



## COMPARATIVE STUDY OF THE EFFICACY OF ZINC GLUCONATE SOLUTION FOR ROUTINE USES IN PATIENT CARE IN HOSPITAL SETTINGS.

### Clinical Microbiology

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### ABSTRACT

**Background:** Different salts of Zinc have been known exhibiting antimicrobial properties. Zinc gluconate, a salt formed by combination of zinc with gluconic acid has been known to have multiple beneficiary effects in the management of various skin diseases and diarrhea. However, its antimicrobial properties have not been studied well in the literature. Therefore, the study was carried out with the aim to find of effectiveness of Zinc Gluconate solution against both Gram positive and Gram- negative bacteria and to help establish a clean environment, bacteria and fungi free, at operation theatres, intensive care units and labour room in hospital settings.

**Methods:** The study was carried out under two objectives-

1. Immediate and residual effects of Zinc gluconate solution on bacterial colonies are analysed after incubation the suspensions upto 24 hours against the effects of distilled water and Alcohol based sanitizer (Sterilium) on bacteria
2. Analysis of effects of pre and post humidification with Zinc gluconate solution at OT, ICU, and labour room

**Results:** Zinc gluconate solution tested for immediate effects show significant antibacterial effects against both gram positive and negative bacteria, namely Staph.aureus and E. coli. In 24 hours, incubation after its immediate application to bacterial colonies, there was negligible growth. Sterilium shows no growth after 24 hours while distilled water shows 100% growth. For residual effects, zinc gluconate gives significant antibacterial effects compared to sterilium. Sterilium did not produce growth even after 24 hours. There was negligible growth with Zinc gluconate solution even after 24 hours. Results after humidification are much satisfactory. Zn gluconate solution mist via humidifier has abled to suppress/kill bacteria after one hour of its application inside the closed room.

### KEYWORDS

Zinc Gluconate, Antimicrobial properties, Immediate and residual effects, Humidification

### INTRODUCTION

Zinc plays an important role in the immune system and zinc-deficient persons experience increased susceptibility to a variety of pathogens<sup>1,2</sup>. It affects multiple aspects of the immune system, from the barrier of the skin to gene regulation within lymphocytes. Zinc is crucial for normal development and function of cells mediating nonspecific immunity such as neutrophils and natural killer cells. Zinc gluconate, a salt formed by combination of zinc with gluconic acid has been known to have multiple beneficiary effects in the management of various skin diseases, respiratory tract infections and diarrhea<sup>3,4,5</sup>. Zinc gluconate are found to be useful in reduction of signs and symptoms of common cold, usually caused by rhino viruses<sup>7</sup>. It is safe for human use because of its non-irritant and odorless nature<sup>6</sup>. However, its antimicrobial properties have not been studied well in the literature. Therefore, we proposed to study the antimicrobial properties, especially antibacterial of Zinc gluconate solution.

### Aim and Objective

1. To test the effectiveness of Zinc gluconate solution against both Gram positive and Gram-negative bacteria.
2. To help establish a clean environment bacterium free at operation theatres, intensive care units and labour room in hospital settings.

### MATERIAL AND METHODS

#### Culture And Sensitivity Of Bacteria To Zinc Gluconate Solution:

For our study we used Zinc gluconate solution available as GZ -08 solution marketed by Tycoons brothers. It is odorless, colourless and non-irritant to eyes and skin. Immediate and residual effects of Zinc gluconate solution will be tested separately with simultaneous-comparison with sterile distilled water and Alcohol based sanitizer (sterilium).

For immediate effects, a loop of colony of gram positive bacteria (Staph. Aureus) and Gram negative bacteria (E. coli) is mixed with 1 ml Zn Gluconate solution separately and solutions thus prepared are plated in separate culture mediums (Mueller Hinton agar) for 24-48 hours incubation and observe the growth.

For residual effects, separate culture media are pretreated with 4 ml of Zn Gluconate for 2 hours, 6 hrs, 12 hrs, 18 hrs and 24 hours then followed by inoculation of loop of bacteria and 24-48-hour incubation. Similar procedures are adopted for distilled water and alcohol-based sanitizer for both immediate and residual effects. Macroscopic results are then analysed.

### Humidification in OT, ICU and Labour room:

Effects of Zn Gluconate mist produced via humidifiers will be tested over a loop of known species of bacteria spread over sterile petridish kept inside the closed room for six hours in operation theatre, labour room and ICU. Samples before and after humidification are then processed in our microbiology laboratory by incubating for 48 hours and results are then analysed.

### RESULTS

#### 1. Test For Immediate Effects

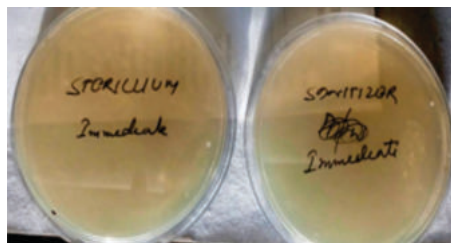
Simultaneous inoculation of a loop of Gram +ve and -ve bacteria separately after mixing with 1ml of Zn gluconate into the culture media (Mueller Hinton agar)

**Table 1.1 Effects With Gm +ve Bacteria**

Reagents	Immediate simultaneous inoculation with Staph. Aureus
Sterile distilled water	100 % growth after 24 hours
Sterillium	No growth after 24 hours
Zn gluconate	No growth after 24 hours

**Table 1.2 Effects With Gm -ve Bacteria**

Reagents	Immediate simultaneous inoculation with E. coli
Sterile distilled water	100 % growth after 24 hours
Sterilium	No growth after 24 hours
Zn gluconate	No growth after 24 hours



**Fig 1. Immediate Effect After 24 Hr Incubation**

#### 2. Test For Residual Effects

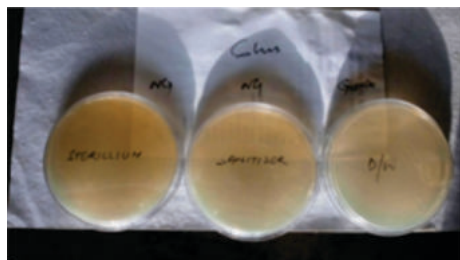
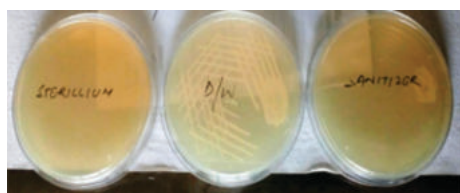
Inoculation of loop of bacteria into culture media pretreated with 4 ml of Zn Gluconate for 2 hr, 6 hr, 12 hr, 18 hr and 24 hr followed each by 24 hr incubation.

**Table 2.1 Gm+ve Bacteria (staphylococcus Aureus)**

Reagents	Inoculation at 2 hrs	Inoculation at 6 hours	Inoculation at 12 hours	Inoculation at 18 hours	Inoculation at 24 hours
Sterile distilled water	No Growth	Growth	Growth	Growth	Growth
Sterilium	No growth	No growth	No growth	No growth	No growth
Zn gluconate (GZ-08)	No growth	No growth	No growth	No growth	Less than 5% growth

**Fig 2.1 At 2 Hours Of Treatment****Table 2.1 Gm -ve Bacteria (e. Coli)**

Reagents	Inoculation at 2 hrs	Inoculation at 6 hours	Inoculation at 12 hours	Inoculation at 18 hours	Inoculation at 24 hours
Sterile distilled water	No Growth	Growth	Growth	Growth	Growth
Sterilium	No growth	No growth	No growth	No growth	No growth
Zn gluconate	No growth	No growth	No growth	No growth	Less than 5% growth

**Fig 2.2 At 6 Hours Of Treatment****Fig 2.3 At 24 Hours Of Treatment**

### 3. Humidification Effects

Effect of Zn Gluconate mist via humidifier over a loop of bacteria spread over the surface of table in closed room for 6 hours.

**Table. 3 Humidification Effects**

Reagent	Growth after 24 hours	Growth after 48 hours
Pre humidification sample	Growth seen	Growth seen
Post humidification sample.	No growth seen	No growth

### DISCUSSION

Common zinc salts like zinc sulphate, zinc chloride, zinc citrate and zinc gluconate have antimicrobial properties, however lately zinc gluconate is being greatly marketed as it is safe for human uses<sup>5</sup>. Zinc gluconate glycine are safe and well tolerated by a geriatric population and are suitable for prophylactic or therapeutic use to reduce the duration or severity of common cold. Solution we used in our study is odorless, colorless, and non-irritant to eyes and skin. Thus, it can be used for all ages especially newborns and pregnant ladies protecting

them from contact infections. ICU cabinets can also be effectively sanitized using humidifier of Zn gluconate without disturbing any neighboring patients.

Zinc gluconate solution have been subjected to variety of tests in our microbiology laboratory. This solution is tested for immediate, residual and humidification effects by subjecting it to known bacterial colonies while, in the same time, comparison being made against sterilium and sterile distilled water.

In the test for immediate effects, it shows significant antibacterial effects against both gram positive and negative bacteria, namely Staph. aureus and E. coli. In 24 hours, incubation after immediate application to bacterial colonies, there was negligible growth with GZ08. Sterilium shows no growth after 24 hours while distilled water shows 100% growth.

Test for residual effects also show similar satisfactory results.

Naturally, bacterial colonies mixed with sterile distilled water shows 100% bacterial colonies after incubation at 24-hours incubation. Sterilium does not produce growth even after 24 hours. In case of Zn gluconate solution, there is negligible growth seen after 24 hours

Results after humidification are much satisfactory. Zn Gluconate solution is able to suppress/kill bacteria after 01 hour of its application inside the closed room as Mist as shown by no growth seen in culture plates after 24 hours of incubation.

As we know zinc has an important role in maintenance of our immune system guarding against universe of microorganisms<sup>2</sup>. In this study its antimicrobial property, especially antibacterial, is clearly demonstrated by testing its immediate and residual effects.

Other properties like antiviral and antifungal could not tested due to lack of proper infrastructure in the microbiology lab, however we can assume they exist. This must be the reason why zinc formulations and supplements are effectively used in the control of various viral induced common colds, skin disease and diarrhea<sup>7,8,9,10</sup>. Zinc gluconate is also found useful in control of halitosis.<sup>11</sup>

In our study effects of humidification and eventual culture of samples of air and from surfaces proved its strong antibacterial property. It is active against many species of bacteria including Gm+ve bacteria (Staph. Aureus), Gm-ve bacteria (E.coli, Pseudomonas, Salmonella) and all type of enterobacteriaceae group of bacteria) and antifungal (Candida albicans).<sup>12</sup> It is also effective against various viruses namely H1N1 swine flu virus and H5N3 bird flu virus.<sup>13</sup>

### CONCLUSION AND FUTURE ASPECTS

Zinc gluconate solution possesses antimicrobial properties. Being odourless, non-irritant to skin and safe to eyes its usage can range from personal hygiene, baby care to offices malls, movie theatres, schools, and other such places vulnerable to infections. For hospitals, its use will not only benefit patients and personnels involved in health care but also reduced the infectivity and transmission of infectious organisms from patient to patient or patient to health care providers and vice versa.

Humidification with Zn gluconate solution kills or reduces population of microbes. Patients who require nebulisation may be benefitted from the use of Zn gluconate solution in place of normal saline for making mist in nebulizer.

### Conflicts of Interest

The authors have none to declare.

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