

Silver Nanoparticle as Antiviral Agent and Its Uses

G. Dutta (Rajdeep)^{1,*}, Sukhen Roy², Chandan Datta³

Professor, J.L.D. Engineering University, West Bengal, India

Abstract

Silver had been used by human thousands of years ago as various types of medicines (Rasaratna Samuccahay, Bhagbhatta). As the years passes more scientific uses of silver metals had been seen as the human civilization progresses. After the discovery of nano technology Silver is being used in a variety of ways. Nano particles exhibits less toxicity as compared to their ionic counterpart. Nowadays silver is used in various forms colloidal silver Nanoparticle (AgNPs) is one of the main form of silver, Today is being used in Human body considering toxicity level Colloidal Silver is being used as a new antimicrobial agent having broad microbial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella typhi* (Nauran H Assar and Hayam M Hamuoda, 2010). Domestic cleaning products enhanced with antimicrobial silver have been patented (Minner and Eatough 2007). Viral infections make disparate need for the development of safe and potent alternatives to conventional antiviral drugs. In now days, nanoscale materials have emerged as novel antiviral agents for the enormous possibilities offered by their unique chemical and physical properties. Colloidal silver or silver nanoparticle has its own antimicrobial properties to combat all types of viruses including human immunodeficiency virus, hepatitis B virus, herpes simplex virus, flu virus etc. Our main focus through this review is to literate the people about this rediscovered material and it has antimicrobial properties which will be very much helpful for the society in long run.

Keywords: Antibacterial effect, antiviral agent, colloidal silver, nanotechnology, silver nanoparticles, immune booster

*Author for Correspondence E-mail: rajdeepdutta2012@gmail.com

INTRODUCTION

Antimicrobial Properties

Silver has been known to have antibacterial properties [1, 2] since Roman times, however, the increased use of Colloidal in a range of (as yet largely) experimental area of treatment in immunological studies of humans and, its use in various potential field from sanitization to combating virus in human body maintaining certain prescribed dose for all kinds of patients from new born baby to oldster personnel [3–6].

Silver and AgNPs have been shown to have general (i.e. not specifically water disinfection related [7] anti-bacterial properties against a range of both Gram-negative (e.g. *Acinetobacter*, *Escherichia*, *Pseudomonas*, *Salmonella* and *Vibrio*) and Gram-positive bacteria (e.g. *Bacillus*, *Clostridium*, *Enterococcus*, *Listeria*, *Staphylococcus* and *Streptococcus*)—Wijnhoven *et al.* (2009) [8]. Silver nanoparticles reacts with fungi, like *Aspergillus niger*, *Candida albicans*

and *Saccharomyces cerevisiae* (Marambio-Jones and Hoek, 2010) as it is shown in Figure 1 [9–16].

What is a Colloid?

The colloidal particles having .01 to .001 micro meter in diameter consists of ultra-fine particles suspended in a aqueous medium. According to Russian scientist, S.S. Voyutsky, [17] colloidal consist three properties:

1. It must be heterogeneous (meaning: consisting of dissimilar ingredients or constituents, like silver and water).
2. The system must be multiphasic (meaning: having more than one phase, i.e., solid/liquid, gas/liquid, etc.).
3. The particles must be insoluble (meaning: does not dissolve) in the solution or suspension. Each one of these three characteristics interacts with the others giving colloids their unique qualities. The fascinating thing about colloids is that they remain heterogeneous, multiphasic, and

insoluble at different concentrations as long as a larger number, if not all of the particles,

are within the range of sizes of colloids (1 nm to 100 nm) as shown in Figure 2 [17–22].

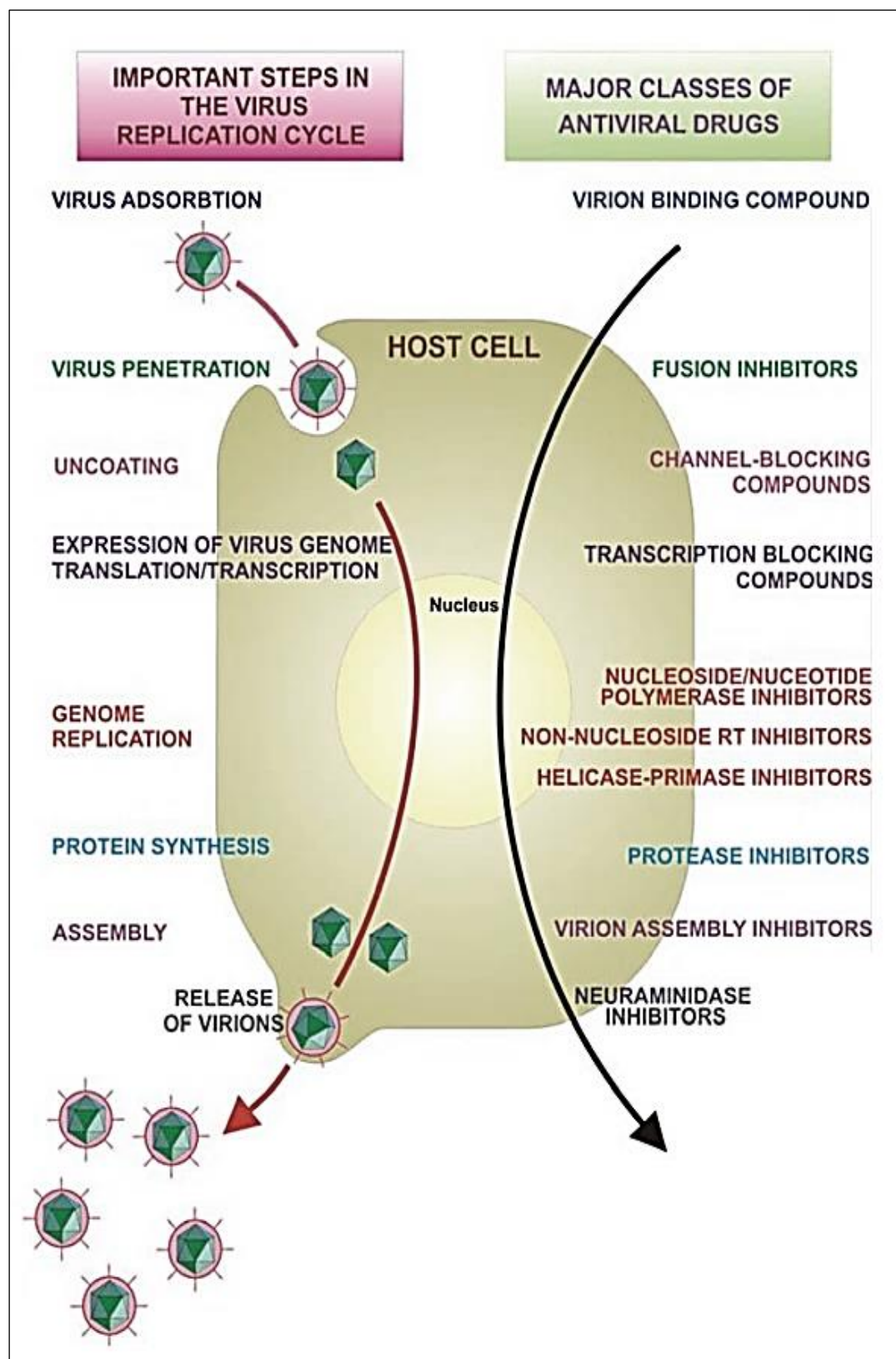


Fig. 1: Key steps in the virus replication cycle that provide antiviral targets.

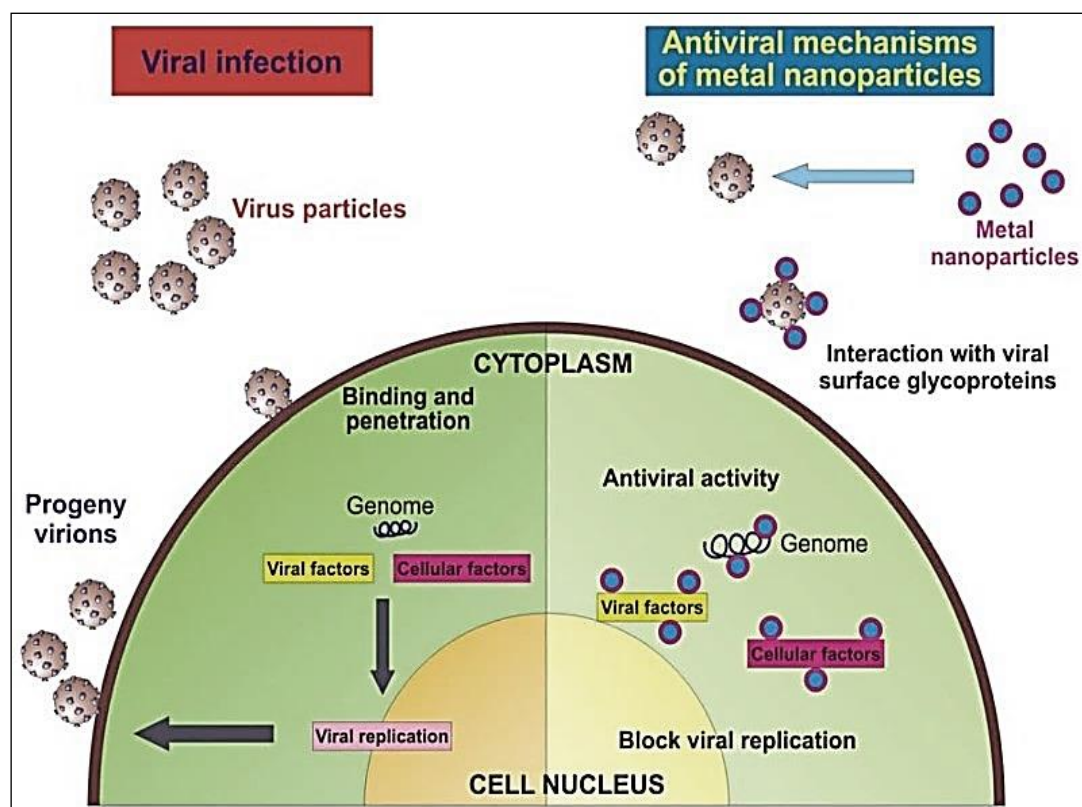


Fig. 2: Schematic model of a virus infecting an eukaryotic cell and antiviral mechanism of metal nanoparticles.

At molecular level biochemistry [23–25] particle size plays very important role. Below 1nm the system will tend to be a molecular system. Within 1nm to 100nm, colloidal form of matter comes into play. Coarse particles larger than 100nm are usually found in systems that range from micro- heterogeneous systems, those that exhibit many of the same characteristics as colloids, to coarse suspensions—all of which are part of the dispersion system continuum. Due to size difference both micro heterogeneous particles and colloidal particles exhibit different color. In a highly concentrated form, the color will tend to be more of a black color because the light passing through the suspension is blocked or reflected by the coarse particles. The coarse particles will also tend to fall out even if they have received an electrical charge like the smaller particles. Because gravity has more effect on a larger- sized particle, its effect is stronger than the repulsive forces of the electrical charge. Thus, the coarse particles will settle to the bottom of the container.

Elements have an affinity for each other on an atomic structure level. They are magnetically

attracted to each other. They want to bond. The higher the concentration of the metal particles in a solution, the more likely the affinity attraction force of the metal particles for each other will bring them together and they will cling together in ever-larger particles. Once they get to certain largeness in size, they will precipitate out due to the action of gravity on them. In an ideal colloid, the particles are small enough so that they will not cling together [18–22].

PRESENT SCENARIO OF COLLOIDAL SILVER

Before the discovery of antibiotic medicine colloidal silver is considered as drug by the Food and Drug Administration [26]. The interpretation of this fact creates a lot of confusion in the marketplace, arising from a letter from the FDA dated 9/13/91. It states that if manufactured in the original manner and advertised (labeled) for the same purpose, colloidal silver may continue to be marketed without submitting evidence and effectiveness. Many companies have construed this letter (which was officially reversed by another letter released from the FDA soon after) to grant the

authority to make claims about colloidal silver's effectiveness against infectious disease. In fact, the current status of colloidal silver is that it can be manufactured and distributed, but no claims regarding effectiveness against disease can be made without going through the complicated and expensive drug approval process. It is one thing to say that colloidal silver has anti-bacterial properties; it is another thing to say that, because of these anti-bacterial properties, colloidal silver will cure strep throat or bronchitis [27].

PRIOR USES OF COLLOIDAL SILVER

Another source of confusion regarding the current use of colloidal silver has been the lack of information about which form was originally used. It is known that, prior to 1938; colloidal silver was administered in just about every way that modern drugs are administered: intravenous and intramuscular injection, throat gargle, douche, oral use, topical administration, and as eye drops. The exact dosage, its concentration and precise diameter of colloidal silver is not well known for effective result. Aqueous metallic silver suspensions are used extensively as a gargle and, in Genito-urinary diseases, as a douche, or irrigation for inflamed mucous membranes. It can be used as intravenous or intramuscular injection with some special preparation. These certain colloidal suspension (continuous source of ions) shows ruinous effect on harmful microorganism without effecting body tissues. Even it can be applied directly to delicate mucous membrane without any issues. These colloidal particles give therapeutic action after diffusing throughout the blood. (Robert J. Hartman in 1939) [28].

QUALITY OF COLLOIDAL SILVER

Within the last few years, a number of colloidal silver products have appeared on the market, as confusing consumers. The best way to determine if a product is a true colloid of silver is to examine the ingredients. If it contains a stabilizer, or listed trace elements other than silver, the product may not be suitable for consumption [17, 20].

The pure colloidal silver is produced by the electro-colloidal or non-chemical method, containing super-fine silver particles in the range of 0.01–0.001 microns in diameter, without the need of any chemical, stabilizer, dye, or other ingredient. There is invisible accumulation of silver particles either in the solution or settled on the bottom [22]. The best products will contain the largest number of particles from the smallest total amount of silver. (Note: an artificial electrical charge applied to any element, including silver, cannot be held infinitely like a battery, its charge will dissipate. Therefore, electro-colloidal silver cannot be expected to have infinite shelf-life; some 'fallout' may occur in any non-stabilized product over an extended period of time) [29–30].

MODERN DAY USES

For 100 years, research relating to colloidal silver, satisfied user information regarding the modern day use is limited. However, through a growing number of physicians, dentists, veterinarians, and nutritionists this information in no way 'proves' colloidal silver 'cures' infectious disorders or disease, and this claim should not be made by any reputable colloidal silver manufacturer. Colloidal silver having tremendous antimicrobial power encourage current health professionals for safe and successful use which is extensively reduce the length and severity of infectious disorders is growing exponentially.

Localized infections are being treated by pouring into the ear canal, dropped into the eye, sprayed into the nose, vaporized into the lung. With systemic infections, including fevers, herpes and hepatitis, the amount of silver used and the length of time for treatment will have to be determined by the severity of infection, age, weight and overall health [31]. Users will do best to rely on labels combined with information from other sources with direct clinical experience [9–14].

Overall, it seems that the effective and safe use of colloidal silver in the treatment of dozens of common infectious disorders is only limited by the imagination and creativity of those afflicted [32–44].

USES OF COLLOIDAL SILVER BEFORE 1938

Here is the list of some of the (pre-1938) documented uses of silver, including the colloidal form, for the treatment of various conditions and pathogens as shown in Table 1. This list in no way should be construed or relied upon as medical advice. Always consult your health care professional if a serious condition exists.

Table 1: The use of colloidal silver before 1938.

S.N.	Diseases
1	Appendicitis (post-op) [34]
2	Balantidium coli [33]
3	B. dysenteriae [33]
4	Anthrax bacilli [33, 34]
5	Axiflac and bland boils on the neck [38]
6	B. coli communis [36]
7	B. pyocyaneus [33]
8	Bacillary dysentery [35]
9	Blepharitis [34]
10	Bromhidrosis in Axilla [33]
11	Burns and wounds of corneal [34]
12	Chronic cystitis [38]
13	Chronic eczema of meatus of ear [38]
14	Cystitis [11]
15	Dermatitis suggestive of Toxemia [35]
16	Diphtheria [34]
17	Epididymitis [38]
18	Eustachian Tubes (potency restored) [11]
19	Furunculosis [34]
20	Gonorrhoea [38]
21	Gonorrheal ophthalmia [34]
22	Hemorrhoids [33]
23	Imper sign [38]
24	Infected ulcers of the cornea [34]
25	Influenza [12]
26	Intestinal troubles [10]
27	Leucorrhoea [11]
28	Nasal Catarrh [9]
29	Edematous enlargement of turbinates without true hyperplasia [37]
30	Offensive discharge of chronic suppuration of otitis media [38]
31	B. tuberculosis [36]
32	Bladder irritation [13]
33	Boils [38]
34	Bromhidrosis in feet [38]
35	Cerebrospinal meningitis [34, 37]
36	Chronic eczema of anterior nares [38]
37	Colitis [35]
38	Dacryocystitis [14]
39	Diarrhea [35]
40	Dysentery [34, 10]
41	Enlarged Prostate [13]
42	Erysipelas [34]
43	Follicular tonsillitis [38]
44	Gonococcus [36]

45	Gonorrheal conjunctivitis [38]
46	Hypopyon ulcers [14]
47	Infantile disease [41]
48	Inflammatory Rheumatism [34]
49	Interstitial Keratitis [14]
50	Ophthalmology [13]
51	Para-typhoid [34]
52	Perianal eczema [33]
53	Phlegmons [34, 1, 21]
54	Pneumococci [33]
55	Puerperal septicemia [40]
56	Pustular eczema of scalp [38]
57	Phlyctenular conjunctivitis [38]
58	Pruritus ani [13]
59	Puruleneophthalmia of Infants [14]
60	Pyorrhoea Alveolaris (Rigg's disease) [11]
61	Quinsies [34]
62	Rhinitis [37]
63	Scarlatina [34]
64	Septic tonsillitis [38]
65	Septicemia [9, 11]
66	Soft sores [38]
67	Sprue [10]
68	Staphylococcus pyogenes [36]
69	Staphylococcus pyogenes aureus [33]
70	Sulcus inflammation [13]
71	Tirueavetricolor [38]
72	Typhoid [34]
73	Ulcerative Urticaria [35]
74	Valsalva's inflammation [34]
75	Vorticella [32]
76	Whooping cough [11]
77	Ringworm of the body [38]
78	Sepsis [41]
79	Septic ulcers of the legs [38]
80	Shingles [11]
81	Spring catarrh [38]
82	Staphylococci (inhibits) [33]
83	Staphylococcus pyogenes [33]
84	Streptococcal Tonsillitis [36]
85	Suppurative appendicitis (post-op) [38]
86	Tonsillitis [11]
87	Typhoid bacillus [39]
88	Urticaria suppurative of toxemia [13]
89	Vincent angina [38]
90	Warts [33]

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