion, we will compare the absorption of ZnO particles to chemically identical types of DNA, except for their radiological status. The radiation of the isolated element was monitored in DNA / ZnO DNA complexes, whose concentration in the solution changed at the level of 0.05-15 μm. This is up to a (2 μm) of original DNA concentration, however, as a DNAv increased concentration, the amount of stranded interpolated will be low in the identified complexes when compared with a thiolated strand. It should be noted that the ratio between radioactive signals of the two types of DNA / ZnO nano particle is indicated at the general level of saturation. If we assume that all DNA is not present in the single molecule DNA / ZnO nano particle, which is linked by hybridization to thiolated DNA, Assumption is a safe assumption because it shows that the compounds made up of unsaturated DNA that were split into ZnO nano particles did not maintain the electric field and thus migrate as nonbound DNA. So that if the adsorbed DNA continues in this double similarity, Therefore, the ratio of the unit of interactive measurements is Absolutely predictable and without any doubt. The absence of the delay resulting in the loss of the complementary strand should be clearly reduced in the signal obtained from the second type, resulting in a lower proportion of immunity.

As shown in Fig. 1, which clearly shows that for DNA 26bp, when the concentration of the solutions is <2 μm, the quantity of supplemental complementary markers that are associated with the zinc nanoparticles has always been less than the corresponding quantity of threads that has been collapsed, However, distortion and mutilation have already occurred. This transformation allowed for the migration of genes from the DNA / ZnO complexes and eventually the dispersion process was carried out by the molecular coverage of ZnO nanoparticles, which resulted.

## 4.Conclusions

In this study it was found that non-saturation occurs when the system becomes somewhat dense, which allows the release of unmatched cords and more related branches. This is perfectly consistent with the observations we have obtained on the surface area of two different sizes of ZnO nanoparticles. The use of ZnO nanoparticles and the analysis performed on the gel is a means of direct bonding. Finally, the introduction of this research to guide the understanding of scientific information to be known in the field of nanotechnologies of metal molecules is that the absorption of dsDNA on nanoparticles ZnO is at low density, and can also use long 20-30 oligomers, with the unexpected rate of ~ 10% only. When the higher density is needed, we should use dsDNA longer than 50 bp to reduce saturation, so it is necessary to change the general specification of the genetic material of the Streptococcusmutantsbacteria.

## 5.References

[1] Weibenrieder, K.S. and Muller, J. Thin Solid Films, 300, 30-41(1997).

[2] Masai, H., Toda, T., Ueno, T., Takahashi, Y. and Fujiwara, T. Appl. Phys. Lett. 94, 151908 (2009).

[3] Behnajady, M. A., Modirshahla, N., Ghazalian E. Digest Journal of Nanomaterials and Biostructures, 6(1), 467 (2011).

[4] Lorenz, C., Emmerling, A., Fricke, J., Schmidt, T., Hilgendorff, M., Spanhel, L., Muller, G. J. Non-Cryst. Solids, 238, 1(1998).

[5] Radu, A., Iftimie, S., Ghenescu, V., Besleaga, C., Antohe, V.A., Bratina, G., Ion, L., Craciun, S., Girtan, M., Antohe, S. Digest Journal of Nanomaterials and Biostructures , 1141 (2011).

[6] Gupta, A., Bhatti, H.S., Kumar, D., Verma, N.K., Tandon, R.P. Digest Journal of Nanomaterials and Biostructures, 1(1), 1 -9(2006).

[7] Vlad, S., Ciobanu, C., Gradinaru, R.V., Gradinaru, L.M., Nistor A. Digest Journal of Nanomaterials and Biostructures, 6(3), 921 (2011).

[8] Purica et al., 2001 M. Purica, E. Budianu, E. RusuZnO thin films on semiconductors substrate for large area photo-detector applications Thin Solid Films, 383 (1–2) (2001), p. 284.

[9] Ayudhya et al., 2006
S.K.N. Ayudhya, P. Tonto, O. Mekasuwandumrong, V. Pavarajarn, P. Praserthd amSolvothermal synthesis of ZnO with various aspect ratios using organic solvents Cryst. Growth Des., 6 (2006), p. 2446.

[10] Gorla et al., 1999C.R. Gorla, N.W. Emanetoglu, S. LiangStructural, optical and surface aqoustic wave properties of epitaxial ZnO films grown on (011 over-bar2) sapphire by metalorganic chemical vapor depositionJ. Appl. Phys., 85 (5) (1999), p. 2595.

[11] Phan TN, Buckner T, Sheng J, Baldeck JD, Marquis RE. Physiologic actions of zinc related to inhibition of acid and alkali production by oral streptococci in suspensions and biofilms. Oral Microbiol Immunol. 2004;19:31–8. [PubMed]

[12] Lansdown AB. Silver in health care: Antimicrobial effects and safety in use. CurrProblDermatol. 2006;33:17–34. [PubMed]

[13] Morones JR, Elechiguerra JL, Camacho A, Holt K, Kouri JB, Ramírez JT, et al. The bactericidal effect of silver nanoparticles. Nanotechnology. 2005;16:2346–53. [PubMed]

[14] AydinSevinç B, Hanley L. Antibacterial activity of dental composites containing zinc oxide nanoparticles. J Biomed Mater Res B ApplBiomater. 2010;94:22–31. [PMC free article] [PubMed]

[15] Heravi F, Ramezani M, Poosti M, Hosseini M, Shajiei A, Ahrari F. In vitro cytotoxicity assessment of an orthodontic composite containing titanium-dioxide nanoparticles. J Dent Res Dent Clin Dent Prospects. 2013;7:192–8. [PMC free article] [PubMed].

[16] Eshad M, Lellouche J, Matalon S, Gedanken A, Banin E (2012) SonochemicalcoatingofZnO and CuO nanoparticles inhibit *Streptococcus mutans* biofilmformation on teeth model. Langmuir 28: 12288–12295.[PubMed].

[17] Hernández-Sierra JF, Ruiz F, Pena DC, Martínez-Gutiérrez F, Martínez AE, et al. (2008) The antimicrobial sensitivity of *Streptococcus mutans* to nanoparticles of silver, zinc oxide, and gold. Nanomedicine 3: 237–40.

[18] Banas J. A. 2004. Virulence properties of Streptococcus mutans. Front. Biosci. 9:1267–1277.

[19] Friedrich, 1981. Oxidation of thiosulfate by Paracoccusdenitrificans and other hydrogen bacteria **https://doi.org/10.1111/j.1574-6968.1981.tb06239.x**

[20] Kuramitsu H. K. 1993. Virulence factors of mutans streptococci: role of molecular genetics. Crit. Rev. Oral Biol. Med. 4:159–176.

[21] Bergey's. 1994.Manual of determinative bacteriology. [D HBergey; John G Holt;]

[22] Guthof. 1970. ***Streptococcus milleri*** **and** ***Streptococcus mutans*** **in the mouths of infants before and after tooth eruption https://doi.org/10.1016/0003-9969(78)90160-7**

[23] Guthof, O. (1970). (cited in Fridrich, J. (1981).Fridrich, J.(1981).The genus streptococcus and dental disease. In:"procaryotes Hand Book of Habitats, isolation and identification of bacteria".Mortimer, P. S. (ed.), Berlin, New York, PP. 1598-1613.

[24] Ghorbani, Hamid Reza and others, 2016. Synthesis of ZnO Nanoparticles by PrecipitationMethod. http://dx.doi.org/10.13005/ojc/310281

[23] Oberdörster G, Oberdorster E, Oberdorster J (2005) Nanotoxicology: an emergingdiscipline evolving from studies of ultrafine particles. Environ Health Perspect 113: 823–839.

[24] Wahab R, Tripathy SK, Shin HS, Mohapatra M, Musarrat J, et al. (2013) Photocatalytic Oxidation of Acetaldehyde with ZnO-Quantum Dots. . Chem Engg J. 226: 154–160.

[25] Wahab R, Kim YS, Hwang IH, Shin HS (2009) A non-aqueous synthesis, charact erization of zinc oxide nanoparticles and their interaction with DNA. Synt Metals 159 (23-24): 2443–2452.