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Research Article

Disinfectant Compound Using Zinc Oxide Nanoparticles and Pomegranate Peel

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Introduction

Based on the increasing prevalence of antibiotic resistance in bacteria (due to the lack of a forward-looking plan for the use of this drug category and strict monitoring of this use and the indiscriminate and arbitrary use of antibiotics by patients), the widespread spread of emerging or re-emerging zoonosis bacterial, parasitic and viral diseases Endemic and pandemic in the society, the occurrence of allergy and anaphylactic shock to antibiotics, as well as the lack of proper efficiency, adverse environmental effects and causing inappropriate side effects on textiles (such as skin and respiratory sensitivity, carcinogenicity, etc.) [1]. Based on chemical compounds, the design and formulation of a potent antiseptic and disinfectant compound based on plant materials and nanoparticles is necessary [2]. The design and formulation of a strong antiseptic and disinfectant composition based on the hydroalcoholic extract of pomegranate peel and nanoparticles is necessary.

The primary mechanism of antimicrobial activity of plant extracts is the effect of phenolic compounds on the bond between protein molecules and lipids in the membrane of microbial cells, sensitizing the cell and causing disturbances in the transfer of nutrients from the cytoplasmic membrane, increasing the permeability and diffusion of essential components inside the cell and or they damage the enzyme system of bacteria. Many plants show antioxidant effects, including the edible pomegranate species with the scientific name Punica granatum, which has phenolic compounds and high antibacterial and antioxidant activity. Antifungal, antibacterial, and antioxidant properties of pomegranate peel are related to phenolic and alkaloid compounds, including peletirin and hydrolyzable tannins such as punicalagin, gallic acid, ellagic acid, and anthocyanin. Tannins, as well as ellagic acid, a derivative of gallic acid, are compounds found in pomegranate skin that have high antimicrobial activity against pathogenic bacteria in the digestive tract. Zinc oxide nanoparticles are non-toxic and biocompatible nanoparticles [3,4].

Various mechanisms have been reported for the antimicrobial activity of ZnO, including the release of ROS, which causes oxidative stress by damaging DNA, cell membranes, and cell proteins, which causes cell wall breakdown and subsequent leakage of cell contents and, ultimately, death. It becomes cellular [1,2]. The unique formulation of "disinfectant composition using zinc oxide nanoparticles and hydroalcoholic extract of pomegranate peel " tries to increase the antiseptic power and reduce the harmfulness of chemical disinfectants and proper stability by using effective substances including zinc oxide nanoparticles, acids, hydroalcoholic extract of pomegranate peel, hydroalcoholic extract Peppermint, ethylenediaminetetraacetic acid, isopropyl alcohol and distilled water create cooperation with each other and cause antibacterial, antiviral and antifungal properties. The present product is solid in the category of high-level disinfectant compounds.

Study Methods

The process of preparing the hydroalcoholic extract of pomegranate peel and peppermint using the maceration method, which is done using a hydroalcoholic solvent (equal percentage of distilled water and 96% ethanol for 72 hours at a temperature of 37 degrees Celsius and continuous mixing in a shaker incubator) and then plant extract is extracted using distillation method. Zinc oxide nanoparticles with a 40 mg/ml concentration and a particle diameter of 20-60 nm are used. Zinc oxide nanoparticles are dissolved in water by adding acids

such as acetic acid and hydrochloric acid. After reducing the temperature of the zinc oxide solution, EDTA, isopropyl alcohol, and glycerol are added based on the formulation, and the solution is mixed. After proper mixing of the above ingredients, the hydroalcoholic extract of pomegranate peel and peppermint is added. Finally, distilled water is added to reach the final volume. To perform the final integration of the effective ingredients and before packaging, the final composition is mixed for 1 hour by a shaker. It is worth mentioning that this product can use silver nanoparticles, titanium oxide nanoparticles instead of zinc oxide, and the simultaneous combination of two or more nanoparticles. If needed, it is also possible to add permitted aromatic essential oils. According to the tests, the claimed product can remove microorganisms such as Escherichia coli and Staphylococcus aureus by 7 logarithms, and this compound also has potent antiviral effects [5].

Finding

Based on DLS data, the Z-average size of the synthesized nanostructures was 2050 nm, and Pdi was 0.444. According to the tests conducted, the claimed product could remove microorganisms such as Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans by 7 logarithmic reduction (Table 1), and Bacillus subtilis spores by 2 logarithmic reductions, which in total It shows a powerful and practical effect of the claimed compound on a variety of Gram-positive and Gram-negative bacteria, fungi and spores (Table 1) (Figure 1).

Table 1: The results of the combination effectiveness test using the well method are presented. The effect of the claimed compound on Escherichia coli, and Staphylococcus aureus caused a 7 logarithmic reduction of the strains.

Microorganism	Number of inoculated microorganisms (CFU/ml)	Density (%)	Connect Time (min)	Result (CFU/ml)	Percentage reduction
E. coli	1.44×10^{7}	1X	10	<10	>99.9999%
S. aureus	2.91×10^{7}	1X	10	<10	>99.9999%
Bacillus subtilis Spore	1.18×10^{5}	1X	15	3.04×10^{3}	97.42%

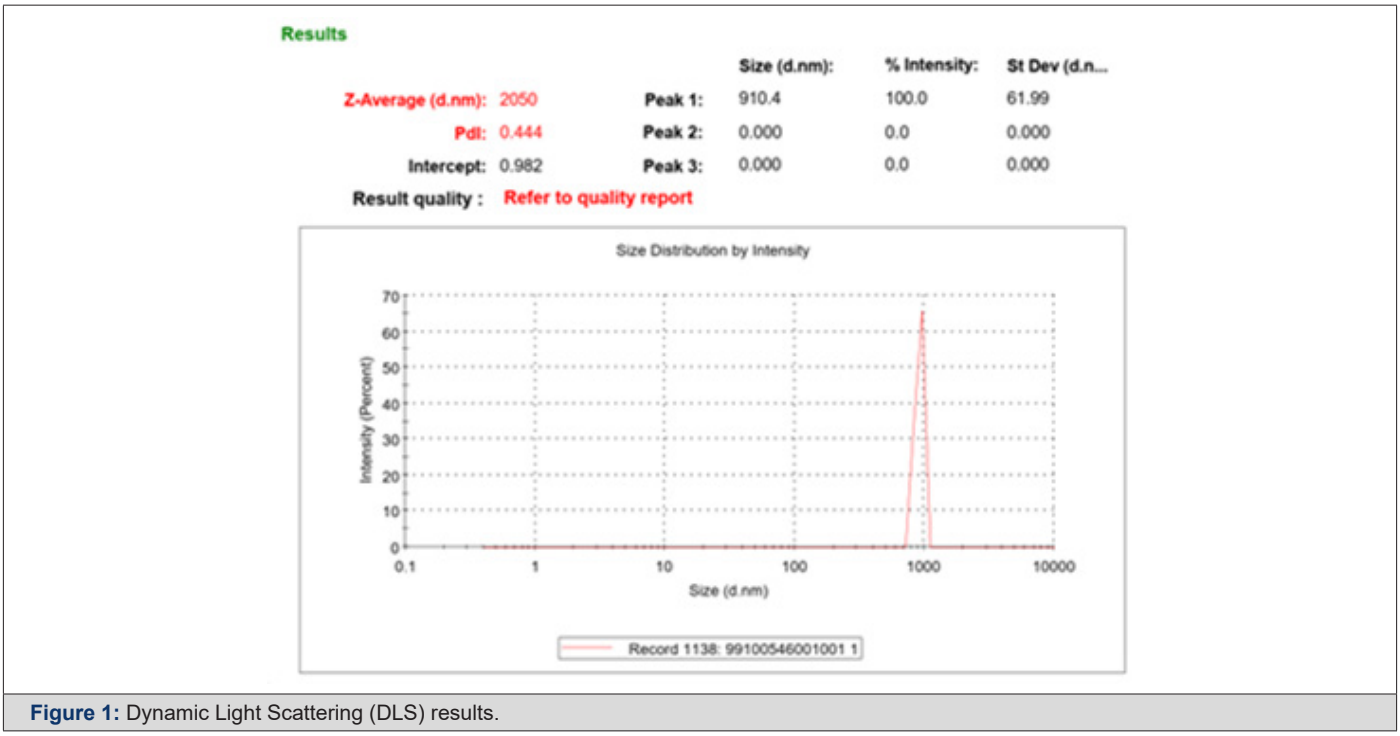

Figure 1: Dynamic Light Scattering (DLS) results.

Two different influenza viruses, H9N2 (enveloped virus) and infectious bursal disease virus (IBD) (Non-enveloped virus), were challenged. The test results showed strong antiviral effects with 100% effectiveness. The results of skin sensitization and respiratory irritation studies indicate the high safety of this compound.

Results and Discussion

Disinfectant composition using zinc oxide nanoparticles and hydroalcoholic extract of pomegranate fruit peel is an ecological and environment-friendly composition that, in addition to reducing the microbial load of the air, disinfects and removes biofilm from the water distribution system and all surfaces, floors of halls, transport vehicles. Transportation, equipment used in the food industry, as well as livestock, poultry, and aquatic breeding centres (disinfection of surfaces, tools, feeding, watering, and other equipment) and slaughterhouses, agriculture and related industries, health, and

treatment centres such as hospitals, clinics, etc.., have public places as well as domestic uses.

One of the essential general advantages of this combination is the use of native medicinal plants to replace disinfectant chemical compounds, the possibility of production on a semi-industrial and industrial scale, lack of resistance of microorganisms, non-toxicity, no damage to the environment, intense effect, no destructive effect on the building and the equipment, its widespread use for disinfection in humans, livestock, poultry, and aquatic animals.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Atefi Aref (2021) The Disinfectant and Antiseptic Nano-Compound using the Ferula Assa-Foetida (NANO HING GUARD®). The 8th International Biennial Conference on Ultrafine Grained and Nanostructured Materials (UFGNSM2021).
2. Atefi, Aref, Dehghan, Parisa, Dehghan, Hossien (2022) Nanostructured combination disinfectant and antiseptic using plant extracts Trachyspermum Copticum, Glycyrrhiza glabra L, Lavandula stoechas, Mentha piperita L. 5th International Conference on Agricultural Sciences, Medicinal Plants and Traditional Medicine.
3. Sarkhosh, Ali, Zamani, Zabih Elah, Fatahi Moghadam, et al. (2007) A review of the medicinal and pharmacological properties of pomegranate. Medicinal plants 6(22): 13-24.
4. Akhavan Hamid Reza (2015) A review of pomegranate functional compounds and their role in human health in laboratory and clinical trials. Journal of Kerman University of Medical Sciences 22(6): 569-591.
5. MirJalili, Seyyed Abbas (2015) A review of biochemical compounds and medicinal properties of pomegranate. Medicinal Plants 14(56): 1-22.