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Silveron Gel (Nano Silver Formulation): A Powerful Antimicrobial for the Future

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Abstract

Introduction: Nano silver itself is not new. It has been used for various applications in consumer and commercial products over the past century without showing adverse effects on patients. Nano-silver dispersions were used as medical products already in the 19th century. Additionally, the concept of Nano-silver being used as a topical antibacterial dates back to the days of Sushrut in the 6th century where finely powdered Silver was used as a topical antibacterial/antiseptic after surgery. ***Material and Method:*** Silver ions and the compounds made like nanosilver exhibit a broad antimicrobial profile against bacteria, fungi and virus and also have low toxicity towards animal cells. Various studies have also demonstrated definitive antibacterial property of nanosilver against *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli,* C. *albicans,* V. *Parahaemolyticus,* S. *enterica,* B. *anthracis,* B. *Cereus, Bacillus subtilis, Salmonella entrica* and *Pseudomonas aeruginosa*. ***Result:*** Nano silver particles have ability to alter the expression of matrix metallo-proteinases (proteolytic enzymes that are important in various inflammatory and repair processes), suppress the expression of tumor necrosis factor (TNF-α), interleukin (IL)-12, and IL-1b, and induce apoptosis of inflammatory cells. Therefore, nano silver gel also displays an anti-inflammatory action. ***Conclusion:*** In conclusion, Silveron gel due to its nano silver particles and unique formulation has the power to protect, penetrate, and heal in cuts, wounds, burns, diabetic foot ulcer, and surgical dressings.

Keywords: Silveron Gel; Antimicrobial; Nano Silver.

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Introduction

The use of silver for the treatment of various maladies or to prevent the transmission of infection dates back to at least 4000 BC. Medical applications are documented in the literature throughout the 17th and 18th centuries as a non-toxic, safe inorganic antibacterial agent capable of killing about 650 microorganisms that cause various diseases. Silver has possibility for various biological applications such as preventing infections, antibacterial agents for antibiotic resistant bacteria, anti-inflammatory and healing wounds. Silver has also been authorized by EU EFSA as E174 for coloring food. Over the last few years, especially in last decade, the world has witnessed remarkable progress in the field of Nanotechnology. Nanotechnology deals with the study of nanoparticles having a size range of 1-100 nm. Nanoparticles are of nice interest, owing to their small size and huge surface to volume quantitative relation. This leads to chemical and physical variations in their properties compared to a bulk of similar compounds.

Nano silver itself is not new. It has been used for various applications in consumer and commercial products over the past century without showing adverse effects on patients. Nano-silver dispersions were used as medical products already in the 19th century. Additionally, the concept of Nano-silver being used as a topical antibacterial dates back to the days of Sushrut in the 6th century where finely powdered Silver was used as a topical antibacterial/ antiseptic after surgery. It was also noticed that tribal women who wore silver jewelry had lesser incidences of skin disease or sickness. The finely pulverized silver was called "chandibhasma" and was used intelligently to heal patients who had undergone surgery, or had suffered trauma or had a skin infection or inflammation.

The stellar properties of silver were then used to combat these conditions and many years later with the advent of nanotechnology the age old therapy is back to help mankind combat topical infections once again. Silver nanoparticles cause less toxicity to human health but are highly toxic to microorganisms[5], Due to this, silver nanoparticles have found good applications in antimicrobial, biomedical, human health, catalysis, and environmental remediation etc. (Figure 1).[5]

Due to unique and desirable nano-related properties of silver nanoparticles like intrinsic antimicrobial and non-toxic nature, it is being widely explored in the biomedical field in wound dressing, tissue scaffold, catheters, stents, bandages, surfaces including wheelchair seats and door handles, protective clothing applications, bio magnetic separations, bio-detection and labelling, imaging, drug delivery, bone cement etc.

In some Southeast Asian countries, nanosilver is used frequently in public; it has been sprayed in Hong Kong subways. Silver nanoparticles also play a role in protection of human health. They are used in cosmetic industry in products like sun protection lotions, skin creams, UV protection ointment and creams, lipsticks and toothpaste. Silver nanoparticles can also be utilized in the environmental bioremediation; in air disinfection, water disinfection, surface disinfection etc.[5] The antimicrobial properties are discussed in detail in subsequent sections. Overall, nanosilver has a wide range of applications and is very effective in making the human life good, easy, and safe.

Owing to this widespread use, nanosilver production has been estimated at 250–312 tons worldwide. The Silver Nanotechnology Working Group—an industry group formed to collect and disseminate data on nano silver has argued enthusiastically for its usefulness and safety, noting as well that most applications use very small quantities of the material.[1-10]

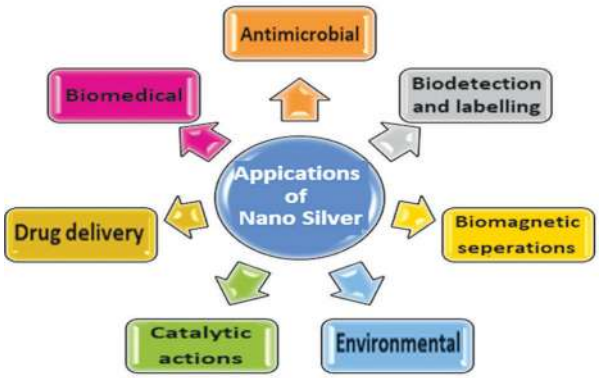

Fig. 1: Applications of Silver nanoparticles (Reproduced from Agarwal et al).

Material and Method

Nanosilver A Powerful Antimicrobial

Silver ions and the compounds made like nanosilver exhibit a broad antimicrobial profile against bacteria, fungi and virus as well (Figure 2) and also have low toxicity towards animal cells. The anti-pathogenic effect of nanosilver is proven to be better than those exhibited by silver ions by various experimental studies. The nanosilver has an additional advantage of their large surface to volume ratio owing to its nanoscale size which improves their dispersion and stability, and avoiding aggregation.

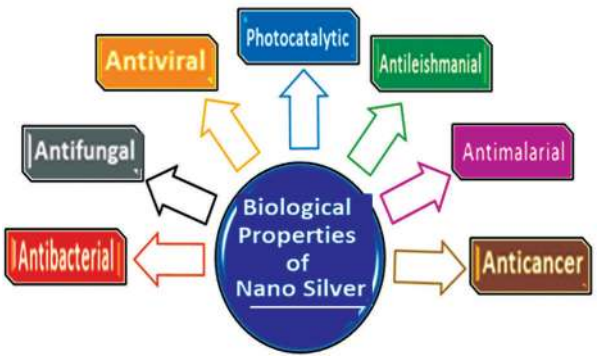

Fig. 2: Biomedical application of Silver nanoparticles (Reproduced from Ullah Khan et al).

Nanosilver particles release more amount of silver ions when compared to micro silver particle of the same weight. As the amount of silver ions released from nanosilver particles will be high, it will exhibit a higher antimicrobial activity while requiring less material. Another advantage is the depot effect of nanosilver particles wherein the depot releases just

small amounts of silver ions, sufficient for along lasting antimicrobial effect. Various studies show antibacterial effect of the nanosilver particles by interaction with the bacterial membrane, penetrate the cell, thus producing a drastic disturbance regarding proper cell function, structural damage, and cell death, hence they have broad bactericidal effects against both Gram-negative and Gram-positive bacteria. Various studies have also demonstrated definitive antibacterial property of nanosilver against *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, C. albicans, V. parahaemolyticus, S. enterica, B. anthracis, B. cereus, Bacillus subtilis, Salmonella entrica* and *Pseudomonas aeruginosa.*

Several studies have demonstrated synergistic effects of combination of nanosilver with antibiotics leading to a greater effect of the antibiotics against microorganisms. This can be attributed to the increase in cell wall penetration by antibiotics with the nanoparticles. This synergistic effect of the antibiotics like *vancomycin, novobiocin lincomycin, oleandomycin, penicillin G,* and *rifampicin*, in association with nanosilver increased the effectiveness against tested microorganisms *(S. enterica, E. coli, V. parahaemolyticus, B. anthracis, and B. Cereus)*. Some studies have demonstrated anti fungal activity of nanosilver, wherein it was found to be an effective and a fast-acting fungicide against a broad spectrum of common fungi including genera such as *Aspergillus, Candida, and Saccharomyces.* The antiviral activity of nanosilver is an emergent field and studies show nano silver around 25 nm or less had outstanding potential in viral infection inhibition. In addition, size-dependent (1-10 nm) antiviral activity of silver nanoparticles has also been shown with HIV-1 virus.[31]

Result

Nanosilver also plays a protective role in prevention of progression of foot, ankle, and leg ulcers in diabetes by their use in special socks, shoes, and bandages; in preventing trench foot for military personnel, athlete's foot, and other fungal infections; and now also in clothing of close-contact sports to slow the spread of MSRA and other bacterial infections. A major concern of the worldwide health care system is represented by antibiotic-resistant infections and there is a powerful incentive to develop new antimicrobial tools, and nanosilver offers great potential to fill this gap. Various new nanosilver-based gels were proven in laboratory tests to kill strains of methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) within minutes and are also approved by FDA for wound care. These gels are also now being approved by the EPA for use as a disinfectant for hard nonporous surfaces.[6] On similar lines, Silveron Gel, introduced in Year 2014 has spherical particles of nano silver of 80 to 200 size nm which adheres firmly to pathogens for cidal action.

Owing to the nano silver particles it should similarly mimic antimicrobial activities against bacteria (even *Staph aureus, pseudomonas, MRSA and VRE* etc.), *fungi, viruses,* and also effective in burns, wounds, diabetic foot ulcers, and in surgical

Fig. 3: Silveron Gel Properties and Uses. (**Source:** Provided by Author.)

dressings (Figure 3, Figure 4). The nanosilver accelerates wound healing due to the reduction of local matrix metalloproteinase activity and the increase in neutrophil apoptosis within the wound. The Silveron Gel is used for wound healing which forms a protective film that protects the lesion against pathogens but on the other hand allows for oxygen to pass through and expedites the healing process. The hydrophilic nature of the gel enables faster re-epithelialization in cases of cuts wounds and burns. In sharp contrast to ionic preparations of silver, nano silver does not form compounds with chlorides and avoids chelating effect on the skin which reduces its cidal activity. Despite several centuries of use of Nano Silver, Silveron Gel is also a potential candidate to treat antibiotic-resistant infections and this makes it superior to other topical agents like Neomycin, Framycetin, etc.[11-20] In addition to the above, recent evidence suggests that nanosilver also has potent anti-inflammatory effects. They (nano silver particles) have ability to alter the expression of matrix metallo-proteinases (proteolytic enzymes that are important in various inflammatory and repair processes), suppress the expression of tumor necrosis factor (TNF-α), interleukin (IL)-12, and IL-1b, and induce apoptosis

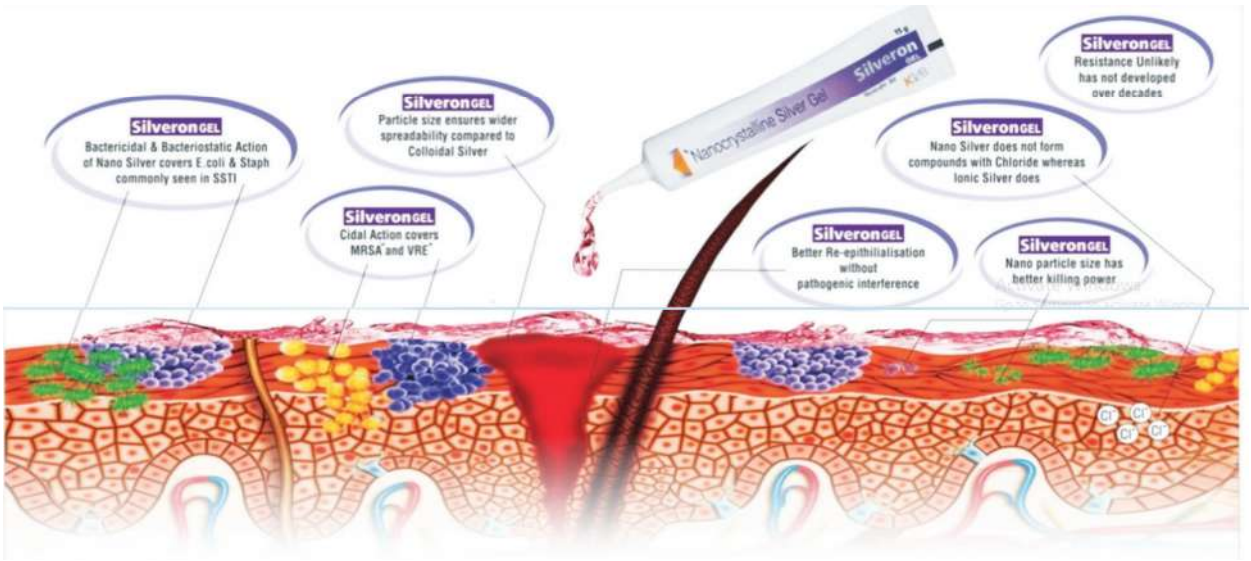

Fig. 4: Silveron Gel Antimicrobial Action. (**Source:** Provided by Author.)

of inflammatory cells. Therefore, nano silver gel also displays an anti-inflammatory action.[21-31]

Conclusion

In conclusion, Silveron gel due to its nano silver particles and unique formulation has the power to protect, penetrate, and heal in cuts, wounds, burns, diabetic foot ulcer, and surgical dressings. The gel also has a potential to act as a powerful antimicrobial tool for antibiotic-resistant infections.

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