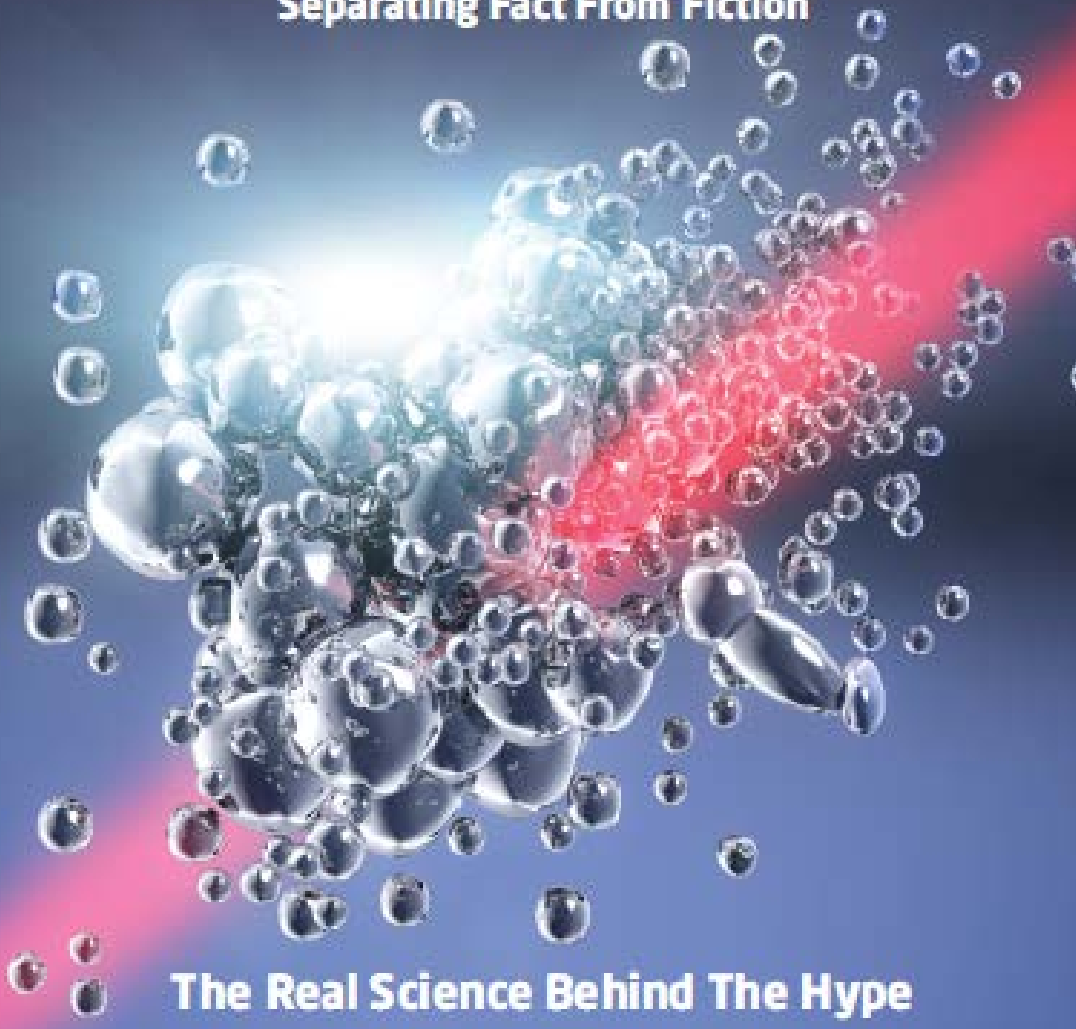
Calin V. Pop, MD

The TRUTH About COLLOIDAL Silver & Gold

Separating Fact From Fiction



The Real Science Behind The Hype

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by

Calin V. Pop, MD

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Acknowledgments

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Introduction

You are likely about to embark on reading this book because you are deeply interested in colloidal silver and/or gold. Perhaps you are intrigued by these, have heard about them in the media, or you or someone you know have had a positive experience with them. Maybe you have seen an improvement in your health and just want to know more. Maybe you have questions or are just not quite sure about some of the things you've read or heard.

We can certainly understand, as there is a great wealth of information and misinformation out there to sift through. While there is much reliable data, there is even more which is not. The purpose of this book is to clear the fog, to provide you with an authoritative voice on the subject. It is our hope that this easily understandable, relatable, scientific handbook will help you to make informed decisions for the betterment of your health.

PART I
COLLOIDAL SILVER

Medical Silver in History: Helping Health from Ancient Times

Antibiotics arrived on the healthcare scene in the early 1940s. Prior to that decade, did people have any way to protect themselves against the onslaught of bacteria or to treat bacterial infections? Yes! And that answer was silver.

Long before the microscope was invented, the ancients observed that water and food stored in silver containers remained fresh for very long periods of time, even years. Although they could not explain why, the people living during the BCE era knew that silver worked. By the time the microscope was put into use, applications of silver were already common, even during World War II.

There is also evidence of direct medical uses of silver during the BCE period. The Macedonians placed silver plates on wounds for more effective healing.[1] Hippocrates not only used silver for healing but also for treating ulcers,[2] Also, it should be noted that a pharmacopeia or medicinal drug handbook was written in Rome around the year 69 B.C. and included silver nitrate.

During the period of CE to 1800 BC, silver became a source for better health and was put into use for a variety of medicinal purposes. It was used as a blood purifier, to discourage heart palpitations, and even as a remedy for halitosis (bad breath." It was discovered that silver contained wound-healing properties, and it also began to be used internally to cure irritations and more serious problems, like brain infections. In one instance, an epileptic swallowed a silver coin that was placed in his mouth to keep him from biting his tongue during a seizure. As a presumed result of inadvertently swallowing the coin, his seizures ceased, so epilepsy was added to silver's ever-growing list of medicinal uses.

1 "Ancient Macedonians". Wikipedia. http://en.wikipedia.org/wiki/Ancient_Macedonians
2 "Hippocrates". Wikipedia. http://en.wikipedia.org/wiki/Hippocrates

U.S. pioneers continued the use of silver as a food and drink preservative. They dropped silver dollars into food or drink containers, allowing non-refrigerated foodstuffs to be transported across the country without spoilage.

Silver quickly became widely known as a preservative and medical treatment. In the 1800s, more and more medicinal properties were discovered. Dr. J. Marion Sims was quite interested in solving the problem of fistulas in slave women, a condition that occurred during child delivery, abnormal openings that produced horrible body smells.[3] Sims tried unsuccessfully to close the openings with surgery. When that did not work, having faith in the healing property of silver, he ordered the creation of fine silk wires. He used those silk strands instead of surgical silk and closed the openings, with excellent results.

Another contributor to the dossier of silver was Dr. Carl Siegmund Franz Crede, a German obstetrician. He was the first to use silver nitrate eye drops in newborn infants. As a result, the rate of ophthalmia neonatorum (neonatal conjunctivitis) was significantly reduced.[4]

Between 1900 and 1940, silver began to be presented in its colloidal form. Doctors used colloidal silver to treat corneal conditions, aiding the outermost, transparent layer of the eye. Colloidal silver was also used to treat a wide range of bacterial infections. This early use of colloidal silver taught doctors about proper dosing; it was during those early times when medical professionals learned that high doses of silver could be detrimental to a patient's health.

Currently, health professionals continue to discover new ways that silver can be used to generate better health. One of the more popular applications of silver is as a biocide, "a chemical substance or microorganism which can deter, render harmless, or exert a controlling effect on any harmful organism by chemical or biological means."[5]

3 "Fistula." MedlinePlus. http://www.nlm.nih.gov/medlineplus/ency/article/002365.htm
4 "Neonatal Conjunctivitis." Medline Plus. http://www.nlm.nih.gov/medlineplus/ency/article/001606.htm
5 "Biocide." Wikipedia. http://en.wikipedia.org/wiki/Biocide

As the history of silver has indicated, its use in medical applications is not new. Rather, it is a tried and true practice, one that has been refined empirically and scientifically through the years. Modern techniques are making the use of silver even safer and more practical. The wide use of silver as an antimicrobial agent was abandoned decades ago, in response to the discovery and development of antibiotics; however, with the fast increase of antibiotic-resistant bacteria, silver-based compounds are enjoying a well-deserved resurgence of great popularity.

Forms of Silver and Their Medicinal Uses

Silver offers its own very special way to fight bacteria, and this is very useful in a great and ever-growing number of medical applications today. With increasing efforts to promote healing and reduce infection, products such as medical uniforms, surgical thread, hospital duct-work, catheters, and wound dressings are beginning to incorporate silver in some form.[6] Let's take a look at some of these in more detail.

Silver Salts

In chemistry, there are acids and bases. Since these terms have different definitions depending on which theory is being used, this book will define them in terms of their properties. An acid generally tastes sour and has a pH of less than seven. Strong, inorganic acids dropped onto metals may generate hydrogen gas. A base usually tastes bitter, has a pH of greater than seven, and feels slippery. When an acid and a base combine, a salt can form. There are a wide variety of silver salts. Some of those used for antimicrobial/antibacterial purposes include:

- silver chloride: a component of bandages and wound healing products
- silver fluoride: a tooth decay preventative
- silver nitrate: a wart treatment
- silver sulfadiazine: the most powerful, topical dressing for burns[7]
- silver sulfate: an ingredient in topical creams and bandages

6 It appears that when silver is a part of a wound dressing, the dressing adheres or sticks less to the wound. This makes it more comfortable when changing dressings. However, the frequency of dressing changes may also be lessened due to the antimicrobial action of the silver. https://www.silverinstitute.org/site/wp-content/uploads/2011/07/futuresilverindustrialdemand.pdf

7 First Majestic Silver Corporation. "Why Silver?" http://www.firstmajestic.com/s/SilverUses.asp

Microbe Wiki, a student-edited information project of Kenyon College in Ohio, states that one advantage of the salt form of silver is that it "is effective at providing a large quantity of silver ions all at once."[8]

Silver Nanoparticles (AgNP)

Nanoparticles (NP) are very small metal entities. Their dimensions are measured in nanometers (nm), 1nm being equal with 3.93700787 by 10-8 inches; a nanometer is roughly 400 million times smaller than an inch. Depending on the size, a nanoparticle can contain anywhere from a few hundred to several tens of thousands atoms of silver. Currently, silver nanoparticles are considered as perhaps the best form for internal antimicrobial purposes. *Microbe Wiki* suggests that this may be due to "their simple synthesis and highly effective, observed antibacterial activity."[9] Research points to nanoparticle size and shape as the reasons for this increased effectiveness. Some studies suggest that the smaller particle size enables the nanoparticle to dissolve easier in liquid environments and more easily pass through cell membranes and cell walls. Nanoparticles come in a variety of forms, including spheres, platelets, needles, and wires. Obviously, the transportation of spheres through the body poses far fewer issues than the other forms. The fewer facets (sides) the particle has, the better its chances of preventing bacterial growth. In addition, nanocrystalline silver dressings have been shown to be anti-inflammatory.[10]

Silver nanoparticles are basically balls comprised of hundreds or thousands of atoms in a metallic state, as explained earlier. When these are placed in a liquid environment, a small fraction of atoms leaves the particle, and these are converted into silver ions (Ag^+), following their interaction with oxidizing species (oxygen in the external environment). The silver ion is the species responsible for the antibacterial activity.

8 "Silver as an Antimicrobial Agent". Microbe Wiki. http://microbewiki.kenyon.edu/index.php/Silver_as_an_Antimicrobial_Agent#Silver_salts
9 Ibid.
10 "Anti-inflammatory Activity of Nanocrystalline Silver-derived Solutions in Porcine Contact Dermatitis." *Journal of Inflammation*. http://www.journal-inflammation.com/content/7/1/13

The metallic silver itself does not offer antibacterial activity, but it does function as a reservoir, providing a slow release of silver ions.

Silver Powder

Silver powders are aggregates of very large silver crystals. They have been used with good results in treating wounds resulting from pressure, sores, and burns. The powder is generally placed in or on the wound site, either directly or as a dispersion in an acceptable cream, then covered with a bandage.

In addition to the above forms, gels and sprays containing silver are also in common use today.

It is certainly not uncommon for medical equipment production to incorporate some silver components. Studies have shown that urinary catheters containing silver alloys more effectively prevent urinary tract infection (UTI). Compared with non-silver-containing catheters, the reduction in infection incidence is ~300 percent.

These and other results have given rise to the use of silver-based antimicrobial coating on items such as prosthetic heart valves and vascular grafts. The general current opinion is that, "despite the initial higher cost of the silver-bearing products, the longer-term benefits of reduced spending on aftercare may justify the economic cost of using these materials."[11]

11 Silver Institute, The. "The Future of Silver." https://www.silverinstitute.org/site/wp-content/uploads/2011/07/futuresilverindustrialdemand.pdf

Other Uses of Silver

Of all the metals, silver is the best conductor of electricity, followed by copper and gold. Silver also exhibits the highest thermal conductivity of any element and the highest reflectance of light. It does not corrode and resists oxidation. As a result, if an electrical product must perform well for a long period of time, it will generally include silver. Below are a few examples of how silver is currently being used in our world:

Silver Metallic Flakes

Available in a variety of sizes, typically larger than one micrometer, these are not generally used for medical purposes. However, they are widely used in the electronics industry, solar panels, and for other industrial needs.

Switches and Circuit Breakers

Every time an electrical item is turned on or off, a conventional switch is used. Today's cars can be equipped with more than forty silver-tipped switches to allow occupants to start the engine, raise and lower windows, lock and unlock door, and even keep the power steering and brakes functioning as they should. Silver content in these switches is typically between 70 and 90 percent, the balance consisting of metal ingredients such as oxides and carbon that greatly extend the life of the switch by reducing silver evaporation.

Printed Circuit Boards (PCBs)

Almost every electrical product today uses one or more PCBs. Some of these include computers, mobile telephones, security systems, electrical appliances, and airplanes. Connectors used to hold all these PCBs and their components together are often comprised of silver.[12]

12 "PCB," TechTerms.com. http://www.techterms.com/definition/pcb

Batteries

A lead-acid battery has half the capacity of a silver oxide and zinc one. Applications requiring long-term battery usage without recharging, such as film crew equipment and research submersibles, prefer batteries with silver. The oil industry also favors batteries with silver. At oil well drilling depth, temperatures are high; batteries with silver are unique in that they can withstand these high temperatures.

Superconductors

This material allows electricity to flow without resistance below a certain temperature,[13] which is important because resistance causes a loss of energy. In theory, and almost in reality, a closed loop of superconducting material that has been turned on can infinitely keep its electrical current flowing. Using silver in the superconductor assembly increases both its speed and its effectiveness. Although their use is limited today, superconductors are constantly being researched and developed, and they are seen as the future of power transmission.

The uses of silver are broad, and they are also used in non-electrical applications. One of these is photography. There are many modern, non-silver-based photographic techniques. The experts know that silver-based photography is relatively low cost and produces pictures with superior definition. Pictures of bones (X-rays) also rely on silver. Although these are of a slightly different general composition, the coating of X-ray film contains silver halide crystals, like those used in regular silver-based photography.

It appears that everything can be bettered by the incorporation of silver. Chemical reactions become more efficient in the presence of silver. In addition, silver can help produce unique chemical results. For example, the oxidization of ethylene gas into ethylene oxide is only possible if silver is the catalyst. Polyester textiles are built from blocks of ethylene oxide. Without it, many of the clothes we wear today would

13 "Superconductor Information for the Beginner." http://www.superconductors.org/INdex.htm

be impossible to create. Also, ethylene oxide is part of the material that forms many molded items, such as electrical control knobs and computer keyboards. Chemical processes involved in the expanding field of silver nanotechnology is also a significant application.

Another important application is solar energy. The U.S. Department of Energy Photovoltaic Technology Division states that crystalline silicon photovoltaic cells are the most widely used type of solar cell. All crystalline silicon photovoltaic cells on the market contain silver paste as a defining component. Many satellites are powered with silicon cells as well. In these cells, silver deposited on the front side of the silicon acts as the collection grid for the photon ejected from the p/n junction that lies beneath the semiconductor surface. Not only does silver guarantee efficient conduction of electric current, but it also offers enhanced reflection of the sunlight, more energy, and better reflection of solar (thermal) heat.

Speaking of heat, a transparent coating of "invisible" silver can deflect solar energy. In this way, windows and windshields treated with silver can reduce about 70 percent of entering solar energy; this means less work for air-cooling systems. In recent years, the U.S. Department of Energy Star Program has promoted the use of silver-coated glass, often called "low E squared." The resulting increase in usage (50 percent) means that the annual need for 350 million square feet of glass requires only 5 million ounces of silver.

As in ancient times, silver is being used in water purification systems today. More and more of the water filters sold in the U.S. are relying on silver to help them remain bacteria- and algae-free. Recent studies show that combining silver with oxygen in a catalytic format creates a powerful water cleaner. This methodology could provide an alternative to the current use of chlorine, which is dangerously corrosive.

Not to be dismissed is the significant use of silver in jewelry and silverware. Compared to gold, silver is more reflective, and it can be polished to the

highest shine of any metal. Unfortunately, by itself, silver is too soft for these uses, so it is typically mixed with a percentage of copper for greater durability. What we know as "sterling" silver is often a 92.5 percent silver mixed with 7.5 percent copper.

Protective and decorative coatings are yet another application for the versatile metal. Silver electroplating is not only used in jewelry, cutlery, and serving pieces but also for fuse caps and heavy-duty electrical equipment. Mirrors also use a form of silver coating, since polished silver is almost totally reflective. The bearings of many jet engines are silver coated to provide more reliable performance and a high level of safety.

In sum, whether we see it or not, silver has become an everyday metal that we likely encounter many times during our days. The Silver Institute predicts that the trend of using silver will continue. Its recent report, "The Future of Silver," discusses quite a number of emerging silver-using applications. These include solid-state lighting (SSL), radio frequency identification (RFID) tags for tracking and theft prevention, wood preservatives, super capacitors (similar to batteries but last almost indefinitely), and food packaging.[14]

14 Silver, Institute, The. "The Future of Silver." https://www.silverinstitute.org/site/wp-content/uploads/2011/07/futuresilverindustrialdemand.pdf

The Case for Colloidal Silver

Perhaps the most important aspect of evaluating colloidal silver is to separate fact from fiction. This book strives to include only credible, reliable information, but after reviewing this data, the case for colloidal silver will be highly compelling.

Before delving into the research, it is wise to say a word or two about what colloidal silver actually is. There are a number of definitions of *colloid*, but for the purposes of this book, we shall view it as: "a substance consisting of particles that are dispersed throughout another substance and are too small for resolution with an ordinary light microscope but are incapable of passing through a semi-permeable membrane".[15] The particles that are too small to be seen with a regular microscope are silver nanoparticles. A *nanoparticle* is one whose measurements are in nanometers. In general, we can view it as something very, very, very small! Nanosize is understood to be somewhere between 1 and 100nm; however, this meaning can be extended to 200nm.

Colloidal refers to particles floating in a liquid, meaning they are not dissolved and simply hang in suspension, like dust in the air. Therefore, colloidal silver is a liquid solution in which nanoparticles of silver are floating around.

There are several meaningful considerations that should be taken to mind regarding items and events at nanoscale:

- Particles at the nanoscale do not have the same properties or behavior as larger-sized particles of the same material.
- Interactions are governed by the laws of quantum physics, which are often not the same as the big-scale laws of physics.
- Quite a number of cell functions occur on the nanoscale level.

15 "Colloid." Merriam-Webster. http://www.merriam-webster.com/medical/colloid

Nanotechnology itself has a lengthy history. While they wouldn't have described it as such, ancient artisans created nanostructured items as a result of empirical evidence and their expert knowledge of the materials with which they worked. The fourth-century Roman Lycurgus cup housed at the British Museum is one famous example. Under normal viewing conditions, when lit from the outside, the cup appears to be opaque green; however, when illuminated from the inside, the colloidal gold and silver in the glass create a translucent red effect. There are many milestones on the nanotechnology timeline: ceramic glazes made items shine as a result of metallic nanoparticles in the ninth to seventeenth centuries); European stained-glass windows not only glowed with rich colors but were also thought to purify the air due to the inclusion of gold nanoparticles in the sixth to fifteenth centuries); and Damascus saber blades were made stronger by nanocarbon in the thirteenth to eighteenth centuries.[16]

Modern advances in microscopy, as well as new methodologies, have allowed scientists to toy around a bit with nanotechnology and, thus, colloidal silver, even though colloidal silver is essentially nothing new. In the joint American-Swiss paper, "120 Years of Nanosilver History: Implications for Policy Makers," Bernd Nowack et al. state, "Colloidal nanosilver has been administered as a medicine for almost 100 years."[17] In 2011, the American Chemical society published the authors' conclusion: "nanosilver materials have a deep historical record of demonstrated safe use."[18]

Colloidal Silver Conclusion 1: Colloidal silver is not just something someone dreamt up recently to make money. Current knowledge of colloidal silver is the result of thousands of years of direct and indirect experimentation and practice.

16 National Nanotechnology Initiative. "Nanotechnology Timeline." http://www.nano.gov/timeline
17 Percival, Stephen, et al. "The Antimicrobial Efficacy of Silver on Antibiotic-Resistant Bacteria Isolated from Burn Wounds." http://www.academia.edu/2455924/Therapeutic_Properties_of_Silver#3
18 Ibid.

What is new is knowledge of the mechanism(s) by which colloidal silver accomplishes its work. An article by Imperial College London (England) discusses how silver executes a binding or sticking action: It sticks to the cell walls of bacteria, causing them to malfunction. It also adheres to bacteria DNA and RNA, preventing the bacteria from replicating or reproducing. The article also says silver may act by inhibiting the cell from breathing.

Further evidence of this alleged attachment is found in a study published in *The Journal of Nanotechnology* and reported by Syeda Z. Hamdani in "Study Shows Silver Nanoparticles Attach to HIV-1 Virus." This 2005 article reports on research into how silver nanoparticles react with HIV-1. This study, the first of its kind, used silver nanoparticles in a variety of sizes, shapes, and mediums. The results showed that the silver did not allow the virus to bond with host cells. The researchers believe the silver nanoparticles accomplished this by somehow attaching themselves to protein knobs on the HIV-1.

This stickability of silver is further confirmed in an article on the U.S. National Library of Medicine National Institutes of Health website which reports, "The survival rate of bacterial species decreased with increase in adsorption (sticking) of SNPs (silver nanoparticles)."[19]

Another way in which colloidal silver can positively influence health is through stimulation of our immune systems. Very simply, our immune systems work by recognizing foreign bodies or substances and taking specific actions against them. Silver nanoparticles appear to boost the recognition ability of our immune scouts (officially known as "toll-like receptors," or TLRs). The way in which colloidal silver does this may be by effecting cytokine expression. Cytokines are proteins that affect individual cell behavior or the interactions or communications between cells.[20]

19 "Studies on Interaction of Colloidal Silver Nanoparticles (SNPs) with Five Different Bacterial Species." http://www.ncbi.nlm.nih.gov/pubmed/21640562

20 "Cytokines." http://www.medterms.com/script/main/art.asp?articlekey=11937

It is not merely a solo act, for silver nanoparticles can also enhance the effects of antibiotics. The ever-increasing number of strains of harmful, antibiotic-resistant organisms is a continuing worry for the public and the medical community. Colloidal silver has been shown to rev up the power of antibiotics, boosting them with a more significant and widespread effect.

The Wyss Institute for Biologically Inspired Engineering is located at Harvard University. In June of 2013, they published a journal article in *Science Translational Medicine*. The Harvard researchers found that by treating bacteria with a compound containing silver, the previously antibiotic-resistant bacteria became antibiotic-sensitive again. In addition, this same silver-containing compound widened the scope of effectiveness of the antibiotic vancomycin, which is known to kill Gram-positive bacteria but is ineffective against Gram-negative bacteria, meaning it kills in a very selective way. The presence of silver changed the playing field, in that the vancomycin became effective against Gram-negative bacteria too. Lastly, treatments for infections caused by dormant bacteria and microbial slime layers (biofilms) were speeded up. In other words. fewer rounds of treatment were needed for a complete cure.

With each passing day, the volume of the evidence for colloidal silver increases. Here are some further references:

A comment on ResearchGate, a professional scientific and research network, cited four studies:

- Department of Pharmaceutical Biotechnology and Medical Nanotechnology Research Center: Faculty of Pharmacy and Medical Sciences at the University of Tehran, Iran, support that in the presence of colloidal silver, drug-resistant pathogens could once again be killed by the antibiotics that used to be effective.
- The Department of Microbiology/Molecular Biology of Brigham-Young University, U.S.A.: A study took place two months after the previous study in Iran and supports its results.

- Department of Physical Chemistry at Palacky University in the Czech Republic: Small-size silver nanoparticles effectively destroyed both Gram-positive and Gram-negative bacteria.
- Department of Textile Science, Nanya Institute of Technology, Chung-Li, Tao-Yuan, Taiwan: Research a year later showed that colloidal silver can prevent deadly pathogens from colonizing.

A Korean study which took place at the Department of Microbiology at Kyungpook National University in Daegu found that nanosilver was equal to or outperformed two current treatments. A common cure for systemic fungal infections is the intravenous application of Amphotericin B. This study found that nanosilver was equally effective. In regard to another anti-fungal drug, fluconazole (more familiarly called Diflucan), nanosilver performed better. Both of these results were so significant that the article was accepted for publication by the prestigious Journal of Microbiology and Biotechnology.

Scientists from The Washington University School of Medicine and the University of Akron, Ohio, conducted a study about the effects of aerosolized nanoparticles on mice infected with the bacteria pseudomona aeroginosa, which often causes bacterial pneumonia in humans who have weakened immune systems, need machine-assisted breathing such as ventilators, or suffer from cystic fibrosis. Two types of once-daily inhalation treatments were prepared: One contained aerosolized nanoparticles of silver carbene complexes (SCCs), known for their antimicrobial properties, while the other was a placebo. Inhaling the SCC mixture resulted in statistically lower concentrations of bacteria in the lungs of mice as compared to inhaling the placebo mixture. In addition, all the mice in the SCC group survived. This was not the case in the control group.

The final study cited here is the "Summary Report of the First African Human Trials."[21] Although a number of years old, this research is still highly relevant due to its comprehensive nature. The summary report discusses

21 Cambridge University. "Colloidal Silver Research Trials." http://www.thenakedscientists.com/forum/index.php?topic=2394.0

the first series of 58 trials and the results of 60 of the 120 participants. Three hospitals in Ghana, West Africa took part. The patients, who had a variety of ailments, were not treated with the usual course of antibiotics. Instead, they were given varying quantities of colloidal silver as non-ionic 50nm silver particles suspended in distilled water. It is important to add that, in light of recent scientific knowledge, those particles always release silver ions. The concentration was ten parts per million, which is relatively small. The summary report states that in almost every instance, patients treated with drinkable colloidal silver fully recovered in no more than eight days. The ailments presented by the patients were bronchitis, vaginal yeast infection (Candida), conjunctivitis (eye infection), external cuts and infection, external otitis (ear infection), otitis media (middle ear infection), gonorrhea, malaria, mouth problems, pelvic inflammatory disease, pharyngitis (sore throat), retro-viral infection, HIV, sinusitis or rhinitis (nasal infections), tonsillitis, and upper respiratory or urinary tract infections.

Colloidal Silver Conclusion 2: The abundant, reliable, statistically significant, scientific data supports the reality of colloidal silver as a highly effective antimicrobial agent.

How the Human Body Absorbs and Eliminates Colloidal Silver

It may seem odd for us to allow microscopic metallic pieces to roam around in our bodies. Perhaps you fear they will they will clog up your veins or arteries or cause damage to vital organs and body tissues.

Silver enters the human body through three main routes: inhaling powders and vapors containing silver, through the digestive tract (food, water, or medication), and through the skin. The adult human body contains approximately 29µg/kg of silver, and our average oral intake of silver is 20 to 80µg/day.

The absorbed fraction is carried by the bloodstream and may be deposited in various tissues throughout the body, depending on many factors. These determining factors include the size of the nanoparticles and the type of cells they are attempting to penetrate. In general, silver is stored and is accumulated intra-cellularly, apparently without any effect. This means that generally spherical silver nanoparticles can be accumulated inside our cells without disturbing the cell metabolism.

One useful tool for examining any issue is to put things into perspective, and this also holds true with the case of metals as they apply to our health. Are they naturally present in a healthy human body? Perhaps to your surprise, the answer is yes. We can examine some of these metals according to the periodic table of the elements, keeping in mind that some elements can change forms inside the body.

The information below is taken from a publication by the National Institute of General Medical Science, part o the U.S. National Institute of Health.[22] This section concentrates its research on biological processes at a range of levels "from molecules and cells to tissues, whole organisms, and populations."[23]

22 "Healthy Metals." http://publications.nigms.nih.gov/findings/mar05/popups/lead_sb.htm
23 "About NIGMS." http://www.nigms.nih.gov/About/Pages/default.aspx

Metals that Naturally Occur in a Healthy Human

[Ca] Calcium: Found at a level of 1.5 percent, this essential element is not just for bones and teeth. The lungs, kidneys, liver, thyroid, brain, muscles, and heart all use calcium for healthy functioning.

A healthy human body also contains traces of several metals, as listed below:

[Fe] Iron: In the blood, iron aids the transport of oxygen throughout the circulatory system. Iron is also important for proper heart function.

[Cu] Copper: Free radicals are linked to increased risks of disease. Copper helps the body collect these dangerous chemicals for safe disposal. In addition, copper is involved in the maintenance of strong limbs, good bone growth, and healthy hair.

[Mg] Magnesium: Magnesium assists in maintaining strong bones, good teeth, and proper muscle contraction/relaxation.

[Zn] Zinc: Although zinc is only present in trace amounts, its functions are quite significant. First, zinc keeps our immune responses functioning at the right levels. Second, it aids in maintaining a healthy nervous system. Zinc also helps with the regulation of hormones. A fourth function is on the gene level: Some genetic proteins require the presence of zinc in order to carry out their activities. Perhaps this is because many of our body proteins "need one or two zinc atoms to fold into the right shape."[24] Fifth, it has been shown that zinc is beneficial in speeding up some of the important chemical reactions in the body. Lastly, research indicates that zinc may be involved in learning and memory. Stephen Lippard, a chemist at the Massachusetts Institute of Technology (MIT), found that "zinc helps regulate communication between two types of brain cells in the hippocampus."[25] The hippocampus is known as the seat of memory and learning.

24 "Metals: In Sickness and in Health." http://www.livescience.com/18247-metals-human-body-health-nigms.html
25 Ibid.

[Co] Cobalt: This element, the basis for Vitamin B12, aids in the formation of red blood cells.

[Mn] Manganese: Manganese is a healthy destroyer, of sorts. It is involved in the breakdown of fats, carbohydrates, and proteins, allowing food to be converted into usable energy.

Other metals present in extremely scant amounts are chromium, molybdenum, and selenium.

Last but not least, as relatively surprising as it may be, a recent Hungarian study found that there are silver-specific receptors on human tissue. Since the body is only equipped with receptors for items it requires, the logical conclusion is that topical and internal silver has a part to play in maintaining optimal human health

Colloidal Silver Conclusion 3: The presence of metals in a human body is a natural state of being. Moreover, the absence of these metals at their proper levels can lead to disease and even death. In other words, these metals are essential for the proper functioning of the human body.

Based on this conclusion, ingesting a metal is not necessarily problematic. What is important is to make sure that the absorption and elimination is acceptable to the body and that the ingested levels are not toxic. (Toxicity will be discussed in depth in the next chapter).

How Colloidal Silver Is Absorbed

While there is much more to be learned about silver absorption, there is a plethora of reliable information already available. Silver can be absorbed orally (via the mouth to the gastrointestinal tract), nasally (via the mucous membranes in the nose), and dermally (via the skin). Humans can absorb silver from food or drink, the air, and via skin creams or sprays. The human body can also absorb inserted silver; for example, a silver-coated medical device inserted in the body can allow the body to absorb a certain amount of silver.

The average person who does not actively use any silver-containing preparations may feel that he or she is not absorbing silver, but this is not necessarily true. In the modern world, there is a wide range of ways in which silver can be absorbed passively. Some include:

- dental fillings using silver amalgams
- drinking water filtered with a silver-containing filter
- anti-smoking therapies containing silver acetate
- foods containing silver

The World Health Organization (WHO) has measured silver levels in several common substances. With regard to air, a WHO study found that "ambient air concentrations of silver are in the low nanogram per cubic meter range."[26] Most water in the U.S. that has not undergone any special treatment has a silver concentration ranging between non-detectable and 5mg/quart. The WHO found that the silver levels of food varies between 10 to 100 mg/2lbs; however, this passive silver absorption does not appear to be a cause for concern. According to the World Health Organization, "Only a small percentage of silver is absorbed. Retention rates in humans and laboratory animals range between 0 and 10 percent."[27]

On the other hand, the body can absorb much higher rates of orally administered colloidal silver. The WHO reports that this can be as much as 5 percent. People who are exposed to silver on a daily basis can retain as much as 10 percent.

Other known points regarding colloidal silver absorption include:

- Colloidal silver that enters the bloodstream gets ferried around by globulins, proteins present in the human circulatory system.
- When colloidal silver enters the tissue, it is usually found as part of cell cytosol, the liquid inside the cell.
- The body prefers to store silver in the liver and skin, with lower concentrations in various other organs.

26 "Silver." http://www.who.int/water_sanitation_health/dwq/chemicals/silversum.pdf
27 Ibid.

- Silver stored in the liver has a biological half-life of between a few to fifty days. Half-life refers to the time it takes for a quantity to decay to half its value.

How Colloidal Silver Is Eliminated

To date, research tells us that the liver plays a primary role in the elimination of silver from the human body. Silver mixes with bile that is then excreted in the feces. Animal studies report that cumulative excretion levels were 90 to 99 percent.[28] Silver is also eliminated through the urine.

Roger Altman, EngScD (doctor of engineering science) used himself as a lab rat to investigate the accumulation and elimination of drinkable colloidal silver. While his study is technically non-statistically significant, due to a population of one, it provides much food for thought.

Altman consumed colloidal silver every day for about five and a half months. He drank 1mg/day for the first month, then increased to 2.34mg/day for the remainder of the study. Five days after his last self-administered treatment, Altman measured his first fecal and urine sample. Then, for five weeks, he collected samples once a week during a twenty-four-hour period. Subsequently, Altman reduced his twenty-four-hour sampling to once every three weeks. He sent his samples to a professional laboratory for analysis and used mathematical algorithms to calculate average results.

Altman found that the more silver there was in the body, the more was eliminated. As the silver levels drop, so do the amounts found in feces and urine. Altman feels that some residual silver probably remained in his body at the end of the study, after ninety-six days, but that the amount was insignificant.

Altman's results appear to show that the human body first eliminates excess silver primarily via the urine. Over time, the amount of silver excreted in the feces rises. It is, therefore, evident that two separate elimination mechanisms function simultaneously, though some studies

28 "Silver in Drinking Water." http://www.who.int/water_sanitation_health/dwq/chemicals/silver.pdf

have found the opposite.[29] Altman also found that silver excretion via the urine can be facilitated by drinking a larger amount of water than usual.

Altman concluded that "ingestion of properly prepared CS (colloidal silver) does not result in silver accumulating in the body."[30] He checked his hair and fingernails and found no accumulation of silver. The rate and levels of silver that were eliminated after Altman stopped drinking the colloidal silver meant that not much of it remained in his body. In addition, it took a relatively short time for his body to get rid of the silver. The process was accelerated by drinking larger quantities of water, several quarts a day.

Colloidal Silver Conclusion 4: The human body is equipped to absorb colloidal silver. The body also has natural mechanisms to eliminate any unneeded/unwanted silver so excess accumulation does not occur.

All About Bioavailability

There has been much discussion as to whether or not colloidal silver is bioavailable. As the word implies, *bioavailability* is determined by the following:

- how much of a substance enters the systemic circulation (bloodstream) and is, therefore, available to do the work intended
- at what rate (how fast) this happens

Bioavailability depends on several factors: the form of administration, the frequency, and the treatment dosage. Treatments given orally encounter several filters before they even get near the bloodstream. The first is the intestinal wall. Next is part of the liver. Both of these sites do their best to metabolize (change the form of) the treatments. Thus, a less-than-optimum amount of the treatment will reach the bloodstream after the liver, resulting in lower effectiveness.

29 These researchers found that "Urinary excretion of silver is appreciably lower than biliary elimination." http://www.hindawi.com/journals/aps/2010/910686/

30 "Colloidal Silver: Where Does It Go When You Drink It? How Long Does It Stay There?" http://www.silver-colloids.com/Papers/AltmanStudy.PDF

Other factors have to do with the individual. A person's age, sex, weight, and genetic phenotype all have a bearing on bioavailability. So, too, is the level and frequency of the individual's physical activity. Stress levels, other physical disorders, and gastrointestinal (GI) surgery can also play a part. Gut disorders like leaky gut syndrome, in which the connection between intestinal cells loosens, can alter the absorption of any ingredient. The health of a patient's skin is also part of the equation. Research using the electron microscope has found that nanosilver can pass through human skin. Skin that is damaged in some way allows up to 400 percent more silver to pass through.

Another factor is the environment into which the nanosilver is deposited. Scientists at the University of Helsinki, Finland were interested in learning about the toxicity of nanosilver to aquatic ecosystems. They examined the effects of nanosilver on two common crustaceans in both natural and artificial fresh water. The researchers selected Daphnia magna, a type of water flea, and Thamnocephalus platyurus, a type of fairy shrimp. The results indicated that water conditions do affect bioavailability. Natural water often contains other substances, such as sulfides. It may also be home to high levels of minerals; this is often known as hard water. All the items present in natural water create conditions for lower bioavailability. Artificial water, in this sense, is typically cleaner; as a result, bioavailability is higher in artificial fresh water.

The above information paints a rather complex picture: Bioavailability is not a constant. Rather, it varies according to a variety of external environmental conditions (outside the organism), as well as internal ones.

While it would be nice to aim for some sort of uniform bioavailability, in which the same dosage of colloidal silver will produce the same results in each patient, this is most likely not possible. A more realistic scenario is a set of general guidelines per medical condition (bacterial infection, virus, etc.) with some tweaking room, depending on the situation. We must also realize that the usual absorption and metabolism issues pertain to complex large molecules rather than tiny metal spheres.

We are postulating here that nanoparticles are small enough to slip into the spaces between cells and be sucked in easily, like grains of fine sand through a porous sponge with large holes. It is likely and possible that, due to the small size and the high solubility factor triggered by the high surface area, the transport through the gastrointestinal tract begins in the stomach. Depending on many factors that can influence transport, however, we believe that a considerable amount of a nanoparticle solution is rapidly passed through the stomach wall like water through sand. The remainder of this evenly dispersed solution that is not quickly absorbed in the stomach will be absorbed in the first area of the small intestines, thus never having a chance to encounter the beneficial intestinal bacteria located in the latter part of the small intestine and the large intestine. This is a good explanation as to why colloidal silver does not destroy beneficial bacteria in the human body. Bowel disturbance and disruption of the beneficial organisms' balance are seldom reported, if ever, considering the number of willing consumers of colloidal silver.

Another factor to consider is that the intercellular spaces are, more or less, on the order of magnitude of 50nm.[31] This explains why nanoparticles of 35nm or less can easily travel between cells and, in general, are much safer than bigger nanoparticles, which are ingested by cells called macrophages.

The bioavailability of colloidal silver is very high because, as explained above, the small particles slip through tiny spaces between cells, as opposed to uncoated particles and ionic silver, which is very chemically reactive and sticks to tissues. Ionic silver attaches to cellular structures and functional groups, modifying cell structures, including DNA. Those in excess can go farther and dislodge deeper structures. There could be many unwanted chemical chain reactions until a few ions escape in the bloodstream, where they will continue with further chain reactions. The dose of ions is usually a trillion times the number of particles and is not as gentle as the suspended colloidal particles. Thus, bioavailability is much higher in colloidal silver.

31 http://jcb.rupress.org/content/116/6/1487.full.pdf

Toxicity: Keeping It Safe

As with any treatment, it is advisable to be informed about any negative side effects that might be associated with taking colloidal silver. The previous chapter illustrated that, under normal circumstances, it is difficult for the body to accumulate excess amounts of silver, even when ingesting high daily amounts of colloidal silver. How, then, does toxicity occur? Perhaps prior to how toxicity occurs, we should investigate whether it actually does occur as a result of treatments involving internal colloidal silver. Colloidal and nanosilver have been in the limelight in recent years. As a result, there is an accumulation of solid, scientific research to consider.

In general, silver is relatively nontoxic to mammalian cells. Most humans today are exposed daily to very low levels of silver from food and drinking water and, to a smaller extent, even from the air we breathe.

The estimated fatal dose of AgNO3 for humans is 1.4×105μg/kg−1. However, most of this data was extrapolated from studies on animals and extended to humans, a process that is inherently prone to errors.

It is to be noted that the toxicity of silver nitrate is millions of times higher than that of silver nanoparticles.

After exposure and absorption, silver nanoparticles are transported by the bloodstream. If these are the wrong size or shape, silver can accumulate in organs and tissues such as the liver, skin, kidney, spleen, heart, lung, olfactory bulb, corneas, gingival mucous membranes, brain, and testes. Silver also can re-precipitate in these organs; ions reduced to metallic silver and nanoparticles can occur.

It should also be noted that mostly bigger, asymmetrical shapes of silver nanoparticles can cause toxic effects such as inflammation, cell activation, or depletion of glutathione levels in association with mitochondrial dysfunction and ROS production. AgNPs may interact with sulfur-containing proteins and enzymes (such as thioredoxin peroxidase,

thioredoxin, superoxide dismutase protein, and glutathione, the most sensitive indicator of the cell to silver toxicity) and at least partially deactivate them. Free radical accumulation can also initiate an inflammatory response.

The following are some review articles useful in helping to form conclusions regarding silver mechanism and toxicity. They are also included in the reference list at the end of the book:

□ *Review Article: "A Pharmacological and Toxicological Profile of Silver as an Antimicrobial Agent in Medical Devices"*

A section of this journal article discusses the occurrence of soft tissue and bone damage as a result of silver treatments. The authors of the article report, after analysis of the published literature, that silver does not, in any form, cross the blood/brain or blood/cerebrospinal fluid (CSF) barrier. Thus, brain damage due to silver treatments is highly unlikely. Furthermore, silver is not absorbed into the central or peripheral nervous systems, virtually eliminating the opportunity for nerve damage. Hepatic (liver) damage has not been confirmed. While silver can cause temporary changes to some chemical levels in the body (triglycerides, cholesterol, etc.), the fluctuations are not permanent, nor do they cause damage. Renal (kidney) damage has not been observed. Although silver can enter the bone marrow, there are no significant negative effects. Cases of hypersensitive or allergic reactions are mostly believed to be the results of additives.

□ *Article: "A Shot in the Arm for Old Antibiotics"*

This report discusses a group of Harvard scientists and includes a paragraph about their toxicity studies. The researchers found that the amount of silver used to enhance the effects of the antibiotics were significantly lower than the amount needed to harm cultured human cells.

□ *Lab Report: "An In Vivo Human Time-Exposure Investigation of a Commercial Silver Nanoparticle Solution"*

These researchers conducted a sophisticated, double-blind study to investigate the effects of exposure to oral nanosilver. Volunteer research subjects took the silver for periods of three, seven, or fourteen days (three groups of twelve subjects, a total of thirty-six subjects). The following results were statistically significant:

- The silver did not cause negative changes to the body metabolism, blood, or urine.
- Examined organs, (heart, lungs, abdominal) did not show evidence of damage to form or structure.
- Analysis of the sputum (spit) did not show negative changes, such as inflammatory proteins.

□ *Report: "American Biotech Labs' Nanosilver Proven Safe for Humans"*

Many commercial products seek U.S. Environmental Protection Agency (EPA) approval. To receive it, products must undergo rigorous, strictly controlled scientific studies. This report discusses the 160 studies, comprising roughly 10,000 individual antimicrobial tests, that one company has undertaken to test their nanosilver products. The results indicated that nanosilver does not damage human cells; ingested nanosilver was not harmful to the human study subjects; and injected nanosilver was nontoxic to test animals. They found no evidence of heavy metal poisoning, an increase in cancer, or higher rate of cell mutation. As a result of these and other studies, the EPA has awarded this company several silver product registrations.

□ *Research: "Genotoxicity, Acute Oral and Dermal Toxicity, Eye and Dermal Irritation and Corrosion and Skin Sensitisation Evaluation of Silver Nanoparticles"*

This experiment, conducted in Korea, attempted to see whether nanosilver causes irritation or damage to genes, skin, or eyes. The experiment reports that no clinically significant abnormal signs, including mortality (death), were observed.

Colloidal Silver Conclusion 5: The overwhelming majority of reliable clinical research shows that responsible, appropriate colloidal silver treatments are nontoxic or otherwise harmful to the human body.

What is very important to note in the above conclusion are two words: "responsible" and "appropriate." Irresponsible and inappropriate colloidal silver treatments, on the other hand, do harbor the potential for damage to the human body.

It is very easy to manufacture colloidal silver with a battery and silver wires; however, the particles manufactured with home kits are electrically charged, and their size is not controlled. As a result, they tend to quickly clump together, grow very big and heavy, and finally settle at the bottom of the glass. If ingested, these large silver clumps will either be non-absorbable, or else they will become trapped in the body tissues, like debris caught in the bottom of a sieve. This silver debris is potentially troublesome, and a handful of people have experienced problems as a result, always due to homemade silver from garage kits.

Two Rules to Avoid Toxicity

To avoid toxicity, colloidal silver users should pay attention to the following two rules.

Rule #1: Use professionally made colloidal silver products.

There are many seemingly well-documented articles about how you can make your own silver products and save money. At the moment, the only guaranteed safe colloidal silver products are those produced by experts, under strictly controlled conditions, in reputable laboratories. Any money saved by do-it-yourself (DIY) silver-making is not worth the risk to your health.

Professionally made colloidal silver products have many advantages:

- They do not include silver salts, which appear to overreact with body tissues and have been shown to have a significantly higher toxicity for humans.
- They can and should contain coated particles. This issue will be discussed more than once in this book, but coated nanosilver

particles operate in a time-released fashion, spreading the antimicrobial silver ions into the body in a slow, controlled manner. Uncoated nanosilver particles tend to clump together quickly, depositing in body tissues. This makes it very difficult for the body to eliminate them naturally.

- They are of the correct size and shape. Evidence shows that silver nanoparticles between 5 and 30nm can be handled easily and safely eliminated by the body. The shape of the particles should be symmetrical, as asymmetrical shapes appear to have a much greater potential for toxicity.

Rule #2: Get professional advice about dosages.

While results vary by individual, the general findings are that professionally made colloidal silver is safe, in small quantities. When talking about dosages, silver is measured in parts per million (PPM) or mg/L, which indicates how much silver is suspended in how much liquid. What many people fail to realize is that, for example, 1mg can be suspended in a shot glass or a full bottle of water. These liquids will have very different ppms, because the same silver amount is dissolved in different amounts of water, but the effect in the body will be the same. Why is that? Because in both cases, 1mg of silver is ingested and suspended in the body fluids. The final body concentration of silver after ingestion will be the same number of ppm. In short, do not confuse the PPM of the drinking bottle with the final ppm that will be established in the body; the ppm does not matter as much as the quantity of silver ingested. There are conversion charts for ppm in the appendix of this book.

Due to the fact that a large number of workers are exposed to silver daily while on the job, there have been a variety of governmental studies to assess safe exposure levels. In some cases, these workers were exposed to much higher amounts of silver than the average person. The studies found that silver toxicity was consistently rare; a discussion of these rare cases is included in the next chapter.

Please keep in mind that, due to the huge variety and inconsistency of the colloidal silver commercially available, the requirement and safety recommendations are likely flawed.

To find out just how much silver is safe to be taken orally, consult The Silver Safety Council (SSC), an organization of knowledgeable and reputable doctors, scientists, and medical professionals. Their website at http://www.silversafety.org/ contains a wealthy of reliable information and guidance for safe and effective use of silver.

On the website, The SSC discusses the U.S. EPA reference dose (RfD), the EPA safety guideline for daily oral silver consumption. If overall, daily silver consumption is 100 percent, the EPA recommends using no more than 25 percent of the daily recommended allowance for active oral silver intake, leaving 75 percent for passive ingestion of silver from food, water, and air. According to the EPA, the oral RfD for silver is 0.005mg/kg/day, based on body weight.[32] The SSC has devised a way to calculate the amount of silver that is most beneficial and correct for each individual, the silver safety calculation. By combining EPA recommendations with this calculation, the SSC has devised the silver safety pyramid, which provides easy calculations for safe doses of silver on a daily, short-term, or lifetime basis[33]

Colloidal Silver Conclusion 6: Professionally made colloidal silver taken in the appropriate doses for your body is virtually nontoxic.

32 "EPA R.E.D. Facts: Silver." http://www.epa.gov/oppsrrd1/REDs/old_reds/silver.pdf
33 These calculations are on their website at http://www.silversafety.org/pyramid.html

Argyria: A Rare Side Effect of Silver

Sometimes, exposure to silver in one form or another can cause a side effect that can be seen with the naked eye. When this occurs, the skin will take on a permanent bluish- or ash-gray hue. This condition, known as argyria, is taken from the word *argentus*, another name for silver.

Argyria results from silver sequestration in the body. The change in pigmentation is caused by excessive silver ingestion. Similar to tattoos, silver can remain in the body for an extended period without causing a problem.

It has been suggested that AgNPs may act as Trojan horses, entering the cells and then releasing silver ions that damage intracellular functions. Such ions can damage the membrane too.

Argyria can be localized or generalized. *Localized* is found at the place where the silver entered the skin, while *generalized* argyria involves a silver-gray coloration in the skin, eyes, or nails. This change in pigmentation may be also found in the internal organs. When silver deposits come in contact with sunlight, a reaction takes place similar to that of old photographic plates. While this cosmetic change may be alarming, it is not really dangerous. Once again, it is important to put things in perspective using reliable sources with scientific data.

How common is this condition?

Orphanet is an informational reference portal for rare diseases, composed of health professionals from roughly forty countries. Inserm, the French National Institute of Health and Medical Research, is the overall coordinator of the project. Funding is provided by Inserm, the French Directorate General for Health, and the European Commission. As a result, the project does not serve any commercial or for-profit organizations. Its goal is to provide reliable medical information for public wellbeing.

According to Orphanet, argyria is currently a rare disease. By definition, this means it is a disease that affects 1 person in 2,000.[34] There are several reasons why the number of cases of argyria has decreased dramatically. One is that many people became argyric due to exposure to silver salts. Guidelines for when and how to use silver salts have become more precise, resulting in very few cases of overexposure. Also, many cases of argyria resulted from ingestion of homemade silver particles. People are increasingly aware of the dangers associated with DIY silver and are wisely choosing professionally made products. In addition, many people became argyric from medical treatments that have since been discontinued. Lastly, the great majority of argyria cases happened because workers absorbed too much silver while on the job. Tighter global health and safety guidelines for the workplace mean employees are more protected against over-absorption of silver.

If you really research this issue, you will find that in all of human history, there have been very few cases of argyria, and each and every one of them were due to the above causes and/or human irresponsibility.

How dangerous is this condition?

To put it very simply, argyria is not dangerous. Other than the discoloration, research to date shows no significant evidence of clinically negative effects or damage. In fact, the opposite is the case.

One recent example is a study reported in *The Bone and Joint Journal* in 2013. The article discusses patients who received silver-coated *megaprostheses*, medical devices "widely used in the reconstruction of large bone defects in revision surgery or following the resection of tumors".[35] Over a period of seven years (2004-11), thirty-two patients received megaprosthetic implants at two medical centers, one in Austria and one in Germany. Of these thirty-two, seven developed local argyria about twenty-six months after implantation. Tests revealed no neurological symptoms, or was there

34 "About Rare Diseases." http://www.orpha.net/consor/cgi-bin/Education_AboutRareDiseases.php?lng=EN

35 "Argyria Following the Use of Silver-Coated Megaprostheses." http://www.boneandjoint.org.uk/highwire/filestream/65456/field_highwire_article_pdf/0/988.full-text.pdf

any renal (kidney) or hepatic (liver) failure. The researchers conclude that while the discoloration of local argyria may not be cosmetically pleasing, the condition is generally benign (harmless).

There is no reliable information that argyria has ever been caused by coated silver nanoparticles. One mechanism by which argyria can occur is when a high amount of silver ions (salts) travels to tissues and skin. Due to particular conditions there, they can precipitate and possibly even form nanoparticles from ions. This a very likely mechanism with a chemical base, but coated nanoparticles do not release enough ions to come even close. Coated nanoparticles are basically chemically neutral and do not interact with tissues.

Once silver ions arrive in peripheral tissues, an environment like glutathione, for example, can reduce silver ions to solid silver nanoparticles.

Colloidal Silver Conclusion 7: While much has been made of argyria, the actual number of cases is quite small. To date, argyria has been shown to be generally harmless, and its occurrence is rare and not at all present in those using coated nanoparticles.

Mechanism of Action: How Colloidal Silver Does What It Does

The way colloidal silver works as an antimicrobial is an emerging knowledge field. Advances in equipment and methodology have enabled researchers to expand their understanding in this area. The current picture may seem complicated to individuals outside the spectrum of the medical field, but herein, we will attempt to present a simplified, relatively non-medical version of the colloidal silver mechanism of action as we currently know it.

There are several theories out there, and the most reliable, scientific one is based on the fact that silver ions kill bacteria through chemical reactions in several ways. One way is by attaching to key components of the cell membrane or other essential components of the cellular or viral structures; this attachment disables their normal function. Another valid theory is that silver ions combine and then recombine in a chain reaction with several chemical components that are vital for the microorganism.

Silver ions can interfere with cellular enzymes by binding to their amino acids, thus forming silver-amino acid complexes. When enzymes are blocked, so is their respiratory cycle, and free radicals form, promoting further damage to bacterial cells.

The biocidal effect of silver seems to be related to a mechanism involving the binding of silver to various amino acids, mainly those in the thiol (sulfur) groups, including the respiratory chain and citric acid cycle enzymes. This leads to their inactivation and bacterial death. Another mechanism of silver activity in bacteria is the formation of hydroxyl radicals, which leads to DNA damage.

Simply put, silver ions kill bacteria. The surface area plays a role in solid applications, but it has nothing to do with antibacterial properties. What is less understood by most is that if we place any solid substance in any liquid, a small quantity of that solid will be dissolved, and some will become ions. The number of ions maybe extremely low, but in the case of silver, even that low concentration is millions of times higher than necessary for antibacterial applications.

Any competent high school chemistry student knows that a salt or chemical complex dissociates in water or liquid solution. The solubility product constant (Ksp) is universal.[36]

The consequences are multiple. For one thing, silver ions attach to chloride, which may be considered insoluble, though nothing exists that is not at all soluble; Solubility may be high or low but not zero. This universal constant assures us that some of those silver chloride ions re-dissociate and form complex chloride ions that are soluble. Whatever other complex ions are produced later (with phosphates, sulfates, or amino acids, for example), at least part will further dissociate. This chemical chain reaction may play a great role in the killing of bacteria.

The following is an excerpt from Environmental Health Perspective, a journal by the National Institutes of Health:

> *"Silver nanoparticles are an effective tool for killing disease-causing bacteria. But despite their widespread use in catheters, clothing, toys, cosmetics, and many other products, investigators haven't fully understood whether their effectiveness is a function of the release of germicidal silver ions, some feature specific to their nanoparticle form, or both. Researchers at Rice University now report evidence that the release of dissolved silver ions is the driving force behind silver nanoparticles' germicidal action.*
>
> *Silver ions are powerful antimicrobials, but they are easily sequestered by chloride, phosphate, proteins, and other cellular components.[3] "Silver nanoparticles are less susceptible to being intercepted and a more effective delivery mechanism," says Pedro JJ Alvarez, Chairman of Rice's Civil and Environmental Engineering Department. The nanoparticle form is therefore used to ferry silver ions to bacteria they could not reach on their own, for example, by coating devices such as catheters."*[37]

36 "The Solubility Product Constant Ksp." http://www.horton.ednet.ns.ca/staff/richards/apchemistry/ap-notes/apeqkspnotes.pdf

37 Potera, Carol. "Understanding the Germicidal Effects of SilverNanoparticles." http://ehp.niehs.nih.gov/120-a386/

The same conclusion has been drawn by other researchers. Jung et al. report, "Nanoparticles are effective at delivering silver ions…but their nano nature does not appear to imbue them with additional antimicrobial properties."[38]

However, one can not exclude that the surface charge may not be responsible for some unknown interactions with bacteria. It will likely bring the bacteria within proximity of the nanoparticle surface, where the concentration of silver ions is higher.

It is widely accepted that silver ion release is an important mechanism in terms of AgNP toxicity. Other described mechanisms have not yet been convincingly proven. Among them are contact toxicity due to electrical or other attraction forces that create interactions between the silver nanoparticles and bacteria. The formation of free radicals or reactive oxygen species (ROS) has been proposed; however, is this ROS formation a cause or a consequence of the enzymatic blockage by silver?

Silver-Colloids.com contains a collection of public, scientific information about colloidal silver. One of the articles on this site[39] discusses how colloidal silver is produced. A circuit is made between a silver electrode and de-ionized water, which has no positive or negative electrical charge. An electric current is passed through this circuit, and that electricity causes silver nanoparticles and positive silver ions to detach from the silver electrode and move into the water. When the electric current is turned off, these particles and ions remain in the water.

As mention previously, silver content of colloidal silver is measured in parts per million (ppm). This figure describes the total concentration of silver in the liquid, the concentration of silver particles and positive silver ions. Generally, the total silver in these products is composed of 75 to 99 percent positive silver ions and the remainder of silver particles.

38 Jung, WK, et al. "Antibacterial Activity and Mechanism of Action of the Silver Ion in *Staphylococcus Aureus* and *Escherichia Coli.*" http://aem.asm.org/content/74/7/2171.short

39 Key, Frances S. and George Maass. "Ions, Atoms, and Charged Particles." http://www.silver-colloids.com/Papers/IonsAtoms&ChargedParticles.PDF

Research indicates that the silver ions are effective against microbes. When a person drinks colloidal silver, the silver ions move throughout the body and bind (attach) to parts of molecules, thiol groups. One place thiol groups are found is in the amino acid cysteine. Amino acids are the building blocks of genetic materials, DNA and RNA. They are also part of cofactors, helper molecules that assist the body in a variety of life-sustaining chemical reactions. Another group that utilizes thiol groups is enzymes, which can be thought of as the go-to guys that get things moving in the biological world. Enzymes catalyze (cause or increase the rate of) biochemical reactions, and without them, very little would happen within us.

As mentioned previously, it has been suggested that AgNPs may act as Trojan horses by entering the cells and then releasing silver ions that damage intracellular functions, but ions can damage the membrane too.

Silver attaches to the thiol groups that are essential for the wellbeing and survival of bacteria. Silver blocks the thiol groups from being able to participate further in chemical reactions, thus blocking the activity of many enzymes that are essential for bacterial survival. In many cases, silver interferes with bacteriological chemical reactions, preventing them from happening. In other instances, they change components of bacteriological substances, rendering them faulty or unstable. To date, much of the evidence supports the idea that the silver ion somehow enters the bacterial cell to disrupt their structure and their metabolism and finally kill them. A recent Italian study suggests that silver ions interact with proteins on the bacterial cell wall. This interaction creates cell membrane holes, enabling the cell cytoplasm (essential fluid inside the cell) to leak out. Ultimately, this results in cell death. In any event, whatever the mechanism of action, the end result is damage to microbes.

The therapeutic and toxic effects of silver can only be exhibited by free silver ions. Nevertheless, the threshold toxic values of silver must be interpreted with some caution, because the measured silver concentration may include both bound and free silver ions or nanoparticles.

Although the antimicrobial activity of silver is well known, little is known about the eukaryote detoxification mechanisms. The question is often raised: Why does silver not have similar cytotoxic effects on eukaryotic cells as compared to bacterial cells? Eukaryotic cells are usually larger, with a higher structural and functional redundancy as compared to prokaryotic cells; therefore, higher silver ion concentrations are required to achieve comparable toxic effects to those on bacterial cells. This difference provides a therapeutic window in which bacterial cells are successfully attacked.

Colloidal Silver Conclusion 8: Positively charged silver ions, slowly released from particles of a professionally made colloidal silver solution, can enter the body. Once inside, these ions are somehow able to interfere with the normal workings of microbes, bringing about their destruction.

Anti-Infective Activity of Colloidal Silver

This chapter specifically discusses the actions of colloidal silver. There are many claims out there, but not all are scientifically substantiated. Following is a selection of reliable research that illustrates the range of the known capabilities of colloidal silver. For more information on discerning reliable information and data, see the appendix of this book.

Antimicrobial Agent: Prevents Bacterial Growth

Research (*Spectrum of Antimicrobial Activity Associated with Ionic Colloidal Silver*, Volume: 19 Issue 3: March 20, 2013) carried out in the Department of Naturopathic Research at Southwest College of Naturopathic Medicine in Tempe, Arizona examined how effective colloidal silver is in eliminating bacteria, fungi, and viruses. The researchers grew several strains of each microbe, with and without the addition of colloidal silver. The results showed that the presence of colloidal silver inhibited (reduced) bacterial growth. In regard to the fungi, the effect of silver varied with the specific strain. The silver had no effect on viral growth.

Italian researchers investigated the effect of colloidal silver on biofilm-associated infections, bacterial strains that grow at the site of a medical implant and the main reason why such implants are not successful. As more and more people need and receive such implants, the health profession is interested in finding solutions to increase the success of these procedures. The Italian researchers found that implants with a nanosilver coating were significantly more effective in preventing biofilm infections.

Many patients require tissue-engineering scaffolds, medical devices that help the patient grow new skin. Examples include severe burns victims or patients with bedsores resistant to other healing methods. In order for this scaffolding to work, it must be antibacterial so the new tissue does not get infected from the get-go. A group of Hong Kong scientists

investigated whether or not the presence of nanosilver is helpful against such infections. They used a common scaffolding material, degradable (dissolvable) poly-L-lactide (PLLA). They added nanosilver (Ag) to it, then divided the resulting Ag/PLLA solution into several parts. To each of the parts, they added a common strain of bad bacteria: Escherichia coli (E. coli) to one and Staphylococcus aureus (Staph.) to another. The samples were then left to incubate. When checked, there were clearly marked no-grow zones in both samples. Those that did not contain silver exhibited bacterial growth as expected.

AgNPs have a good silver ion release ability, which makes them attractive for the development of antimicrobial biomaterials. In most cases, the size of silver particles was shown to be important.

There are several silver categories:

- metallic silver coatings
- silver-containing nanocomposites
- silver-containing polymers
- surface modification with ionic silver compounds
- hybrid silver materials

Silver has been intensively studied over recent decades for the prevention and treatment of infections on burns, prostheses, catheters, vascular grafts, surgical instruments, and dental devices. One special advantage of using silver-containing materials to coat biomaterials, besides its biocompatibility and antimicrobial activity, is that they may protect both the inner and outer surfaces of the device and its proximity; the coating does not always need to cover the whole implant surface in order to protect an implant from a possible infection.

Some studies suggest that materials containing silver ions or AgNPs have better antimicrobial activity than metallic silver coatings. This is likely true, due to a higher rate of silver ions delivered from the nanoparticles.

In some studies, bacterial growth was regenerated after three or four days. Two possible reasons for this are that the device may have contained only a little silver, as compared to the specifications. It was likely that the particles were too large, about 500nm in diameter, for efficient silver ion release, or else some were buried too deep to be accessible.

Textiles and fabrics are recognized as an ideal medium for microbial development. Silver nanoparticles are recognized as a smart component to use in fabrics such as polyester or cotton. Research suggests that embedding silver within fabrics and polymers can impregnate and stabilize the AgNPs so they can retain their antimicrobial activity for a longer time and, thus, prevent further microbial development. This application is of great interest for the fabrication of antimicrobial bandages or silver-impregnated clothing. Biodegradable coatings or impregnation methods may also be valuable in a controlled release of antimicrobial silver ions.

It has also been demonstrated that silver treatment of stainless steel surfaces can be accomplished through a process called double-glow plasma alloying technology, producing a beneficial stainless steel antibacterial material. This process results in a harder stainless steel, one with improved wear and tear resistance. The material can also be highly beneficial for load-bearing implants that are prone to surface damage.

Silver supports wound healing by maintaining a germ-free area in a moist, wound-healing environment. Silver dressings are frequently used with much success. Silver products, like silver nitrate, silver sulfadiazine [(4-aminophenyl) sulfonyl] (pyrimidin-2-yl)-azanide) are widely used as antimicrobial agents today.

Destroyer of Multidrug-Resistant Bacteria

More and more antibiotic-resistant microbes are developing. Since antibiotics are the current weapon of choice to treat bacterial infections, this is quite worrying. Thus, much interest has been focused on colloidal silver as a viable alternative.

An article in *The International Journal of Microbiological Research* appears to support the use of colloidal silver in this area. The study, carried out in Egypt, showed that nanosilver had a significant bactericidal (bacteria-killing) effect on E. coli, Staph., Salmonella typhi (S. typhi), and Pseudomonas aeruginosa (P. aeruginosa), some of the more harmful strains around today. Also, nanosilver was found to be highly effective against multidrug-resistant, Gram-positive and -negative bacterial strains.

Colloidal Silver Conclusion 9: Colloidal silver functions both an as antimicrobial agent (preventing growth) and as an effective bactericide (killer of bacteria), an alternative to antibiotics in cases of drug-resistant bacteria.

Nanosilver: Virus Vanquisher

Scientific research showing that silver can overcome viruses is more than thirty years old. Study after study found that the presence of silver stopped a wide variety of viruses in their tracks, interfering with the virus replication process; thus, without opportunity to grow, the viruses could not infect the host.

An article published in the September 1992 issue of *Pharmaceutical Chemistry Journal* reported that colloidal silver was effective against the smallpox virus. Depending on the concentration of nanosilver, smallpox particles were reduced by either 700 times (the weaker concentration) or 11,000 times (the stronger concentration).

A 2005 study reported in *The Journal of Nanotechnology* even more firmly established the power of nanosilver against viruses. Researchers from universities in Texas and Mexico cooperated to conduct the experiments, which Phys.org described as the first study of its kind.

Capped nanosilver particles within the range of 1 to 10nm were created. Capping mediums were one of three: foamy carbon, poly (PVP), and bovine serum albumin (BSA). Capping is used to keep the nanoparticles from aggregating (clumping) so they remain their original size. The actual size of the nanoparticles depended on the capping method

used. HIV-1, the virus that causes AIDS, was placed in containers, and the various amounts of capped nanosilver particles were added to each container. The containers were kept at 98.6°F (internal body temperature), and observations began. Within three hours, the virus was destroyed, regardless of the capping methods. Researchers theorize that the nanosilver particles bonded with the virus glycprotein knobs. As mentioned above, this bonding stifled the virus from reproducing, thus causing its death. These results show that as long as they are capped, nanoparticles in the 1 to 10nm size range are effective against HIV-1.

Even the government has recognized the truth about colloidal silver and viruses. The EPA is just beginning to realize the antiviral properties of silver, as is evident by the availability of a liquid spray disinfectant that consists of 30ppm silver. This spray is EPA-approved for businesses and industry, including educational facilities such as daycare centers, schools, and gyms. What's especially interesting is the stated effectiveness: Garden variety (regular) bacteria are killed in thirty seconds with a residual kill time of twenty-four hours. Residual kill time is essentially how long the product remains active on the surface. Therefore, for up to twenty-four hours after application, the disinfectant spray will continue to kill bacteria that reach the sprayed surface. For tougher bacterial strains such as MRSA (Methicillin Resistant Staph Aureus) and VRE (Vancomycin Resistant Enterococcus), the kill time is two minutes. In regard to HIV-1, the kill time is thirty seconds.

New viruses are constantly emerging, and one such group is coronaviruses, so named because the viruses resemble halos when viewed through an electron microscope. In 2002, severe acute respiratory syndrome (SARS), a coronavirus, was a major global concern. SARS spreads rapidly, places great strain on the respiratory system, and can be fatal. Although things have calmed down considerably on the SARS front and no new cases have been reported since 2004, the next frightening and potentially fatal coronavirus is always waiting in the wings. At the moment, Middle East respiratory syndrome coronavirus (MERS-CoV) is a major concern. The virus first appeared in 2012. There were cases in 2013, and new

cases continue to be reported in 2014. Research has found that this virus spreads by landing on surfaces and waiting for victims to make contact. For example, a lunch counter infected with a coronavirus is touched by people picking up their food. The virus is transmitted internally when the hands then place food in the mouth, scratch the nose, etc.

To combat coronaviruses and future generations of unknown contact viruses, industry and medicine are combining to produce a range of surface coatings, be they plastic or paint. Regardless of the form, the common factor is the inclusion of nanosilver. When these mixtures make contact with humans, through touch, for example, the embedded nanosilver emits silver ions. These ions destroy any virus that lands on the surface, and some even enter the human body and work there.

There is an impressive 2010 US Government sponsored study performed through a division of US Army where they showed great activity in vitro against Arenaviruses, the Tacaribe virus family. There is a possibility this testing was performed as part of an initial search done for an antiviral agent, like an "antidote" or protection for the US Army. This study is as close to showing effectiveness against hemorrhagic viruses and Ebola type viruses as possible without endangering the lives of the researchers. This study showed great effectiveness of coated and non-coated nanoparticles against those viruses. The effective concentration was about 50 ppm and it took hours or about a day to destroy the virus. The study is listed on the reference list at the end of the book however if one googles "nanoparticles" and "Tacaribe" it will show on top of the search.

The coated silver used in this US Government sponsored study is the same colloidal silver you will find in Appendix 2 as a recommended product for antibacterial applications.

There are studies showing great response from silver in HIV-1. One example is of this effectiveness the study titled *Interaction of silver nanoparticles* with HIV-1; Jose Luis Elechiguerra, Justin L Burt, Jose R; *Journal of Nanobiotechnology* 2005, 3:6.

As time passes, more and more studies pit colloidal silver against other viruses. The results consistently come back in favor of the nanosilver. Some healthcare professionals take a strong stand for colloidal silver. Despite the lack of government backing, they recommend nanosilver as a remedy for swine flu (or any other flu) and as a weapon against the predicted viral pandemics that we may face in the not-so-distant future.

Nanosilver: Fungus Fighter

To succeed in commercial farming, many challenges must be overcome. One of these is fungi. In the past, chemical mixtures have proven effective in combating them, but they are not environmentally friendly. Commercial growers are very aware of the need to go green in order to help preserve soil, air, and water quality.

One study that experimented with a nanosilver solution concerned white rot, which affects green onions, otherwise known as scallions, a popular eating and cooking vegetable that originated in western China. Green onions are susceptible to a number of diseases, and a field infected with white rot can damage crops for up to four years. The white rot pathogen lurks in the soil in a dormant form and awakens when new green onions are planted. Unfortunately, the chemicals currently used to prevent white rot are harmful to humans, animals, and various microorganisms.

A study published in *Mycobiology* in 2010 used three types of nanosilver liquid in various concentrations. A simplified summary of the results is as follows:

- In the lab, nanosilver liquid, at all concentrations used, was at least 80 percent effective in preventing further white rot growth on infected green onions. In some concentrations, its effectiveness rose to over 90 percent.

- In the field, green onions treated with nanosilver liquid were heavier than those that were not treated or were in the control group. This ensures a larger overall crop yield.

- In the field, soil samples from the area around treated green onion plants were taken. The data shows that the nanosilver did not reduce the number of beneficial soil microbes. Also, after a period of two months, there were no significant differences between the soil around treated onions and the soil around untreated onions.

Overall, this study shows that colloidal silver is an effective treatment for white rot fungus. It prevents growth on live plants, stops the fungus from lying dormant in the soil, and does not harm good soil bacteria. The researchers suggest that agriculturists should consider using nanosilver liquid to treat all general crop fungal infections.

Another study investigating colloidal silver as a greener approach to fungi took place in Poland. It was reported in the journal *Acta Biochimica Polonica* in 2013. The rationale for the research was the issue of asepsis, the absence of harmful bacteria, viruses, or other microorganisms. In certain conditions, maintaining asepsis is vital but highly problematic. One example is high-rise buildings, where some areas cannot be cleaned. These sites are breeding grounds for a whole host of toxic microorganisms. One effect of their presence is peeling paint. Another is mold and mycotoxins that cause allergies.

The Polish researchers began by creating a raspberry extract. They combined raspberries and water, heated the mixture, then filtered out the solid particles. Then they prepared the nanosilver and combined it with the raspberry extract. This final nanosilver-raspberry solution was added to a culture medium containing one of two fungi: Cladosporium cladosporoides (ATCC16022) or Aspergillus niger ATCC16404 (A. niger). The results indicate that the nanosilver-raspberry solution was significantly effective in treating both fungi, even the A. niger, which is particularly resistant to treatment. The researchers conclude with the suggestion that nanosilver be added to construction materials. They feel such an addition will keep structures cleaner, reduce the growth of harmful microbes, and help to maintain the mechanical properties of all constructed elements.

How about Parasites?

There is credible evidence substantiated by well performed studies that silver may be indeed effective against parasites and protozoa like Giardia Lamblia and Toxoplasmosis and also could be effective against at least some forms of helminthes. More studies could be more convincing in this direction however the existing ones can establish at least a serious base of credibility regarding silver activity in the more complex parasite organisms.

Effective Dosage Guidelines

It is essential that we make this absolutely, positively, perfectly clear: There are no set dosages for silver ingestion. For your safety, do not ingest any amount without taking all the important factors into consideration. These include the condition being treated, your age and weight, the half-life of the silver, and how much time is available to build an effective concentration in the body. As discussed in the toxicity chapter, The Safe Silver Organization has a calculation tool on their website. This chapter will discuss further dosage guidelines.

While studies are not yet conclusive, the majority of research appears to show that a concentration of 1 to 3ppm is suitable and sufficient for use as an antibacterial concentration. In a number of cases, a lower concentration is recommended. For example, a concentration of 0.06ppm is considered sufficient for water treatments of high volumes, like the purification of water at the general municipal level.

It should be understood that these recommended ppm concentrations apply to the body and not to the description on the commercial colloidal silver product. By definition, 1ppm of silver is the concentration that occurs when 1mg of silver is placed in 1 liter of water (0.03oz of silver into 1.06 quarts of water). Since the human body has much more fluid in it, one would need to drink a higher quantity than 0.03oz of silver to achieve a bodily concentration of 1ppm. How much? Again, this depends on a variety of factors, some of which are mentioned above. The human body contains about five liters of blood, as well as greater amounts of other fluids. In fact, we are comprised of about 70 percent fluids.

In general, the patient receives a daily dose of silver for a short or longer term. The goal is to take into account all the above factors, including absorption rate, until an equilibrium is achieved. The amount ingested should ultimately equal the amount eliminated.

A person of average weight contains about 5.28 quarts of blood. In order to achieve a 3ppm concentration in such a quantity of fluid, assuming 100 percent absorption, about 75mg (0.002oz) would need to be taken on a daily basis. Adjustments to this average are made on a patient-by-patient basis.

Another important consideration is whether or not the colloidal silver treatments are curative or preventative. Curative (treatment) ppm levels can be as much as eighteen to twenty-eight times higher than preventative ppm levels. More easily cured infections (flu, skin infections, bronchitis, urinary tract, etc.) require about a fifteen to eighteen times higher concentration, a range of 1.3 to 1.5gm (0.045 to 0.052oz) for a week or two. More resistant infections (tuberculosis, malaria, HIV) tend to need higher ranges of concentrations, perhaps even twenty-eight times the base. This translates to about 2gm (0.0706oz) for a period of seven days or more.

Colloidal Silver Conclusion 10: There are no standard dosages for colloidal silver. The amount to take depends on various factors relating to the person, the purpose, etc. As a result, one needs to use discretion and seek competent professional advice.

Misconceptions and Misunderstandings About Colloidal Silver

The information in this chapter is one major reason we decided to write this book. There much speculation and pure nonsense being spread around, so much so that it is staggering. As such, in attempting to sift through all of it, we could not find even a single source of information about silver antibacterial effects that would entirely and fully comprehend the totality of the antibacterial phenomenon.

Even sources that have most information correct do contain some tidbits of misinformation. An article may be 90 percent correct, but there is a good chance that 10 percent of the information is incorrect, thus distorting, muddling, and confusing the reliable information.

Misconceptions and misunderstandings are common. The Internet hosts thousands of websites and blogs that promote all sorts of debatable or even dubious information. It may be truncated, lack elementary logic, or be misleading at best and fraudulent at worst. This misinformation is often presented or supported by individuals and even so-called chemists or doctors who have no deep knowledge of chemical laws, especially as they apply to ions or nanoparticles.

For example, it has been said that nanoparticle surface area is what gives silver its antibacterial properties. Nothing could be further from the truth! It is very unlikely, if not impossible, for tiny particles that are very reactive, as these authors say, to look around for bacteria in the deepest corners of an organism and not be neutralized, especially on such a reactive surface. The fact is that the surface charge of the silver particle has nothing to do with antimicrobial activity, as the misinformed websites would have us believe. The surface charge is strictly due to selective absorption of other ions from the surrounding medium to the metal surface.

The charge of the silver ions is very relevant, as it allows it to interact and bind with specific vital sites in the bacteria; however, this is a chemical reaction.

Nanoparticle surface area has nothing directly to do with antimicrobial activity. There is likely a higher ion concentration emitted by a higher surface area, but the lower ion concentration is more than enough by several orders of magnitude. In the end, there is no real difference. Surface area can only be considered if there is a solid phase (particle). Active antimicrobials are silver ions that are not a solid phase. Their provenience is from the solubilization of Ag nanoparticles in different biological fluids with complex composition or the dissolution or dissociation of other solid particles of compounds/complexes like silver chloride in the biological fluids.

Some websites affirm that silver ions are neutralized in the stomach by the excess chloride that exists in hydrochloric acid, turning the resulting salt into an insoluble complex. Yes, silver ions do interact with the chloride and forms the silver chloride, however, silver chloride (AgCl) salt dissolves further in the presence of excess chloride ions and forms a new soluble complex [AgCl] with two to three chloride ions. This is extensively dealt with in well-researched literature. Someone who is unaware of this and speaks about silver ions is likely to speak outside the realm of scientific fact.

In addition, in the absence of excess chloride, other species (like amines and carboxylic acids) may dissolve the AgCl and form soluble complexes. These complexes are partially dissociated and release Ag ions in the surrounding medium, which attack the bacteria.

There are many other misconceptions out there as well, and these are worth examining. As the old adage states, it is wise to be aware of the counterfeits in order to know the genuine. There are many misconceptions about what silver can and cannot do.

Misconception: *Colloidal silver causes cancer.*

There is no statistically significant scientific evidence that links the ingestion of colloidal silver with an increased risk of cancer. In fact, some evidence to the contrary was presented in an article for pet

lovers, "Natural Anti-Cancer Protocol for Dogs and Other Animals," by researcher Tony Isaacs. The article commends colloidal silver for its curative effects on fatty tissue cancers in pets. The article also suggests silver as a treatment for and preventative against parvovirus. Colloidal silver also shows some effectiveness in treating pet joint problems such as arthritis. Perhaps future studies will show this effectiveness in humans too. In fact there are some studies showing that silver is effective against cancer. One example of a study showing "antiproliferative" (read anti-cancer) effectiveness is the one named Anti-proliferative activity of silver nanoparticles; PV AshaRani, M Prakash Hande* and Suresh Valiyaveettil; BMC Cell Biology 2009, 10:65

Misconception: *Nanosilver damages the environment.*

The overall answer is that this is simply not true, and here's why: In theory, if an enormously, vast amount of nanosilver particles were simultaneously dumped on every ton of soil all over the world (such as 28.5 quarts per ton of soil), there could possibly be some environmental damage, albeit not much. What really happens is that the infinitesimal amount of nanosilver that does makes its way into the environment quickly aggregates (clumps), and these larger pieces of silver metal do not harm the environment.

Misconception: *Colloidal silver can improve or strengthen the immune system.*

Like all antibiotic treatments, colloidal silver is not capable of much influence on the immune system. Any immune system boost is minimal at best.

In addition, just like all other antibiotic treatments, silver can affect the amount of good bacteria inside the body, such as in the gut, but the reduction is not substantial. Most ionic silver interacts with stomach acid and is absorbed as silver chloride, and colloidal silver is so small that it passively diffuses or is absorbed quickly, far before it reaches the beneficial bacteria situated much lower in the intestinal tract. Nevertheless, it is recommended that those partaking of colloidal silver treatments pay close attention to proper nutrition.

It is worthy to note, also, that some recent research indicates that silver nanoparticles may boost TLRs, which are involved with the human immune system; however, much more research needs to be done before conclusive results can be determined.

Misconception: *All bacteria can be killed by colloidal silver.*

At the moment, not every bacteria has been studied, and new strains come into existence every day. What can be said is that colloidal silver has proven effective against a wide range of common bacteria.

Resistance to silver, while possible, is very difficult and requires many mutations within the cells. Many bacteria have not been able to survive in the presence of silver for long periods of time. Some, however, can survive and even manufacture silver nanoparticles out of a ionic environment; these are generally resistant to silver toxicity, as they have developed a mechanism to cope and safely deal with silver ions.

Surprisingly (or maybe not) bacteria that can cope well and even manufacture silver nanoparticles are the same as those found in the lower digestive tract. Some of these beneficial bacteria and fungi are: Aspergillus fumigatus, Penicillium species, Bacillus sp., Brevibacterium casei, Corynebacterium, L. fermentum, Enterococcus faecium, Lactococcus, Lactobacillus, Streptomyces hygroscopicus, E. coli, A. niger, and Enterobacter.

The bacterial development of silver resistance consists mainly of two mechanisms: the accumulation and storage of silver (generally redox chemistry); and the active efflux pump, which sends the silver ions out of the cell.

Misconception: *Colloidal silver is harmful to the human body.*

Anything can be harmful to the human body if it is taken in a high enough quantity. Intelligent moderation is often the key to safety. Previous chapters in this book have discussed reliable research that shows that

professionally made colloidal silver taken in appropriate quantities does not harm the liver, the kidneys, or the nervous system, nor has there been a body of significant evidence to show damage to the body in general. The rare cases of argyria, while perhaps visually unsightly, have no other negative effect.

In vitro studies of spherical silver nanoparticles showed no harm to cells if their sizes were kept between 10 and 30nm. Asymmetric and angled nanoparticles (triangles or star-shaped) may become locally harmful for many different reasons.

Misconception: *Since colloidal silver is harmful to bacterial cells, it must also be harmful to human cells.*

Available studies indicate that colloidal silver is not harmful to human cells, even though it is harmful to many bacterial ones. It appears that the human body has a different metabolism, different enzymes, and uses thiol groups differently. Also, the human body has several ways of neutralizing and eliminating silver particles and ions once they have done their job. One way is to place the silver ions into biological containers. Another is to bind them to certain biological fibers that render the silver ions virtually ineffective and inactive.

Misconception: *The information on colloidal silver is presented in a scientific way, by what appear to be reputable sources, so it must be true.*

As is the case with any information supplied for advertising purposes, *caveat emptor*! (Let the buyer beware!) Here are a few of the favorite ploys currently in use:

Advertising Claim: *"Smallest particle size on the market!"*

Hype about particle size is already misleading. As we have discussed, reliable research shows that a range of nanosizes works equally well. Particles that are too small are unstable. For example, one site advertises that their particles are 0.8nm. Not only can these clog membrane pores

and channels, but they are also not stable in the solution, and they tend to chemically react with impurities and clump together. Given that the diameter of a silver atom is about 0.3nm, these nanosilver particles are comprised of 10 to 20 atoms. Such particles, even if theoretically possible, would be highly chemically unstable, not at all the size we should want moving about inside our bodies. Stable particles are those above 5nm.

Too large is also undesirable, as the particles may lose their ability to slide between cells without becoming trapped. As was discussed previously, the best size for the human body are from 10 to 30nm. Many researchers and health professionals feel 10nm is a great all-purpose particle size.

Advertising Claim: *"The clarity of our liquid shows its purity."*

Any information that makes a connection between colorless, clear liquid and high-quality colloidal silver is inaccurate; in fact, it is the utter opposite of the truth. In professionally prepared colloidal silver, the darker the liquid, the more concentrated the product. In other words, there is more colloidal silver in each drop of a darker liquid. For example, one of the professional products on the market is extremely concentrated at 25,000ppm. As a result, the mixture is extremely dark, because light is absorbed by the particles in the liquid. Colorless liquids marketed as colloidal silver are mostly silver nitrate, a silver salt and not colloidal silver in any way, shape, or form.

Advertising Claim: *"Our products have been endorsed by Drs. X and Y, leading health professionals."*

Are Drs. X and Y really leading health professionals? Don't take anyone's word for it, as your health can depend on it. Today, it is easy enough to Google someone to find information about them. If the so-called doctor is truly a leader in his or her field, they will likely appear often in online searches, on various sites. You should find articles, their own website, or stories about them attending or presenting at conferences. You may even be able to find their CV/résumé. If you find no mention of the alleged doctor or expert anywhere else online, they may not be reliable,

if they even exist at all. Moreover, if the website you are reading makes false claims about their experts, they are likely making false claims about their products as well. In general, is it advisable to independently check as much information as you can. You may be surprised at just how much you can verify or not by simply searching the Internet.

The size of silver nanoparticles can be analyzed with appropriate instruments and will give a spike on a resonant frequency. Even if a doctor endorses the product, it is a chemist who typically produces it. Low-quality products are made by low-quality chemists, and high-tech products of exceptional quality are rare almost unheard of.

Misconception: *Since glass bottles are classier than plastic ones, the products in them must be of a higher quality.*

In the packaging world, glass is often used to maintain product stability. Items that are in no danger of becoming unstable are most often packaged in polyethylene terephthalate (PET) plastic, a type of polyester. Many fruit juices, bottled water, and soft drinks are packaged in PET. In fact, the highest number of beverage bottles manufactured globally are PET.

True colloidal silver does not require any help from its packaging to remain stable. As a result, many products are stored and shipped in PET bottles.

Ionic silver solutions and other mixtures masquerading as colloidal silver are often unstable in the presence of visible light, which will cause the photosensitive products to deteriorate, sometimes rather quickly. Amber-colored glass are used to shield such photosensitive products from visible light, thereby increasing their shelf life. Thus, products stored and shipped in amber bottles tend to be of the lowest quality.

Advertising Claim: *"Our product has Angstrom (subnano) size colloidal silver".*

They are not real colloids. They are likely solutions of silver salts, or ionic silver. One Angstrom is 0.1 nm, a tenth of a nanometer. Angstrom size

particles mean less than 1 nm. The probability of someone producing stable angstrom size silver particles is slim to none, almost impossible. This performance would be at the frontiers of heavily scrutinized peer review science and would bring attention from the scientific world quickly. If someone would prove the existence of stable subnano silver particles they will certainly try to publish their important experiments in prestigious peer review scientific articles and will be recognized in their scientific field as a major contributor. For someone to claim it on the internet without any proof is stretching the believability factor to say the least.

A silver atom has a diameter of 2.9 Angstroms or 0.29 nm, roughly a third of a nanometer. In order for silver particles to have sizes less than 1 nm (~ 3 atomic diameters), they would have to be clusters of silver atoms containing between 4 and 15 atoms. Such small clusters of a few silver atoms are way too unstable due to their high energy.

There are just a few reports published of such silver clusters published (for example by A. Henglein in Berichte der Bunsengesellschaft für physikalische Chemie 05/2010; 94(5):600 - 603. DOI: 10.1002/bbpc.19900940513). They are usually produced in very restrictive and difficult experimental condition (intense radioactive excitation in exotic closed reactors for example). Even then those particles cannot be seen, their presence being detected based on specific absorption bands at 360-390.

The lower the number of silver atoms in a particle the higher their energy is and their potential to interact with another or with the environment is increased by orders of magnitude. At such low numbers of atoms in a particle, the said particles cannot and are not stable due to their high potential energy. They behave more like a fluid cluster stealing atoms from each other and constantly changing their size and shape in attempt to lower their energy.

Only when the particles reach several hundreds and ideally thousands of silver atoms they become stable in time dispersed in water. When this happens the particles are typically above 5 nm in size.

There are two accepted methodologies to prove the existence of dispersed silver nanoparticles. One is by showing the plasmon resonance spike by spectrometry. The other is direct visualization. With all the advances of science there is no current direct visualization instrument capable to effectively observe Angstrom size particles at this time.

Direct visualization usually is achieved by using the scanning electron microscope (SEM) but SEM cannot visualize particles less than 1 nm as the resolution of the method is typically above 1.0 nm. More sensitive is the Transmission Electron Microscope (TEM). Very good (and very expensive) TEM instruments have typically a resolution of ~0.7 nm, or 7 Angstroms. Claiming that one can really detect objects of a size similar to the limit of the instrument resolution (7 Angstrom resolution and 7 Angstrom particles or less) is like saying that is easy or even possible for you to see in detail a nonfunctioning pixel on a TV or computer from a distance. It is simply not credible.

Additionally, if someone wants to visualize Angstrom-size particles using TEM they absolutely need to deposit the particles on a conductive substrate. That alone can cause false images when the high energy electron pass through both particles and substrate. Basically at 1 nm resolution one does not know if they see the particles in question or they see substrate structures/artifacts.

So, since direct visualization is out of question the only other way for the "scientists" on the internet to claim "Angstrom "-size is to show a clear, well-defined plasmon resonance bands below 380 nm.

Since they are not providing any of the above type of scientific evidence, we conclude that their claims to Angstrom sized silver particles are nothing but bogus made by "scientists" that have little understanding of real science.

Commercial Names

Many products claiming to be colloidal silver or angstrom silver or angstrom-sized silver particle colloids are, in fact, mostly ionic silver solutions. Despite this, their labels and advertising never mention ionic silver or specify the total percentage of silver in their product, silver ions versus silver particles. Many different terms are using to describe ionic silver products, in an attempt to obfuscate the truth: monatomic silver, silver hydrosol, covalent silver, and silver water.

Monatomic silver is another advertising term commonly used to describe ionic silver solutions. Claims for monatomic silver products describe their particles as single atoms of silver. Single atom particles cannot exist due to van der Waal's force of mutual attraction, which would cause single atoms to be drawn to each other to form particles consisting of clusters of atoms.

Silver hydrosol is yet another term being used to sell ionic silver products. The definition of hydrosol is a colloidal suspension in water. Therefore, silver hydrosol describes colloidal silver. However, products advertised in this way are actually ads for ionic silver products that are typically 95 percent ionic silver.

Covalent silver is the latest entry in the ionic name game. When you read the detailed description for covalent silver, you will find that the term refers to silver ions.

Misleading Information

Some ionic silver describe their properties in terms of silver particles, attempting to confuse the reader into believing in the existence of ionic silver particles. There is no such thing! There are metallic silver particles (nanoparticles) and silver ions, but ionic silver particles do not exist, and the distinction is crucially important. The product that uses this terminology on its label is mostly ionic silver, not silver particles. In fact,

most of these products only contain an average of 1 to 10 percent of their silver content in the form of silver particles, with the majority of 80 to 99 percent in the form of ionic silver.

Ionic Silver Bioavailability

Promotional claims made for ionic silver products describe it as having high bioavailability, but nothing could be further from the truth. *The Merck Manual* makes it clear that *bioavailability* is the "amount of unchanged drug that reaches the systemic circulation." To be bioavailable the substance being ingested must attain systemic circulation unchanged in form. Because silver ions are highly reactive, they quickly form compounds in the body and, therefore, cannot remain unchanged. While it is the highly reactive nature of silver ions that provides its antimicrobial properties, it also causes the rapid formation of compounds and prevents the continued existence of silver ions inside the human body. Because silver ions cannot exist inside the human body, bioavailability is virtually nonexistent. Silver compounds such as silver chloride in the bloodstream provide no meaningful antimicrobial properties.

Van der Waal's force of mutual attraction prevents the existence of colloids with single-atom particles. The probability of the existence of monatomic colloids is virtually zero. This statement applies to the claims for monatomic colloids of other metals as well, such as gold, copper, zinc, platinum, palladium, rhodium, etc.

Another Name for Ionic Silver

Without exception, laboratory analysis of products claiming to be monatomic colloids have shown that they are, in fact, ionic solutions. Products claiming to be monatomic colloidal silver are ionic silver solutions, just as products claiming to be monatomic colloidal gold are ionic gold solutions and so forth.

Because hundreds of ionic silver products are on the market, how does one distinguish them? In the business of colloidal silver, the answer seems

to be the use of terms that are not really technical or scientific at all but sound like it to the average consumer. Monatomic colloidal silver is one such a term. It is typically explained in impressive detail on websites that promote monatomic silver products, but it is really just a marketing term used to hide the truth: What is being sold is an ionic silver solution, just like hundreds of others.

Virtually all ads for monatomic colloidal silver describe the product as being as clear as water. This is one of the distinguishing characteristics of ionic (salt-derived) silver.

The Reality of Monatomic Silver

Monatomic silver cannot actually exist for the reasons described above. Products advertised as monatomic colloidal silver are actually ionic silver solutions. Not all, but many such products have also been found to contain fairly high concentrations of NO3, which means they contain either nitric acid or nitrates. High concentrations of NO3 are present in some products as a byproduct of the method used to produce them. Neither nitric acid or nitrates should be ingested or applied topically. As far as we can tell, the only reason products claim to be monatomic is to avoid the truth that the products are ionic solutions and not colloids at all. In other words, it is marketing hype, designed to mislead the buying public

How To Compare Colloidal Silver Products

Because there is no accepted standard for reporting the contents of colloidal silver products, producers report the properties of their products in various ways.

You cannot compare ionic silver with colloidal. When comparing colloidal silver within its category, it is best to consider particle size, uniformity, stability, coating, and particle concentration. These properties are verifiable with accurate instruments.

The abnormal practice is to report total silver and nothing else. One problem with this is that it lumps silver particles and ions together in a single value, and this is entirely misleading.

Particle Concentration

The metal concentration in ppm expresses the weight of the metal versus the weight of the liquid in which it is suspended. Particle concentration can be a very confusing measurement when comparing colloidal silver products, because colloids with very large particles can have a high concentration of metal (ppm) but a very low particle surface area.

Some websites claim that concentration (ppm) by itself does not determine colloidal effectiveness and that only the particle surface area does. However that is not the truth. When one is talking about catalytic or chemical effectiveness the surface area of the particles is important indeed. However, antimicrobial effectiveness is granted via the slow, gentle release of silver ions from a particle core, not by the surface area.

Colloidal silver effectiveness is not, in any meaningful way, dependent on particle surface size. A higher surface size will likely release more silver ions in solution; however, this is rather insignificant, as even a few ions released by lower surface particles are, by far, more than enough for antimicrobial properties.

Silver ions are not particles of metallic silver. Silver particles consist of several silver atoms clustered together and have the physical properties of metallic silver. Silver ions do not have the physical properties of metallic silver. A silver ion is a single atom of silver that is missing one orbital electron. Since the outermost orbital electrons of atoms determine the physical properties of matter, the missing electron causes dramatic changes in the physical properties. For example, metallic silver is not water soluble, but silver ions are and cannot exist without water or some other solvent. Because the physical properties of silver particles and ions are so dramatically different, the terms cannot be used interchangeably.

What most silver experts miss is that there is a constant release of occasional ions from a particle made of thousands of silver atoms. Thus, only one atom in a few thousand becomes an ion and is released from the particle, a type of shedding.

Colloids are silver particles in suspension, not silver ions in solution. To make a true colloid is a complicated, complex, costly process. It is no mystery why most producers choose to make ionic silver instead and simply call it colloidal silver. Thankfully, more consumers are educating themselves about this deception, as well as all of the misleading information out there, and more and more are learning this simple test: If it looks like water, it is ionic silver, not a true silver colloid.

Colloidal Silver Conclusion 11: Colloidal silver is not Superman, nor is it the ultimate bad guy. By learning the scientific facts, an accurate picture of its true abilities can be constructed.

Choosing the Best Anti-Infective Colloidal Silver

Every colloidal silver seller claims to offer the best product, but obviously, this cannot be the case. How can we judge which product is worth our time and money?

To reach an informed opinion, we must take into account the characteristics or properties of the colloidal silver product on offer. Here are some more significant points to consider.

Do It Yourself or Professionally Made?

A number of websites play up the cost factor to convince you to make your own colloidal silver. The other question is: What price value do you put on your good health?

Everyone can make colloidal silver at home. You don't need a fancy machine to do it. Connecting silver wires to a battery and placing these wires in a glass of water is a cheap and cheerful way. No matter which DIY method you use, the end product is extremely unreliable. One reason is that such homemade silver particles have an unprotected surface. They tend to clump together and will settle at the bottom of the glass. The human body cannot safely handle these large silver clumps. For the same reason, homemade silver rapidly becomes oxidized (combines with oxygen). Silver oxide creates a plethora of other health problems that will not be discussed in detail here. Lastly, there is no reliable measure of the concentration of silver ions present in the mixture. As we have discussed, it is vital to know the concentration so the correct dosage can be taken.

To avoid danger, it is highly recommended to buy professionally made colloidal silver products, with all of the previous cautions in mind. Just as with all other products, from sports shoes to food processors to ice cream, not every professionally made product is of the same quality. Some helpful questions to ask are:

- What is the concentration? A higher concentration means less product needs to be taken for each dose. This can lead to a significant savings in overall cost.

- Which functions can the product perform? The product should provide antibacterial, antiviral, and antifungal benefits.
- Who are the professionals involved? Websites, merely the middlemen, may not know much about the product they are selling, even if it is supposedly professionally made. Choose a product whose makers are on the website, health professionals who know what they are talking about.

In any form?

Definitely not! The only form to purchase is nanoparticles, and you will be aware of this by the mention of colloids.

First, no matter how they are dressed up, there are only two forms: salts and particles. Ignore labels with fancy names, such as silver hydrosols or any other so-called NASA-recommended form.

Also, don't be fooled by the mention of ionic silver. Both silver particles and salts have and release silver ions. Particles release them slowly and gently, while salts release them like a flood. Slow release and low concentration is several orders of magnitude more than enough for their effect, so it is not advisable or necessary to flood the body.

Second, only the particles are truly colloidal. As explained previously, colloidal silver means silver nanoparticles suspended in liquid, most often water. Silver salts, also known as silver nitrates, will dissolve in liquid, and they do not function the same way.

Labels can be misleading, but here are two tips to help you sleuth out what is being marketed:

- Colloidal silver has a pale yellow to dark brown color. Silver salts will have no color, as they are totally transparent.
- When a laser light is cast through colloidal silver, a clear line is produced. Shining a laser light through dissolved silver salts produces no line. Some gels may have some low amount of

particles and may be close to transparent. Even an inexpensive laser pointer will work for this test.

- Adding table salt to silver salts with result in a cloudy, silver chloride precipitate (substance) that will settle to the bottom of the glass or container. In the same way, silver salts that you drink will settle in your stomach. Adding some table salt to colloidal silver will not cause such a reaction.

What's wrong with silver salts?

Nothing is wrong with silver salts, typically silver nitrates, and they are the form of choice in many situations. However, they are not appropriate in any situations requiring colloidal silver.

It may be useful to think of the situation in terms of Aesop's fable, "The Tortoise and the Hare." The hare raced around, using up energy and foolishly tiring himself out before reaching the end. On the other hand, the slowly plodding tortoise kept steadily on to reach his goal. While the case is not exactly the same, one can think of silver salts as hares. In their silver nitrate form, they race around, releasing too many silver ions, a bit of overkill. This excess of silver ions is not necessary for the job, and it is difficult for the body to safely eliminate it. Like speedy hares, silver salts are also very difficult to control. As a result, it is very hard to create the correct concentrations, enough to eliminate the bacteria while low enough to keep the body safe.

Since salts dissolve in the body almost immediately, silver nitrate does not stay in this form; rather, it separates into silver and nitrate ions. The hydrochloric acid in the stomach comes into play, and silver chloride is formed. This form of silver is not an efficient antibacterial. In addition, silver from silver salts can attach to chemical compounds in the body. If it weasels its way into proteins, for example, it can change their structure and bind to amino acids, thus damaging DNA.

The body does not successfully eliminate silver salts, so they remain in the tissues much longer. As discussed previously, high concentrations of silver in body tissue and organs can produce conditions such as argyria.

Also, silver salts may change the body in a way that actually encourages diseases to set in or flourish, the opposite of its intention. One way is by causing the body to become more acidic, as acidic body conditions are favorable to diseases. Nitrate components can change to nitrites, which have been associated with cancer. In addition, silver salts have been shown to trigger autoimmune reactions. Examples of diseases associated with autoimmune reactions are multiple sclerosis, Type 1 diabetes, psoriasis, and rheumatoid arthritis.

On the contrary, silver nanoparticles are like the trusty and persistent tortoise, slow and steady to win the race. Correctly prepared, silver nanoparticles gently release their silver ions in the right amounts to get the job done, without putting any stress on the human body. Indeed, in a given liquid environment, the concentration will always be the same and very low. As discussed previously, nanoparticles are harmlessly eliminated from the body through several naturally occurring options. Therefore, proper concentrations are easy to establish and maintain, keeping the body safe.

Silver nanoparticles are nonreactive and chemically inert. This means they do not take up residence in body tissue. Also, the particles stay in their original form; they do not separate or react with other chemical compounds in the body.

The pH (measure of acidity) of correctly prepared colloidal silver is 8 to 8.5. This means it is alkaline, the opposite of acidic. Alkaline body conditions have been associated with healing and the fighting of cancer.

Coated or uncoated?

As we've mentioned already, the better option is coated. Coating keeps nanosilver particles more stable. As a result, coated particles have a virtually never-ending effectiveness. Coating also reduces the chance that the particles will clump together. This keeps them uniformly small, at a nanosize that can be safely tolerated by the human body.

The coating itself should have certain characteristics. It should be slightly porous, with openings, so silver ions can be released from the larger nanosilver particle. The coating should be safe for human consumption, as well as chemically inert and nonreactive.

Colloidal Silver Conclusion 12: The best colloidal silver comes from a firsthand source and contains professionally made, coated nanosilver particles.

Is Colloidal Silver More Efficient Than Silver Nitrate?

The answer to this question can be quite complicated, even a bit technical.

The Short Answer

In a nutshell, colloidal silver is not more efficient than silver nitrate. Silver salt forms ions a bit faster, so if time is a factor, silver nitrate is more efficient; however, this does not really translate to a significant health benefit, since silver nitrates can and do cause a lot of damage. In every way, colloidal silver is the best form of silver administration for the greatest, safest antibacterial effect in the human body.

The Long Answer

For a clearer picture of colloidal silver versus silver salts, imagine that you live in the suburbs of Los Angeles and wish to travel downtown. You might ask yourself, "Would a space shuttle or a car be more efficient to get me there?"

Truthfully, a space shuttle would be more efficient from a time perspective, but in every other way, it would be impractical, if not entirely dangerous. If you took a space shuttle to downtown L.A., you would definitely overshoot your destination, waste a great deal of fuel and resources, and do a lot of irreparable damage to the environment in the process. In many ways, silver salts (usually nitrates) are similar to that space shuttle, while colloidal silver can be viewed as that reliable, much safer, less extreme automobile.

Face the Facts, Folks

Even chemists are unaware of many technical details about colloidal silver.

Silver particles (colloidal silver), especially the coated variety, function as a reservoir of silver ions. These are released from the particles into the body, until a saturation concentration for the metal (silver) is achieved.

Imagine a ball made of 200 to 300 atoms of silver, releasing 1 to 2 ions periodically. The released ions will have no problem penetrating the ball coating, and in the process, they will be protected from oxidation by the coating, so no damage is done in the meantime. Particles will move slowly through the reticulo-endothelial system (tissues) and slowly and constantly release the silver ions responsible for the antibacterial effect.

The particles are gentle, nonreactive, and chemically inert; they do no damage to the surrounding tissues. The concentration of equilibrium of silver ions is established gently, over a period of hours. Nothing is excessive, and the concentration of silver necessary to destroy bacteria is too low to spawn any harmful side effects - a major benefit of coated silver particles. For even more added benefit, the pH of our colloidal silver is a gentle 8 to 8.5, thus alkalinizing the body, a benefit we already discussed.

On the other side, silver salts (silver nitrate) are much more violent, liberating a mass exodus of silver ions - far more than necessary to kill harmful bacteria at a rate literally trillions of times more (ten to the twelfth power) than colloidal particles. Silver nitrate has no practical equilibrium concentration. In other words, it dissolves up to a 1:1 ratio within the solvent, while silver particles have an equilibrium concentration of 1 to the minus 10^{12} to 10^{13}. This difference is trillions of times in order of magnitude, and it is major overkill. The concentration of silver needed to kill bacteria is so small that there are more than enough ions liberated from silver particles to get the job done.

The concentration of equilibrium of silver particles effectively ensures that nothing higher than that concentration and no great excess of silver ions is dissolved. Thus, the number of silver ions are effectively limited in the solution or the body, no matter how much more metallic silver you add. This concentration of equilibrium of ions from silver particles is very, very low, but it is still way over the limit of concentration necessary to kill microorganisms and bacteria. You really don't need more than what colloidal silver can provide, and you cannot overdose with the right kind of colloidal silver!

It would be absolutely impossible to reduce the amount of silver nitrate dissolved to obtain the same safe concentration as from silver particles. Why? Because the limit of measuring silver nitrate is one milligram, but even that would be over a billion times more than necessary to garner antibacterial effect. Again, it begs repeating that there is great risk of overshoot and harmful physical effects when using silver salts.

Salts instantly dissolve in the body. This is very excessive, up to a trillion times more ionic invasion than necessary. Released in the body, this very chemically reactive type of silver can precipitate (settle into organs) and will attach to proteins, amino acids, carboxyl groups, and other components, blocking enzymes, modifying protein structures, and changing receptors. It may even block or damage DNA, which is made of amino acids.

For example, if silver nitrate comes in contact with Vitamin C, the reaction causes silver ascorbate to be deposited in the tissues rather than eliminated. Silver salts also react with copper-containing proteins and distort the surface, thus modifying the behavior of these essential proteins within the body.

Not only are there adverse effects, but some are irreversible. The silver from salts attaches permanently to proteins and tissues, causing the infamous argyria, a graying or blue discoloration. Other side effects and problems can occur when organs and skin are overloaded with silver. Silver salts also oxidize very rapidly to silver oxide, which is even more reactive and dangerous to tissues. In short, silver salts are dangerous because they are not eliminated; instead, they are deposited in the tissues, where they can do much damage.

Also, when ingested, silver nitrate is instantly dissociated to silver and nitrate. This, coupled with an abundance of hydrochloric acid in the stomach, results in silver chloride. The silver chloride molecule is very stable, but it does not dissociate well enough to provide ions for an antibacterial effect. Moreover, if there is an overabundance of

hydrochloric acid in the stomach as compared to the amount of silver ingested, which is usually the case, molecules of one silver ion connected to two or three chloride ions form complex ions that are very stable; in other words, there will be no antibacterial activity. This is similar to the burning of the environment from the space shuttle engine, and once it happens, nothing can be used there anymore.

Another major concern is that nitrates can change to nitrites, a possible cancer-producing agent. The dose needs to be high for this to occur; however, silver salts are so reactive that they de-naturate and change proteins and DNA. This can trigger autoimmune reactions and even cancer. This high reactivity can result in the formation of free radicals, which can lead to cancer, albeit through a different mechanism.

Last but definitely not least, silver nitrates entail chemically acid hydrolysis. In other words, the moment you ingest silver nitrate, the chemical reaction itself produces acid. This reaction of dissociating nitrate salts instantly drops the pH by several points, thus acidifying the body. As we know from the alkaline-versus-acid concept, acidic foods and chemicals are disease- and cancer-producing, while alkalinizing agents are disease- and cancer-healing. It is always in your body's best interest to be alkalinized, and this is yet another reason silver salts should be avoided: They are cancer-producing through three to four mechanisms.

In addition to the above, you never know how many silver ions are inactivated through different mechanisms like attachments to proteins, combining with chloride and other ions, etc

These are some serious considerations when comparing silver salts (nitrate) to colloidal silver, especially coated. Excess overshooting, free radicals, protein modification, being stuck in the body, argyria, other side effects, organ blockage, and acidifying the body are the risks involved. All things considered, this is far too high a price to pay to see results a few minutes or hours earlier!

With all these factors in mind, your perfect vehicle for gentle, effective antimicrobial effect with minimal problems and side effects is coated colloidal silver.

It is also advisable to note that all of the above are valid in the case of coated gold nanoparticles as well, although to a different degree, since gold is more stable and the gold dissociation coefficient is several orders of magnitude lower. Overall, the comparison of particles versus salts is the same, except for the fact that gold will not dissolve or react in the stomach as silver does.

Colloidal Silver: Coated or Uncoated?

Now that you realize that colloidal silver (silver particles) is the best option for antimicrobial effect, should you rely on coated or uncoated silver particles? This issue has been touched upon, but it is crucially important and should be revisited.

Coated is better for many reasons. It is the best option for colloidal silver because the coating prevents particles from clumping together and also makes them safer for human consumption.

Coating accomplishes many things:

- particle size uniformity, so particles will be safe in the body and not get trapped in tissues
- concentration, so it can be easily, conveniently, and inexpensively transported
- stability, so it has a practically unlimited shelf life
- stability in complex liquids (paints, soups, cans, drinks, etc).
- higher degree of safety, as most coated nanoparticles are

Not every coating is appropriate. The coating must be safe to ingest and chemically inert and not reactive. It must also incorporate the right dimensions and be permeable enough for ions to pass through at a feasible rate.

Coated silver particles can be used in water treatments, soups, liquids, filters, or as an anti-infection agent dispersed in water. Presently, it is used in the International Space Station, hospitals, pools, and in several applications by big corporations like Samsung.

PART II
COLLOIDAL GOLD

Medical Gold Through the Ages

Evidence of gold as a medical treatment dates back to ancient times, and it is believed to be mentioned in the Bible. One form used was a colloidal gold solution.

It is known that Alexandrian Egyptians used colloidal gold to purify their minds, bodies, and spirits. They created their gold elixir because they believed it held mystical, magical properties. They were certain that ingesting gold would energize and revitalize their bodies, as well as cure disease and this by curing disease and restoring youthfulness.

Egyptian dentists also used gold, as evidenced by surviving examples, about 4,500 years old, found and verified by archeologists. Gold continues to be favored by dentists, and it is chosen for its nontoxic, non-tarnishing properties. Shaped easily, it is used for dental work such as inlays and crowns.

Egyptian women used cosmetics containing gold. There is evidence that some of their facial paint contained gold.

Ancient Chinese people used red colloidal gold to increase their lifespan. Modern Chinese echo these ancient gold traditions, sometimes adding a gold coin to their cooking pots or including a twenty-four-karat gold leaf in their food recipes.

Red colloidal gold was also used in Indian Ayurvedic medicine to calm the nerves, and it is still prescribed for these purposes today. A 1988 study investigated the ability of red colloidal gold to function as a pain reliever. The researchers compared red colloidal gold with two Indian analgesics. While all three substances relieved pain, the effects of the colloidal gold could not be blocked by a pretreatment designed to prevent the colloidal gold from working successfully.

Medieval Europeans were fond of taking gold-coated pills. They also liked to drink powdered gold, mixed with water to create a beverage; it was said that the drink comforted sore limbs, and researchers believe this was a reference to what we know today as arthritis.

Theophrastus Phillippus Aureolus Bombastus von Hohenheim, 1493 to 1541, better known as Paracelsus, was a German-Swiss physician, alchemist, and forerunner of the modern chemist. He is credited with incorporating chemical principles into the area of medicine, considered the first step in the development of pharmacology. Paracelsus contributed important new methods of treating wounds, and he created a mixture known as *aurum potabile*, "drinkable gold." The mixture is similar to what we would know today as colloidal gold, and his creation was used as a treatment for a variety of physical, mental, and spiritual ailments.

Michael Faraday, an English-born chemist, is credited with creating what is recognized as the first official colloidal gold. His activated gold solutions date back to 1857 and were used for many medical conditions.

Nineteenth-century uses for colloidal gold in the U.S. included dipsomania, known today as alcoholism, and this use continues in modern times.

Early twentieth-century surgeons relied upon a gold cure for joint pain; a subcutaneous (under the skin) gold piece was placed under the ailing joint, and this often resulted in a reduction or cessation of the pain. During the 1920s, tuberculosis was treated with gold cyanide as a result of the experimental findings of Robert Koch. In 1927, gold injections became an accepted form of treatment of arthritis and are still in use at the present time. In 1935, an article in a medical periodical discussed the use of colloidal gold for terminal cancer patients. The surgeon who wrote the article described how colloidal gold "helps prolong life and makes life much more bearable, both to the patient and to those about them, because it shortens the period of terminal cachexia (general physical wasting and malnutrition usually associated with chronic disease) and

greatly reduces pain and discomfort and the need of opiates (narcotics) in a majority of instances."[40]

Cutting-edge technological advances and methodology mean uses for gold, both in general and colloidal gold specifically, are expanding, as we will discuss later.

In sum, gold, as part of a medical kit, is not a new concept. As knowledge expands, scientists and healthcare professionals are able to offer a wider variety of gold-based treatments with a higher level of safety to the human body.

40 "A Brief History of the Health Support Uses of Gold." http://www.purestcolloids.com/history-gold.php

Forms of Gold and Their Medical Uses

Gold is popular with surgeons, and many use it to patch damaged body parts such as blood vessels, bones, and nerves. It is also being used in cancer treatments, biomedical applications, and body-cleansing procedures. Today's medical gold appears in many forms.

Gold Salts

Salts, as they are discussed here, can be defined in the same way we discussed them in relation to silver. A long-standing use of gold salts is in the treatment of arthritis, and they offer the most beneficial effects in rheumatoid cases. A variety of gold salts are available, such as gold sodium thiomalate and aurothioglucose.[41]

While scientists are not sure of the exact mechanism, The American College of Rheumatology explains that gold salts appear to inhibit joint swelling and pain. Gold salts may also prevent the immune system from carrying out normal processes that result in pain and inflammation.

Gold Flakes or Gold Leaf

Gold flakes can be added to paint and fabric for decorative purposes. Gold leaf, the larger form, is used to gild non-gold objects for a real gold finish. These forms are usually not found in medicine.

Gold Powder

These are used to generate conductive structure in highly reliable electronics and microelectronic devices.

Gold Nanoparticles

Gold nanoparticles are showing up with increasing frequency in biological

41 "Gold Preparations (Myochrysine, Ridaura, Solganol)." https://www.rheumatology.org/Practice/Clinical/Patients/Medications/Gold_Preparations_%28Myochrysine,_Ridaura,_Solganol%29/

uses. A recent article in a publication of the U.S. National Library of Medicine (part of the National Institutes of Health) extensively discusses how gold nanoparticles are used in biology and medicine. The article explains that current technological processes can create reliable gold nanoparticles (AuNPs) in sufficient quantities. Some of the properties of these gold nanoparticles are different from those of larger gold particles. Gold nanoparticles can be bound to biological structures for a variety of uses such as "assembly and crystallization of materials, arrangement of nanoparticles into more complex molecules onto DNA templates, bioelectronics, and detection methods. The application of gold nanoconjugates for biodetection and biodiagnostics have been reviewed."[42]

The area of nanoconjugates is especially exciting. A *conjugate* is a particle made from two or more molecules. *Nanoconjugates* are conjugates on the nanosize level; in simple terms, they can be thought of as hitching a ride. Other molecules can hitch a ride with a nanogold driver. Studies have shown that nanoconjugates are able to penetrate cell walls. To date, this includes "thirty cell lines, primary cells, and neurons."[43] Thus, the driver can deposit the hitchhiker exactly where it needs to go. This is a simple concept, but it speaks volumes on the powerful potential of gold:

- A promising extension of this finding is using gold nanoconjugates as a drug delivery service. Simply put, gold nanoparticles and the drugs are bound. Gold nanoconjugates are then told where to deliver the drugs, such as at the site of a cancer-causing tumor.
- Another use could be to control genes, turning on beneficial ones and turning off problematic ones.
- A third is as markers in biological systems. Researchers need ways to detect and measure biological substances and structures. Marking the substances and structures with gold nanoconjugates makes them visible under an electron microscope. At the moment, this visibility can be as detailed as the cellular level.

42 "Gold Nanoparticles for Biology and Medicine." http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3930332/

43 "Gold Nanoparticles for Biology and Medicine." http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3930332/

- Fourth is photothermal therapy (PT), which combines the use of lasers with light-absorbing dye. Now, interest is turning from dye to gold nanoconjugates, which include antibodies. These antibody nanoconjugates search out and mark bad cells such as cancer, giving the PT lasers a more defined target. In addition, the use of such nanoconjugates makes the PT treatment less traumatic to the body. A slight twist makes the nanoparticles themselves act as the destroyer. The methodology being currently tested is to inject nanoshells (special nanoconjugates) at a specific site, such as a cancerous tumor. A laser is aimed at this site, and the nanoshells absorb the laser light and turn it into heat. The release of this heat destroys the cancerous tumor.
- A fifth use of nanoconjugates is in combination with antibacterial silver coatings. It appears that adding gold nanoconjugates to silver increases their overall effectiveness.
- Lastly, gold nanoconjugates appear to inhibit the growth of tumor tissue.

Gold Pellets or Seeds

External beam radiation therapy for treating prostate cancer is improving its accuracy through the use of gold pellets/seeds, planted in the prostate as markers for the external beam. The markers pinpoint the prostate to a 1 to 2mm degree of accuracy.

Gold is also used to form instruments used to clear buildup from coronary arteries. Since gold resists infection, gold implants are being used in delicate surgical procedures involving the ears and eyes. When taking an X-ray, gold-plated stents show up the best. This means they can be placed with greater accuracy during surgery. Also, the inertness of gold means stents will cause the least number of clinically significant bodily changes, which can be seen by the naked eye.

Other Uses of Gold

Without a doubt, the main use of gold is for jewelry. About 78 percent of global annual gold output, from mining and recycling, is used to craft beautiful rings, bracelets, necklaces, etc. that people love to own and wear.

Gold's special glow, rich yellow hue, and high resistance to tarnish make it one of the best metals for jewelry crafting. In addition, gold is malleable, easily shaped into sheets, wires, or other designs. These properties have created the gold tradition, and people expect that significant objects are made from gold; for many, owning gold is a sign of living above the have-nots, but what many may not realize is that it may be far more valuable for their health than just as baubles and trinkets to show off.

Pure gold is not strong enough for jewelry uses, so over time, craftspeople have learned to mix small amounts of other metals with it to create a more robust product. These include copper, silver, and platinum. To clarify gold content, the karatage system was devised. Gold with no metal additives is 24 karat (24K), or 100 percent. A mixture that is 75 percent gold and 25 percent other metals is designated as 18-karat (18K) gold, and 12-karat (12L) gold is a 50-50 mixture. Usually, the greater the gold content, the less the crafted item tarnishes; however, high gold content also means a high level of softness, which translates into a lower ability to resist damage.

Gold mixed with other metals undergoes a color modification. Depending on the color of the other metal used, the final gold mixture can have white, pink, peach, green, or black hues.

In the industrial world, gold is most commonly found in the field of electronics. Many electronic devices are built in solid-state form, constructed from solid materials, with all particles that carry an electrical charge trapped inside it. The electrical points of contact in solid-state devices are very sensitive. Corrosion or tarnish can interrupt the low voltages/currents and cause the device to malfunction or stop working.

The high resistance of gold to corrosion and tarnish make it the metal of choice for such applications. Perhaps the first solid-state technology was transistors, which are still widely used in all types of modern electronic devices.

While fewer solid-state devices are built today, due to other available technology, solid-state electronics are still prevalent is in the realm of computers. In this regard, *solid state* is taken to mean "a storage media that does not involve magnetic disks or any moving parts."[44] An important example of a solid-state component is computer memory, or RAM.

Gold is also an excellent electrical conductor. Any area or place with an electrical connection or where electricity needs to pass through is more reliable when constructed with gold. As a result, some gold is present in almost every sophisticated electronic device available today: cell phones, global positioning systems (GPS), TV sets, and calculators. Besides its solid-state use, gold is found in motherboards, used as an edge connector to hold microprocessor and memory chips in place. Also, gold cables feature in plug-and-socket connectors. Lastly, bits of gold found here and there ensure that digital information moves inside the computer in a fast, reliable manner.

The aerospace field also relies upon gold. Every launched NASA space vehicle uses gold to reduce to virtually zero the need for lubrication, maintenance, or repair during flight. As mentioned previously, space vehicles use gold to conduct electricity or where there are electrical connections. It is also present in gold-coated polyester film. Under normal conditions, infrared radiation is absorbed by the dark-colored areas of spacecraft, resulting in a significant increase in the temperature of the interior cabin. Wrapping dark-colored areas with gold-coated film significantly reduces the amount of infrared radiation absorbed, helping to regulate cabin temperature.

44 "Solid State." http://www.computerhope.com/jargon/s/solistat.htm

Space is a vacuum, where organic lubricants become unstable and break down and cease to perform. The solution is thin films of gold, since its shear strength is very low. To explain *shear strength*, the internal components of a material can slide against themselves, like two hands rubbing or sliding one against the other. If it takes a lot of force for this sliding to occur, the material is said to have a high shear strength. Adhesives are one example. On the contrary, if not much force is needed to create this sliding, the material is said to have a low shear strength. Since gold has a low shear strength, a thin film is positioned between every critical moving part. When the parts move, they create friction. This friction easily causes the internal components (molecules) of the gold to slide around, a reliable makeshift lubricant for the action.

With all the current medical and nonmedical uses for gold, the amount of gold in circulation is slowly being reduced. As quantities are finite, the recycling of gold is assuming an increasing importance. One area where gold can be easily recycled is cell phones. About a dollar's worth of gold is used in every two modern cell phones, and about one billion of these phones are manufactured annually, with an average life cycle of two years. Due to the high quantity of devices, recycling a significant percentage of cell phones would result in a large quantity of recycled gold.

The Case for Colloidal Gold

Much literature praises colloidal gold for its ability to balance and harmonize the physical body, a variety of mental states, and the ethereal spirit. There are also accounts of gold improving intelligence and concentration. Unfortunately, any supporting evidence for these claims is empirical, based on personal observation or experience, gleaned from small clinical testing trials and likely not clinically significant. So, while gold may be able to effect such changes, we cannot discuss them herein; the intention of this book is to present only credible, reliable information.

The emerging power of nanogold appears to be in four areas: drug delivery, cancer treatments, diagnostics, and catalytic action.

Drug Delivery

The use of gold for drug delivery was introduced earlier, when we explained nanoconjugates. Now, we will expand on this topic.

Studies and investigations of the role of gold in drug delivery are quickly accumulating today. Following are a few examples:

□ Research Overview: *"Colloidal Gold Nanoparticles: A Novel Nanoparticle Platform for Developing Multifunctional Tumor-Targeted Drug Delivery Vectors"*

It is generally accepted that gold nanoconjugates have great potential as a drug delivery system. Research has demonstrated that "colloidal gold nanoparticles are relatively inert and biologically compatible carriers."[45] The challenge is to get them to the target site. Blocking their path is a variety of biological mechanisms designed to keep the body safe. This group of U.S. chemists discussed the ways in which the bio-mechanisms could be fooled into letting the gold nanoconjugates continue on their journey. They cite previous research that has shown the following to be effective options depending on the situation: coated

45 "Colloidal Gold Nanoparticles: A Novel Nanoparticle Platform for Developing Multifunctional Tumor-Targeted Drug Delivery Vectors." http://www.eng.biu.ac.il/~motieim1/papers/%EE%E0%EE%F8%E9%ED%20%F2%EC%20%F9%E9%EE%E5%F9%20%E1%F0%F0%E5%20%E1%E7%E9%E5%FA/Drug%20DevRes.pdf

nanoparticles; a smaller nanoparticle size, allowing the nanoparticles to passively accumulate; vascular normalization; reducing the pressure of the liquid inside the cells; having the tumor-targeting material and the therapeutic drug as part of the nanoparticle; and using multifunctional nanotherapeutics, as nanoparticles can perform more than one function.

This group went on to do their own experiment. In one part, they investigated how tumor necrosis (cell death) factor (TNF) could be delivered to a solid tumor. As its name aptly describes, TNF can help the human immune system kill bad cells such as cancer. These chemists found evidence to suggest that colloidal gold nanoparticles affect tumors in two ways. First, they passively accumulate inside the tumor and release their delivered packages. The second is an active process. The TNF in the gold nanoparticle binds itself to receptors in the tumor. This anchors the gold nanoparticle in the tumor for drug delivery purposes.

□ Article: *"Gold Nanoparticles in Delivery Applications"*

Another group of U.S. chemists discuss the versatility of gold nanoparticles. It appears that gold nanoparticles, like ants, can carry objects many times their size. Not only can they transport small, molecular drugs, but gold nanoparticles can also be a delivery service for large biomolecules. This article also supports the findings of the previous one regarding the dual-mechanism (passive and active) by which these nanoparticles affect tumors.

Diagnostics

Colloidal gold nanoparticles show up extremely well under the electron microscope, due to their higher ability to absorb electrons, as compared with structures such as cells and body tissue. As a result, scientists are increasingly using gold nanoparticles as labels or markers, and for this purpose, they use colloidal gold.

Labeling or marking helps health professionals and researchers to reach more accurate diagnoses. For example, infections produce their own

unique molecules, proteins or hormones only present when the infection is present. The human body fights infection by manufacturing antibodies. Like biological detectives, these antibodies search out the infection-unique molecules. Once they find them, they tell the body the location so the body can send its next wave of attack. By attaching gold nanoparticles to these antibodies, health professionals and researchers can more easily track the paths of the antibodies. As the labeled antibodies cluster at an infection site, professionals can see exactly where they need to work.

Antibodies attached to gold particles may clump in the presence of a target, making this process ideal for a new generation of reliable diagnostic kits.

Currently, there are colloidal gold strips and kits available for a number of diagnostic situations such as HIV, tuberculosis, and foot-and-mouth disease.

Catalytic Action

Catalysts are agents that cause or speed up changes but remain unchanged themselves. Catalysts can be people, but here, we are discussing gold nanoparticles. A growing body of research shows that these can facilitate a variety of chemical reactions:

- The Research Center for Molecular-Scale Nanoscience, Institute for Molecular Science, Myodaiji, Okazaki, Japan found that nanogold can catalyze carbon-carbon bonds.
- A recent review of the relevant scientific literature reveals that "colloidal gold nanoparticles without any solid support exhibit intrinsic catalytic activity for some of the typical gold-catalyzed reactions including CO oxidation, aerobic oxidation of alcohols and carbon–carbon cross coupling reaction among other reactions."[46]

46 "Colloidal Gold Nanoparticles as Catalyst for Carbon−Carbon Bond Formation: Application to Aerobic Homocoupling of Phenylboronic Acid in Water." http://pubs.acs.org/doi/abs/10.1021/la0478189

The use of biological catalysts enables professionals to have more control over biological reactions. Reactions that would otherwise proceed slowly can be accelerated, perhaps for a faster healing rate. Reactions that rarely take place could be arranged and turned on with the help of a catalyst, so changes that could be beneficial but hardly occur could happen with a greater frequency. In short, having a range of versatile catalysts enables health professionals and researchers to do more of what they want, where they want, when they want it, in regard to biological reactions.

Colloidal Gold Conclusion 1: *Colloidal gold nanoparticles are showing themselves to be versatile, biological helpers. They appear to have a variety of nontoxic applications as components of effective drug delivery systems, tools to aid in diagnostics, and catalysts for biological change.*

Avoiding Toxicity: Absorption and Elimination of Colloidal Gold

At present, data regarding the absorption and elimination of colloidal gold by the human body is relatively scarce, and there are several reasons for this.

Colloidal gold itself has been used for thousands of years, and as we mentioned before, the first modern study of colloidal gold was William Faraday's now-famous work in the mid-1850s. However, his results did not become well known until forty years later, roughly 1900. The first electron microscope appeared in 1931, but it would take many years and many scientific advances before the type of electron microscope needed for detailed colloidal gold studies would be a commercial possibility. It can be said that such electron microscopes were available beginning in 1980, along with sophisticated computer imaging programs to make more sense of what was being seen.

Another reason for this lack of data is consistency. In recent years, quite a number of studies have undertaken on colloidal gold for the exact purpose of determining its toxicity. Unfortunately, these studies have not been coordinated. In any research, there are numerous important factors such as experimental design, nanoparticle shape and size, doses, in vitro (taking place in a test tube or Petri dish) versus in vivo (taking place in a living organism), and method of particle introduction. To form a consistent picture, each study needs to build on the previous one. In general, to date, studies have been all over the place. While there are many results and much data has been gathered, it is unclear which are reliable for humans and at what concentrations, particle sizes, or shapes. Further coordinated studies need to be done in order to form a more complete picture of the conditions under which any gold nanoparticles might be toxic.

One thing is very clear though: Spherical gold nanoparticles 5 to 30nm in size is very safe, and no problems have been associated with this size

or shape in moderate amounts. In excessive amounts, all bets are off, as there can always be too much of a good thing; even excessive water can prove fatal.

Does this mean some studies have shown that colloidal gold is toxic? We are not talking here about commercially available colloidal gold. We are talking about highly experimental gold dispersions containing different odd, unusual forms and shapes of particles. The simple, general answer is: Yes, some oddly shaped, bigger nanoparticles maybe toxic. However round, spherical gold in 10 to 30nm was always found to be very safe. Let's take a look at some of the data:

□ Review Article: *"Toxicity and Cellular Uptake of Gold Nanoparticles: What Have We Learned so Far?"*

In mid-2010, these authors conducted a review of the findings to date. They reported on both nontoxic and toxic results.

- Goodman et al. showed that positive gold nanospheres can be toxic at certain doses; however, if the same gold nanospheres were given a negative electric charge, they were no longer toxic.
- A group of researchers (Connor et al.) used a variety of different-sized nanospheres and different capping agents on human leukemia cell lines. All the combinations were nontoxic.
- Shukla et al. also found nontoxicity in their study with immune system cell lines.
- Data from Pan et al. indicate that 1.4nm gold nanospheres caused cell stress, damage, and death, while 15nm gold nanospheres did not.
- The human immune system contains cells known as dendrites. Villiers et al. studied the response of dendritic cells to capped gold nanoparticles. The data showed that none of the observable characteristics changed in these cells, and there was no toxicity.[47]

47 "Toxicity and Cellular Uptake of Gold Nanoparticles: What Have We Learned So Far?" http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2988217/

The results are confusing, but in the midst of this confusion, some clear generalities are emerging:

Size matters.

The size of the gold nanoparticle is a critical factor. With regard to colloidal gold, the human body can be thought of as a sieve. The size of the sieve openings is ideally suited to gold nanoparticles ranging from 10 to 30nm. Highly dispersed particles in this size range will be metabolized and eliminated as usual. Individual gold nanoparticles or aggregates of nanoparticles larger than this size will accumulate in the liver, brain, and kidneys, and this accumulation may cause damage .

Don't forget your caps or coats!

In this case, caps and coats are not protection from the cold, as the human body has a toasty, internal temperature of 98.6°F. In this case, capping or coating (putting the complex differences aside) refers to compounds added to nanoparticles. As we saw above, one of these compounds is PEG (Poly Ethylene Glycol), which makes nanoparticles more stable and more easily used by the body. Another vital function of capping/coating is to help keep nanoparticles from joining together. Successful use of nanoparticles depends greatly on ample dispersal. Nanoparticles are separate, individual, and unique. When they clump together, their size and properties change. The end result is that they no longer have special properties or do the work they are intended to do.

Nevertheless, while capping and coating are essential, it is equally necessary to match the choice of compounds to the specific situation. Considerations include the biological species involved, the type of target cell, and the method of delivery (injection, inhalation, etc.). The data indicate that when the composition of the nanoconjugate suits the biological conditions, the treatment is successful. As Dr. Goia puts it, "The properties of the nanogold have to be in sync with the applications."[48]

48 Goia, Dan, PhD. Interview by Dr. Calin Pop.

Form Affects Function

Colloidal gold is, by definition, gold nanoparticles, and this is really the only form of gold we are discussing here. This is an extremely important point.

Many gold products today are ionic or monatomic gold masquerading as colloidal gold. Ionic or monatomic gold is really gold chloride, a gold salt, not gold nanoparticles. In fact, gold chloride is toxic and has been shown to negatively affect tissue in the nervous system, particularly peripheral neurons. Damage to these neurons affects the communication between the brain, spinal cord, and every other part of the body. Messages get garbled or don't arrive. Some resulting effects are weakness, numbness, and strange sensations, such as burning.

Ionic gold appears often in the marketplace because it is relatively simple and inexpensive to produce. As a result, it is seen as an easy way to earn good profits. Given its negative side effects, ionic gold cannot be sold as is and must be relabeled.

To avoid falling into the ionic gold trap, here's a simple test:

1. Pour a small sample of the gold product into a clear glass.

2. Add one drop of a 1 percent silver nitrate solution. (Although silver nitrate is no longer commercially available in the U.S., it can still be obtained. One idea is to order a biological stain kit. In some kits, one of the ingredients is a separately packaged amount of 1 percent silver nitrate solution.)

3. Look for a white cloud in the liquid, the result of the silver combining with the chloride to produce silver chloride.

Colloidal Gold Conclusion 2: *More research (especially long-term, in vivo studies) need to be done in order to clear up some of the existing data confusion. However, it appears that professionally -prepared, highly dispersed, 10 to 30nm gold nanoparticles. well suited to the specific treatment situation, are nontoxic.*

Misconceptions and Misunderstandings About Colloidal Gold

Gold is an expensive metal. By comparison, silver is much more affordable, so many people are more inclined to toy around with silver in an attempt to produce colloidal silver products. Also, the process by which colloidal gold is made is more complicated, so fewer people can accomplish it. As a result, there are not that many misconceptions or misunderstandings in regard to colloidal gold.

Misconception: *Since the data is inconclusive, I should not take colloidal gold.*

In the end, all treatments are up to the individual. Many prescription drugs, approved by all the necessary government agencies, have a variety of severe, negative side effects, yet people continue to willingly take them. It's simply a matter of weighing the potential benefits against the potential risks. Data indicate that professionally made, highly dispersed colloidal gold in the correct doses is nontoxic to humans.

Misconception: *Colloidal gold products look like gold: yellow.*

Color is a result of light absorption, and particle size affects light absorption. The smaller the particle, the faster the electrons vibrate. This affects the light wavelength they can absorb. Gold nanoparticles in the size range recommended for humans (10 to 30nm) are a cherry wine color. Thus, the liquid they are in will turn a shade of red. Smaller gold nanoparticles take on a more orange hue. Larger gold nanoparticles become more red, but over 60nm, they turn blue.

This color property of nanogold is one way to check the authenticity of a colloidal gold product. The method is ultraviolet (UV) spectroscopy. Such analysis will create something called an *absorption band.* A sharp absorption band will provide information about the size of the particles, uniformity of size, and how well dispersed (not clumped) they are. A broad absorption band and presence of turbidity indicates aggregation (clumping).

Misconception: *Gold is nonreactive.*

Gold salts with an electronic charge, mixed with organic matter, are reactive with the human body. Gold salts mixed with citrates, for example, will leave a red stain on the skin. Gold nanoparticles, however, are not reactive.

Misconception: *Homemade colloidal gold is just as good and much cheaper.*

For those who have read the preceding chapters, the falsehood of this statement should be obvious. First of all, the ppm of any end results are only approximate. Second, there is virtually no way to make sure the particle size falls within the ideal range. Third, DIY offers no method to cap or coat the particles. As we mentioned previously, capping helps to keep nanoparticles from clumping together, which is vitally important.

Misconception: *Gold improves mood, focus, and mental ability.*

This may be true, but at the moment, there is no significant, clinical data to support or deny these claims.

One study popularly quoted on the Internet as proof that nanogold can help to create a positive mental state is debatable. The journal in which the study was supposedly published is described as a peer-reviewed, open-access, research portal with the goal of a free exchange of information. There are some unanswered questions though.

Conclusion

New information is continually being gained about the benefits and possible drawbacks of colloidal silver and gold. As has been illustrated in this book, the findings are inspiring. Reliable, scientific data indicates that colloidal silver and gold have significant parts to play in the maintenance of a healthy body. As with all treatments, much attention must be paid to working with health professionals who use only high-quality, professionally made products.

At the moment, however, there is no universal agreement as to whether colloidal silver and gold really work. One example is the August 2014 controversy over using colloidal silver to treat the Ebola virus. The first report was that Nigerian patients with Ebola, living in Lagos, the commercial capital, would be treated with nanosilver. This, in and of itself, was significant. More interesting was that the August 14 decision came just after two important announcements.

The first was a statement by the World Health Organization (WHO) on August 11. The WHO met to decide what could be done in the face of the lack of a conclusive treatment for Ebola. The WHO concluded that, given the vast numbers of lives at risk, the ethical view is to use every possibility. This includes offering treatments that are still unregistered, unapproved, and unproven as of yet. Patients should be given all pertinent information about such treatments and should only be treated with their full consent, without being coerced.

The second announcement arrived on August 14, a statement from the U.S. Food and Drug Administration (FDA) statement. The FDA warned against being tricked by products that claim to treat Ebola but really do not. The FDA says that while vaccines or drugs to treat/prevent Ebola are at various stages of development, none are ready for approval. The FDA further states that anyone who persists in making such fraudulent claims will be punished.

It has since been reported that, for whatever reason(s), Nigeria has reversed its decision and will now treat its Ebola victims with the drug ZMapp™. According to the U.S. Centers for Disease Control and Prevention (CDC)[49], ZMapp™ is an experimental drug that has not been approved. The reason? No tests have been done to see whether or not the drug is harmful to humans. Also, no research has been done to see whether or not this drug effectively treats Ebola in humans.

One could wonder about the logic of such a decision. Colloidal silver, a nontoxic product that, when professionally prepared, has a scientifically proven effectiveness against bacteria, viruses, and fungi, is discarded in favor of a drug that has no clinical evidence to support its safety or effectiveness. Perhaps a contributing factor in this seemingly illogical decision is that one of the collaborators in the creation of ZMapp™ is the U.S. government.[50]

At the moment, too, there is a continuing debate as to whether or not the widespread use of nanosilver is correct. However, more and more products are adding nanosilver to their list of ingredients. Consumers may be surprised to know just how many different items now include nanosilver. Here are some examples:

- hygiene items (toothpastes, pet shampoos, water filters, etc.)
- shoes
- cleaners (disinfectants, fabric softeners, deodorizers, etc.)
- textiles (bath towels, socks, etc.)
- cosmetics
- electronic equipment (computer keyboards, refrigerators, electric shavers, curling irons, etc.)
- baby items (clothes, bottles, toys)
- food containers and kitchen cutting boards
- wrist bands

49 "Ebola Virus Disease Information for Clinicians in U.S. Healthcare Settings." http://www.cdc.gov/vhf/ebola/outbreaks/guinea/qa-experimental-treatments.html
50 LeafBio. "ZMapp™ Information Sheet.." http://www.mappbio.com/zmapinfo.pdf

Silver compounds have a great medical potential, as long as the concentration is controlled. However, groups such as Friends of the Earth Australia and United States are concerned that there is too much nanosilver in the environment. These groups suggest that the constant presence of nanosilver at such levels will allow bacteria, viruses, and fungi to develop resistance in the same way they do to antibiotics. The groups cite research that shows that this may already be occurring. In essence, this would defeat the original purpose of using silver.

Another of their worries is that nanosilver will enter the wastewater via processes such as laundering. Research has shown that clothing containing nanosilver can lose almost all of its silver by the fourth laundry cycle. The wastewater often ends up as sludge or biosolids that must be dealt with. One way is to dump them into landfills or oceans, meaning that the nanosilver would eventually enter the soil and water. From there, it could enter the agricultural cycle: crops, via soil or desalinated water, to herbivores to carnivores, including many humans.

Another way to deal with this waste is incineration (burning). The overall concern here is that the accumulation of nanosilver being ingested by humans and animals will exceed safe levels.

We have to add, however, that in these groups activities, nanosilver is always lumped together. There is no mention that while there may be a mild toxicity of asymmetric silver particles of different shapes, there was repeated demonstrated safety of silver spherical nanoparticles of a particular shape. Implying that all are toxic is a classic case of silver stereotyping and discrimination.

The groups are calling on governments to regulate the use of nanosilver. They feel that now is the time to organize things so nanosilver will retain its effectiveness and ecosystems will remain safe. These concerns, while valid, are greatly exaggerated. It was shown that silver nanoparticles in wastewater facilities are chemically changed by wastewater treatments into nontoxic Ag2S-NPs. Sulfuration lowers silver reactivity by several orders of magnitude.

Colloidal gold is currently much less worrisome. This may be because it is much less widespread and is being used under significantly more controlled conditions in industry and medicine.

Governments do have a role as protectors of the public. Overall, this is positive. The case can certainly be made that in the U.S., public health and safety has been generally improved by a series of governmental rulings and guidelines. However, it can also be said with equal certainty that each individual should always have the right to make decisions about his or her own healthcare and life. This includes the choice to use products that have not yet been officially approved. Some ideal products may never be officially approved due to political or financial ramifications, even if they are greatly beneficial.

As we have mentioned before, each medication has its side effects, even officially approved ones. Anyone who watches a commercial about a prescription drug will hear a laundry list of side effects rattled off at the end—some that sound even worse than the condition the medication is intended to treat. Some of these side effects can be quite debilitating, making it very difficult to live an enjoyable life, yet people choose to use these products because the other option is death. It might also be mentioned that alcohol and nicotine and fast food are not inhibited by the government, and these are known dangers to the human body.

To date, research shows that professionally produced colloidal silver and gold products, when taken according to medically sound guidelines and dosages, are effective, nontoxic options for a variety of medical conditions.

Mahatma Gandhi once said, "It is health that is real wealth and not pieces of gold and silver." Although his original sentiment is still true, modern developments enable us to tweak his statement slightly: Health, that is real wealth, can be helped by pieces of gold and silver—nanopieces, that is.

To your continued good health!

About the Author

Calin V Pop, MD is a leading expert in the nutritional supplement field. As a licensed medical doctor, he specializes in internal medicine and has twenty years of hands-on experience in combining mainstream medicine with unconventional therapies. He has brought back to life hundreds of patients who were not helped by other doctors. He gives advice on nutritional supplements and offers a designer line of powerful daily supplements, Power Source One. (www.PowerSourceOne.com)

Dr. Pop is the founder and president of a medical center that combines traditional medicine with natural, alternative, functional, anti-aging, and complementary medicine. He is a member of the American Academy for Advancement in Medicine (ACAM) and American Academy for Anti-Aging Medicine (A4M).

In addition to this book, he has penned *The Perfect Order of Illnes*s, an informational, symbolic approach to all health problems. This book delves deep into the causes of all illness, synergistically blending modern medicine with ancient wisdom. The doctor also authored a chapter in *Life Extension Book of Scientific Protocols that Integrate Mainstream and Alternative Medicine*, and he will soon be releasing two more books for health improvement.

Dr. Pop designs exclusive individual medical programs and is active in the self-improvement and mind-over-body movement. He serves as a consultant for a nanotechnology advanced materials company and is dedicated to clearing the marketing fog that often surrounds colloidal silver and gold. This is the reason he wrote this book.

APPENDIX 1

Internet Medical Information: Assessing Reliability

There is a lot of medical information on the Internet, much of which is posted by reliable organizations for public educational purposes. It can be an excellent place to seek answers when your healthcare provider is unavailable, you aren't sure if it's worth it to bother him or her, or you are facing a private or personally sensitive situation that you do not wish to discuss with others.

The flipside is that not all information on the Web is completely valid. It can range from somewhat valid to complete nonsense. Unfortunately, many tricks of the marketing trade make it quite difficult to determine whether or not the information is truth or advertising fiction.

Here are some ideas, from reliable sources, to help assess the reliability and validity of information on the Internet, including eBooks: who, what, when, where, and why.

The Five Wh- Questions

The National Center for Complementary and Alternative Medicine (CCAM), part of National Institutes of Health of the U.S. Department of Health and Human Services, suggests starting off by asking five wh-questions:

- Who runs the website or wrote the eBook? What are their credentials?
- What does the content of the website/eBook say? Are its claims logical or too good to be true?
- When was the information posted or reviewed? Is it current or out-of-date?
- Where did the information come from? Is it based on statistical, significant, scientific research?

- Why does the website/eBook exist? Is the goal sales? Perhaps the site is propaganda for a certain opinion or philosophy?[51]

The answers to these questions will begin to paint the background of the information. It's similar to a security check on a potential employee. Instead of accepting the candidate's story at face value, the company digs deeper in an effort to substantiate all claims.

Uniqueness Quotation

As a general rule of thumb, cut-and-pasted information that appears on numerous websites is of dubious reliability. Better authors will often subject their works and ideas to rewrites or expansions. To do this, they find information in several forms from unrelated sources, so they can offer a variety of details that makes their text unique. Text that has simply been copied from elsewhere has been accepted at face value, and likely little or no effort has been made to verify the content.

Sources, Sources, Sources!

Many of the writers of Internet information have adopted the following rule: Saying something makes it so. Unfortunately, this is incorrect. Just because a statement is written or said, that doesn't make it the truth. All facts need to be backed up by reliable sources. When reading, pay attention to the cited sources and references. If no sources are mentioned, there is no way to evaluate the validity of the information. If sources are mentioned, check them out. Do they come from tried and true scientific or medical journals or from self-proclaimed experts?

The University of California San Francisco (UCSF) Medical Center reminds us that valuable information can be gleaned by looking at the Web address ending. Here are the most common endings and what they mean:

- .edu: Short for education, these Web addresses belong to institutions of learning, such as universities. Note that such

51 National Center for Complementary and Alternative Medicine. "Finding and Evaluating Online Resources on Complementary Health Approaches." http://nccam.nih.gov/health/webresources

institutions often allow student-created websites to be linked under their umbrella, so not all .edu Web addresses can be associated with top scholars.

- .gov: Short for government, such Web addresses are part of political systems. No organizations other than governments are allowed to use this ending; however, it should be kept in mind that governments have points of view, and they are not necessarily unbiased.
- .org: Short for organization, these Web addresses usually indicate nonprofit groups. Note that anyone can buy a .org Web address, so deeper checking is recommended before the information is blatantly trusted.
- .com: Short for commercial, such Web addresses belong to for-profit groups.
- .net: Short for network, it generally means the site is hosted by a local network using its own server, so this information may also need to be validated.

It is important to state that, by itself, a website suffix is not necessarily a condemnation. That is, all information posted on a .com site is not automatically hype, written by a company that is only interested in making a profit. Many companies post valid information on their websites as a marketing technique. The companies catch search engine and browser attention with interesting articles, then gently suggest how their company or its products can help people achieve their goals. One example would be a plumber posting an item that educates site visitors about how to prepare their pipes for winter, with a suggestion to call him if they need help. Whether readers take the plumber up on his offer or not, the pipe preparation information is still reliable and useful.

Types of Research You May Find Online

The National Human Genome Research Institute, part of the U.S. National Institutes of Health, gives some pointers about types of research

articles. A review article gives an overview or summary of information collected to date. Review articles are good places to find reliable sources relating to a disease or scientific topic.

Research articles present new information resulting from experiments. These will tell you whether or not new information is statistically significant (valid) or not.

Articles that present details of a specific patient are called case reports. These are often used to discuss rare or unexpected cases.

Treatment articles, as the name implies, deal with data regarding disease treatments in humans. The data reported in treatment articles come from scientific studies such as clinical trials. Treatment articles are written to show that a treatment was effective, had beneficial effects, or was harmless (positive data). These articles are also written to discuss results that indicate the opposite (negative data).

In light of all the misinformation and unproven information out there, take a moment to think about this book. Did you note the footnotes, giving links to where the quoted or paraphrased information was obtained? Perhaps scroll to the references section of the book and note the number of references. Pay attention to the titles of the articles and the website endings.

It is always worth the effort to sift through information to separate the reliable from the unreliable. People new to the investigative process may find it a bit overwhelming, but as is the case in all learning, practically will eventually make perfect. People skilled at reliability sleuthing can accurately evaluate a source in minutes.

APPENDIX 2

RECOMMENDATION
Proprietary Silver Dispersion Concentrate
for Antibacterial Applications
www.nanobiosilver.com

Usage

For antimicrobial, antiviral, antifungal applications including water treatments, drinking bottles, soups, foods, canned items, paints, dyes, and other applications.

Composition

Concentrated silver dispersions contain only metallic silver and a safe food additive, both in concentrations of approximately 2.5 percent. 2.5 percent is 25,000ppm. Higher concentrations are available. Unmatched, guaranteed particle size, consistency, and stability. No other product comes even close.

Form

This silver product is present in the form of completely non-aggregated silver nanoparticles, on average 10nm in diameter, maintained indefinitely in a fully dispersed state by the food additive.

Properties/Advantages

Because of their concentration in silver, these dispersions are the most convenient for transportation, storage, and dispensation. For example, only 1 drop added to 100ml of liquid provides a concentration of 12.5 ppm silver. Since each drop contains 54 trillion nanoparticles, with a diameter of 10nm, this concentration is more than double or triple concentration for very effective antimicrobial properties. In other words, 1 liter of our concentrated dispersion can be converted in 8,250 liters

(more than 8 tons) of liquid phase, with a concentration of approximately 3ppm silver. Even higher concentrations are available.

Silver nanoparticles remain fully dispersed when they are diluted in liquids with very complex compositions. As a result, the distribution of silver in the resulting samples remain homogeneous (the same) for extended periods of time. On the contrary, not only do competitor samples tend to aggregate after they are mixed with other liquids, but also, in time, even in the very containers in which they are supplied. This particular silver dispersion, by contrast, retains its properties for many years, even in complex drinks like soups, cans, soda, seltzer, or other liquids.

Because of their excellent stability, these concentrated dispersions have a practically unlimited shelf life.

APPENDIX 3

Dilution Guidelines For Silver Colloids 2.5% (25,000 ppm)

Assuming 1 cc equals 20 drops. This is generally true but please check and calibrate Dropper

1 drop in 100 ml ---------- 12.5 ppm
2 drops in 100ml ----------25 ppm
4 drops in 100 ml----------50 ppm
8 drops in 100 ml ----------100 ppm
10 drops per Liter -------- 12.5 ppm
20 drops per Liter ----------25 ppm
40 drops per liter ----------50 ppm, etc

1 drop contains 1.25 mg of silver

APPENDIX 4

Silver Concentration Equivalents

PPM Conversion Table

0.3mMol/L =	0.06g/L =	60mg/L =	0.006% =	60ppm
0.5mMol/L =	0.1g/L =	100mg/L =	0.01% =	100ppm
1mMol/L =	0.2g/L =	200mg/L =	0.02% =	200ppm
1.5mMol/L =	0.3g/L =	300mg/L =	0.03% =	300ppm
2.5mMol/L =	0.5g/L =	500mg/L =	0.05% =	500ppm
5mMol/L =	1g/L =	1,000mg/L =	0.10% =	1,000ppm
10mMol/L =	2g/L =	2,000mg/L =	0.2% =	2,000ppm
12.5mMol/L =	2.5g/L =	2,500mg/L =	0.25% =	2,500ppm
1ppm =	1mg/L or 1 mg/1,000,000mg (water has specific gravity of 1g/mL)			

APPENDIX 5

Colloidal Silver Concentrate Answers

Nanobiosilver.com product particle size is 10nm, one of the most consistent particle size products available.

This product is dark in color because is extremely concentrated to an unheard-of 25,000ppm. Even higher concentrations are available. The darker the color, the more concentrated the silver colloid. On some websites, this truth is expressed as a negative, and darker colors are not recommended, but in the end, this decision should be left to the consumer who will be using the product. You will have difficult time finding anything higher than 2,500ppm on the market. There is some very advanced technology able to make silver 25 percent-60 percent concentration, equivalent with 250,000-600,000ppm at this time. Concentration is, again up to the consumer, based on the intended purpose; the concentration can be diluted accordingly.

Super-concentrated nanosilver is manufactured via the most advanced technologies available today. The vast majority of small companies selling silver retail have no knowledge of advanced nanotechnology. The nanosilver field is full of misinformation.

Nanobiosilver.com actually does not claim any antibacterial effect. They guarantee only the size, consistency, and stability of silver particles. This is all about science, not fluff. Customers should always do their own testing in order to verify that this silver corresponds to their needs

There is always the question of competition. Most competitor products contain ionic silver under the most common form of silver nitrate. It is widely available and inexpensive, and it is also easily sold. However, this is not the best form of silver, which is colloidal, and it is dangerous to put nitrates in your body.

Most products are easily made with a mixture of nanoparticles and a greater portion of silver salts. The process is ancient, easy enough that an experienced chemist can do it. Still, if you ask for high quantities and concentrations, they will give you the run around. Why? Because they cannot do it! With those easy chemistry methods and without advanced nanotechnology and state-of-the-art equipment, they cannot produce a uniform, stable, clean silver.

How do you confirm that they are using silver nitrate? They won't tell you up front, but you elicit the Tyndall effect, visualizing a laser beam through the silver solution. Put three to four drops of the product in a glass and shine a laser beam through it. If you see a clearly defined beam, that is the Tyndall effect.

Some claimed colloidal silver products are clear, but science says colloidal silver is darker because it is more concentrated; light is absorbed when more particles are present. There are some ways to minimize this slightly but not much. Low concentrations can exist in clear gel or liquid. If it is clear and there is no or minimal Tyndall effect, the product is very likely silver nitrate. If it looks like a duck, sounds like a duck, walks like a duck, it's a duck!

Anyone can manufacture colloidal silver rather simply by placing two silver wires connected to a battery in a glass of water. The hard thing is to make the particle size the same, to coat them so they can maintain stability and antimicrobial action, to concentrate them enough, and many other important properties.

You might be impressed by the facilities that appear in the pictures on websites, but no matter how fancy and modern the lab looks, you cannot be sure that it is actually where the product is being produced.

Sometimes the competition claims that their silver is not colloidal but contains suspended silver suspended. If it is not diluted, it is colloidal, for that is the very definition of colloidal silver. Some companies claim their product does not contain nitrates, but scientific analysis will often

prove this false. Silver nitrate is widely available and inexpensive. There is much inconsistency in advertising for silver products, and some even claim that colloidal silver is contaminated. Some claim their products are 96 percent charged, but the important thing is to determine if it is or is not actually colloidal silver.

A company may claim, "We offer the purest, safest, most effective colloidal silver hydrosols ever seen in the history of colloidal technology." All of these claims can be rebutted. All colloidal silver is pure, especially if uncoated. Safety is questionable if the product is not coated.

Consumers and users of silver products are always advised to be cautious. It is an industry, and companies do prey on consumer ignorance about some key facts about colloidal silver. This makes it very easy to make false, contradictory claims that sound good and back it up with false data.

APPENDIX 6

Frequently Asked Questions (FAQs) About Colloidal Silver

What is colloidal silver?

Colloidal silver is a stable dispersion of small silver particles (less than ~100nm) in a liquid, most often water.

What color is colloidal silver?

Due to particles scattering and absorption of radiation in the visible electromagnetic spectrum, silver colloids (sols) are typically yellow. The more concentrated the dispersion, the more intense the color. Products that are not colored either do not contain colloidal silver or contain only an extremely low concentration. Almost all transparent silver products on the market contain silver nitrate, and nitrates produce cancer.

How can you know if a solution contains particles?

A narrow laser beam sent through the solution will become visible; this is known as the Tyndall effect. If the laser beam is not visible, no particles are present.

What sizes and shapes do silver particles come in?

They are usually spherical but can also be like platelets. The dimensions vary from ~2nm to 100nm.

What is the optimum size? Can particles be too small or too big?

If particles are too small, they tend to aggregate, making the dispersion unstable and, thus, creating problems with long-term storage. If they are too big (above ~ 35 to 40nm) they tend to be trapped in various body tissues and organs, like debris caught in a sieve.

Is metallic colloidal silver required for an antimicrobial property?

The particle is not responsible for the antimicrobial effect; rather, it is the ionic silver resulting from the dissolution of metallic silver and oxidation of silver atoms to Ag^+ ions. For this reason, one can also use silver salts (such as silver nitrate) for antibacterial applications. However, nitrates are carcinogenic, and they also represent an inefficient method because they do not provide a slow release of silver ions in the targeted environment the way small silver particles do.

Does the size and shape of the particles affect the antibacterial effect?

They do, albeit only in a minor way. Smaller particles have a high surface energy (low curvature), which allows for faster dissolution of the metal and a more rapid increase in the concentration of Ag^+ ions responsible for the antimicrobial effects. For a similar size, shape plays a minor impact on how rapidly the needed silver ions concentration is attained.

By what mechanism is the antimicrobial effect achieved?

It is believed that silver ions interact with the sulfur-containing functional groups in the molecules of bacteria-blocking metabolic pathways and reproduction mechanisms. Other mechanisms proposed by some companies, like resonant frequency-killing bacteria, are not true.

Does colloidal silver work for nonbacterial agents, like viruses, parasites, or fungi?

Experiments and studies show that they do work as well on these infectious agents.

How can one make colloidal silver?

There are several methods, but it can be produced by treating salts with reducing agents like ascorbic acid or by generating silver atoms in water through an electric arc.

Should I drink this silver?

It is not recommended, because the particles may clump together in the digestive tract and form larger entities that may get trapped in the different organs, thus resulting in graying.

So graying is caused by excess silver?

It is something like the photographic silver exposed to light. Ingesting too much silver can lead to accumulation of in the body in the form of various organic salts. When exposed to light, these salts are reduced to metallic silver, giving the skin a darker hue. However, to reach this level one has to ingest a very large amount of silver. There have only been a few reported cases, and the gray color was the only issue. No other health problems can be linked to silver unless one ingests exaggerated amounts and chokes.

Can the silver-trapping and graying be prevented?

By using the right particle size, not exceeding 5 to 20nm, and coating the particles so they do not clump together, in the right amounts, this can be prevented. You should choose a high-quality colloidal silver, and the coating has to be specially designed not to be toxic and to allow ions to diffuse into the solution. This special coating also offers stability of the dispersion in time.

What is the right ppm for antibacterial effects?

Again, the antibacterial effects depend on the concentration of ionic silver established in the surrounding solution. It all depends on the size, shape, and time of contact. There is no clear, proven number. Various product specialists recommend different ppm concentrations for different products and their applications.

What is silver hydrosol?

This is basically another name for colloidal silver. It is also known as monatomic silver, silver hydrosol, covalent silver, and silver water. One should be wary and not confused, as there are only two forms of silver: colloidal silver, which releases ions too; or silver salts (ionic silver), which has an enormous amount of silver ions only. Colloid silver has some ions, but ionic silver has no colloids.

Are there real Angstrom size silver particles on the market?

They are not real colloids. They are likely solutions of silver salts, or ionic silver. One Angstrom is 0.1 nm, a tenth of a nanometer. Angstrom size particles mean less than 1 nm. The probability of someone producing stable angstrom size silver particles is slim to none, almost impossible. This performance would be at the frontiers of heavily scrutinized peer review science and would bring attention from the scientific world quickly. If someone would prove the existence of stable subnano silver particles they will certainly try to publish their important experiments in prestigious peer review scientific articles and will be recognized in their scientific field as a major contributor. For someone to claim it on the internet without any proof is stretching the believability factor to say the least.

APPENDIX 7

How to Choose the Best Commercial Colloidal Silver

When faced with a decision of which colloidal silver would be best for you, there are several things to take into consideration. Some of the most important are:

- Should you buy the product or make it yourself?
- Are you looking for particles or salts?
- Should you choose coated or uncoated?

There are several products on the market labeled "Colloidal Silver" and even more silver-based antibacterials. Most of those labels make dubious claims, and some companies even produce do-it-yourself kits for you to manufacture the products at home on your own. All of these products contain different concentrations and can be of various strengths. Even the color is not consistent.

Considering all these factors, it can be very difficult to choose the right colloidal silver product. Unless you understand the scientific basis, how silver chemically behaves, you will be a victim of unscrupulous marketers who will shamelessly feed you all sorts of imagined statistics and so-called facts, invented words and half-truths that mean nothing.

So, how do you choose the BEST silver product? Before you can make the right choice for your health, you must be able to discern fact from fiction, and this information is intended to equip you to do just that.

Buy it or DIY it?

There are two ways to get silver: You can make it yourself, or you can buy it. Which is better? While we live in a very DIY world and some things are better left to your own ingenuity, in the case of colloidal silver, it is definitely best to buy the best product.

Why is buying better? Let me say from the start that everyone and their mother can make colloidal silver at home by using nothing more than a battery with silver wires and a glass of water. Unfortunately, those who promote these methods fail to disclose how unusable and potentially dangerous the produced silver particles and ions can be. For more information on the dangers of ingesting too many silver ions, please refer back to some of the information in this book or see "Silver Particles vs. Salts."

The particles manufactured with home kits are electrically charged. As a result, they tend to quickly clump together, grow very heavy, and finally settle at the bottom of the glass. If ingested, these large silver clumps will either be non-absorbable, or else they will become trapped in the body tissues like debris caught in the bottom of a sieve. To make matters worse, homemade silver is quickly oxidized to silver oxide; this substance is very chemical and will present a whole other multitude of problems.

For all of these reasons, and for your convenience and safety, it is best to avoid the claims that homemade silver is the best option. Buy your silver already manufactured instead of trying to do it yourself.

Particles or Salts?

When you examine the silver products for sale, you will discover two varieties: particles or salts. Some marketing claims will indicate that there are other types, but this is simply not true. Of these two types of silver, your best bet is most definitely particles. Anything else is not actually colloidal silver. You may read or hear another label for silver-hydrosols, gels, ionic, etc.-but don't let this terminology confuse you. Silver comes in only two forms. Both particles and salts release ions, some more and some less. If someone tells you, "We have only ionic silver," this is a non-issue, as even the metallic silver will generate far more ions than necessary to be antimicrobial.

Only silver particles are colloidal. In colloidal silver, the particles are suspended in the liquid; they are not dissolved. The color of colloidal

silver is pale yellow to dark brown, depending on concentration.

In silver salts, however, the silver is ionic and is combined with another ion, most commonly silver nitrate. This product will be devoid of color, entirely transparent.

Beyond the labeling, there are two easy ways to detect if a product is actually colloidal silver (particles) or silver salts:

- Check the color. If it is yellowish or brownish, it is colloidal silver. If it has no color, it is safe to assume it is silver salts.
- Shine a laser light through the product. If you see a clear line, it is colloidal silver. If there is no light line, it is silver salts.

Another confirmation that the product consists of silver salts is that it will react very distinctly in the presence of table salts. Adding table salt will form a cloudy silver chloride precipitate that settles, and this is exactly what happens in the stomach if you ingest silver nitrates.

To coat or not to coat? That is the question.

Colloidal silver particles are available in their natural form or coated. When you have this option, it is most definitely better to choose coated silver.

This is really a no-brainer. Coated particles are safely enveloped with a substance that enhances their stability. It also keeps them from clumping together so they remain small, as they were originally created. The coating also has to be safely porous enough to release the silver ions from the bigger particles.

So how do you choose the BEST silver product? Simple!

Make it or Buy it? BUY IT

Particles (Colloidal) versus Salts? COLLOIDAL

Coated vs. Uncoated? COATED

APPENDIX 8

Colloidal Gold

History

Colloidal gold has been around since ancient times. The ingestion of gold is mentioned in the Bible (Exodus 32:20), and the Chinese were using it in 2500 BC as the "drug of longevity."

A precious metal that has been treasured throughout history, gold is often used as a symbol of wealth and power. Five thousand years ago, the Egyptians ingested gold for mental, bodily, and spiritual purification. The ancients believed gold worked in the body by stimulating the life force and raising the level of vibration on all levels.

The words *chemistry* and *alchemy* both originate from names given to red herbal elixirs of colloidal gold. The alchemists of Alexandria developed an elixir because they believed gold was a mystical metal that represented the perfection of matter. As gold was, itself, perfect, it was thought that it could produce perfection in the human frame and that its presence in the body would enliven, rejuvenate, and cure a multitude of diseases, as well as restore youth and perfect health.

The ancients devoted massive amounts of time and energy to alchemy and labeled a primitive form of colloidal gold the "elixir of life." Many alchemists studied and searched their whole lives to find a means of creating a potion made from liquefied gold, believing it would cure all sorts of bodily ailments and strengthen mental and physical capabilities.

Over the centuries, low doses of drinkable gold were considered beneficial for many conditions. According to several sources, colloidal gold has a balancing, harmonizing effect on all levels of health—body, mind, and spirit. It is used to improve mental attitude and emotional states. It has been reported to promote a feeling of increased energy,

willpower, mental focus and libido. Paracelsus prescribed liquid colloidal gold as something that "makes one's heart happy."

The Chinese were the first to prepare and use red colloidal gold as an alchemical drug of longevity. Alchemy began by synthesizing red colloidal gold from herbal elixir gold preparations to make the body everlasting and to confer the vigor of youth and make life eternal. The word alchemy is derived from two Chinese words: *kim* (gold) and *yeh* (juice). *Kimyeh* (gold juice) entered the Arabic language as *kimiya*, and with the definite article, al, the Arabic word for the red colloidal gold was *alkimiya*; in the Western world, we now know this as alchemy. The procedure for the preparation of red colloidal gold is still in use today in India, prescribed by Ayurvedic physicians for rejuvenation and revitalization in old age, for the nervous system, heart, liver, and as a detoxicant, anti-infective, and anti-aging product under the name of *swarna bhasma* (red gold).

Usefulness

According to studies, colloidal gold increases mental acuity and the ability to concentrate. Colloidal gold is thought to strengthen mental function and cognition by increasing the conductivity between nerve endings in the body and on the surface of the brain. A study showed that after four weeks on colloidal gold, participants exhibited a 20 percent increase in intelligence quotient (IQ) test scores.

Gold is considered by many cultures to be the master healer, stabilizer, harmonizer, and balancer. It is excellent for purification of the physical body. It is a symbol of wealth, prosperity, love, generosity, power, illumination, and sacredness. Gold balances the heart energies and amplifies thought forms. It was thought to be the metal with the highest capacity of accumulating and transmitting good intentions. It is used to open and activate the third-eye, crown energies, and clear negativity from the energy field. Gold has been used to attract healing, power, wisdom, money, and success.

Gold is said to strengthen the wearer's self-confidence, mind, heart, joints, and skin, and it is thought to bring wealth and happiness to its user. Gold

was used to enhance sexuality and creativity and is a great element for those going through difficult situations, including poor health. Those who are experiencing depression or lack of stamina use gold to help improve these conditions, bringing a more positive energetic influence into life. Patients feel an indescribable sense of wellbeing, and they claim they feel a lightening. Intellectual faculties are more active, and sexual life is enhanced.

Benefits of Gold

- Creates a feeling of greater physical, emotional, and mental wellbeing.
- Calms and balances the mind and deepens concentration, an ideal aide for meditation.
- Makes the body supple, deepening physical practices such as yoga and the martial arts.
- Increases body receptivity to wellness approaches.
- Improves memory, focus, and intellectual acuity over time.
- Strengthens the immune system and stimulates liver function.
- Assists in promoting cardiac health, heals the skin, enhances sexuality.
- Helps relieve mild or occasional insomnia and depression.

Colloidal metallic gold has been used since ancient times as a remedy for revitalization, rejuvenation, and to improve memory and mental alertness. Red gold was considered an elixir of life and longevity and by some as an elixir of happiness and immortality. Colloidal gold, by virtue of being the founding element of alchemy, served as the spark behind all modern chemistry marvels and modern human civilization.

Modern Uses of Gold

Today, medical uses of gold have expanded greatly. It is used in surgery to patch damaged blood vessels, nerves, bones, and membranes. It is also

used in the treatment of several forms of cancer. Injection of microscopic gold pellets helps retard prostate cancer in men. Women with ovarian cancer are treated with colloidal gold, and gold vapor lasers help seek out and destroy cancerous cells without harming their healthy neighbors. Every day, surgeons use gold instruments to clear coronary arteries, and gold-coated lasers give new life to patients with once-inoperable heart conditions and tumors.

Gold has become an important biomedical tool for scientists studying why the body behaves as it does. By attaching a molecular marker to a microscopic piece of gold, scientists can follow its movement through the body. Because gold is readily visible under an electron microscope, scientists can now actually observe reactions in individual cells.

Some researchers have placed gold on DNA to study the hybrid genetic material in cells. Others use it to determine how cells respond to toxins, heat, and physical stress. Because it is biologically benign, biochemists use gold to form compounds with proteins to create new lifesaving drugs.

Colloidal and metallic gold is extremely safe for biological systems, without any known side effect. For many other considerations, though, particle size or carried molecule mismanagement, as well inappropriate use of enormous amounts of gold, raise some concerns.

There is ample evidence that gold nanoparticles are very effective delivery vectors for many drugs. They are well tolerated by the body, can effectively access all organs, and can also enter the intracellular space. In order to be able to effectively travel through the body, the gold nanoparticles must not be too large and must remain highly dispersed in the blood and other body fluids. Unfortunately, this is a technological obstacle most manufacturers do not understand or care to consider.

Gold nanoparticles are excellent delivery vectors and carriers to cancer cells, as they selectively accumulate many times more in cancer cells, injury sites, or inflammation than in healthy or non-cancerous cells. Furthermore, it has been shown that in certain cancer lines, gold

nanoparticles, alone and without being covered, have been able to induce apoptosis and, therefore, stop cancer.

Nanobiosilver.com and Goldsol, Inc. (www.goldsolinc.com) an Arizona advanced materials company, obtained unique gold nanoparticle carriers and highly concentrated, uniform colloidal gold. This particular product is well absorbed, bioavailable, and biocompatible. It has unmatched concentration, purity, and particle uniformity. This gold nanocarrier particle will resonate with a specific electromagnetic frequency. It is very efficient and can reach and enter target cells and cell components. When exposed to this specific frequency, gold particles vibrate with increased amplitude. Once a certain energy absorption threshold is attained, local heat effect is generated, and the carried substance can unload to the targeted body site, at least partially.

The fabulous healing properties of gold are, slowly but surely, being rediscovered, as modern scientists and physicians uncover what the ancients seemed to have known all along: Gold is, indeed, a very precious metal!

APPENDIX 9

Gold Concentration Equivalents

0.3 mMol/L =	0.06 g/L =	60 mg/L =	0.006 % =	60 ppm
0.5mMol/L =	0.1 g/L =	100mg/L =	0.01 % =	100 ppm
1 mMol/L =	0.2 g/L =	200mg/L =	0.02 % =	200 ppm
1.5 mMol/L =	0.3 g/L =	300 mg/L =	0.03 % =	300 ppm
2.5 mMol/L =	0.5 g/L =	500mg/L =	0.05 % =	500 ppm
5 mMol/L =	1 g/L =	1,000mg/L =	0.10 % =	1000 ppm
10 mMol/L =	2 g/L =	2,000mg/L =	0.2 % =	2000 ppm
12.5 mMol/L =	2.5 g/L =	2,500mg/L =	0.25 % =	2,500 ppm
25 MMol/L =	5 g/L =	5,000mg/L=	0.5% =	5,000 ppm
50 mMol/L =	10 g/L =	10,000 mg/L =	1% =	10,000ppm
100 MMol/L =	20 g/L =	20,000 mg/L =	2% =	20,000ppm
125 mMol/L =	2.5 g/L =	25,000 mg/L =	2.5% =	25,000ppm
250 mMol/L =	5 g/L =	50,000 mg/L =	5% =	50,000ppm
500 mMol/L =	10 g/L =	100,000 mg/L =	10% =	100,000ppm
1000mMol/L=	20 g/L =	200,000 mg/L =	20% =	200,000ppm
1 ppm =	1 mg/L, or 1 ppm =	1 mg/1,000,000mg (water has specific gravity of 1 g/mL)		

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Fig. 1: Silver Coins and Cup

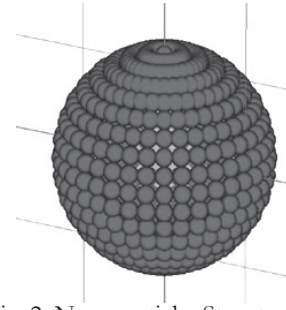


Fig. 2: Nanoparticle Structure

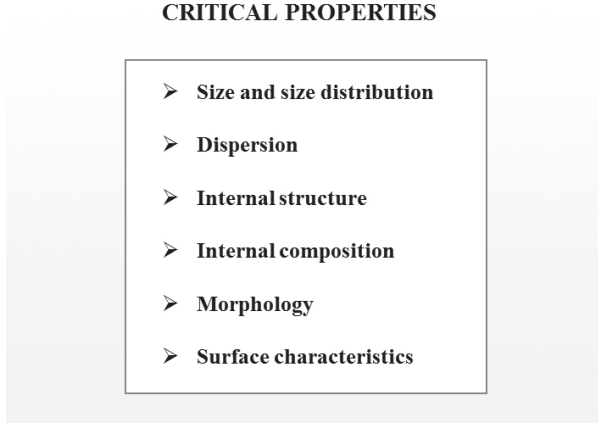


Fig. 3: Critical Properties of Nanoparticles (NP)

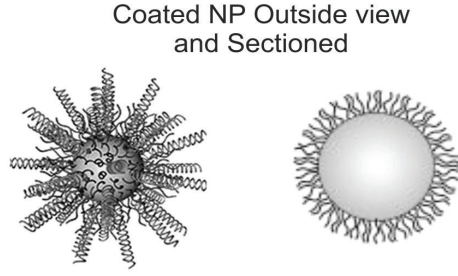


Fig. 4: Coated NP Outside view and Sectioned

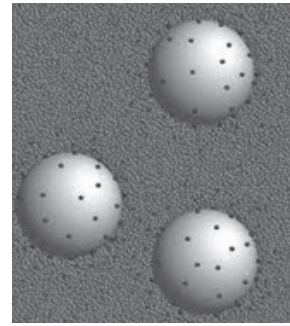


Fig. 5: Nanoparticles With Ions

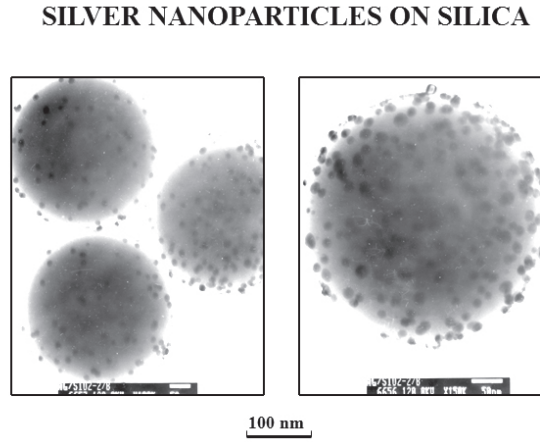


Fig. 6: Silver Nanoparticles on Silicia

Fig. 7: Image of Increasing Concentrations of NP in a Liquid

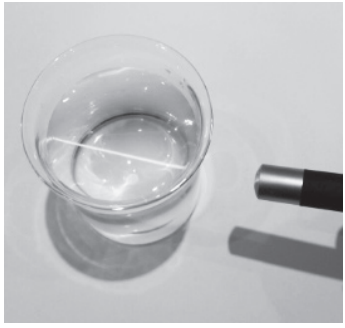


Fig. 8: Tyndall Effect

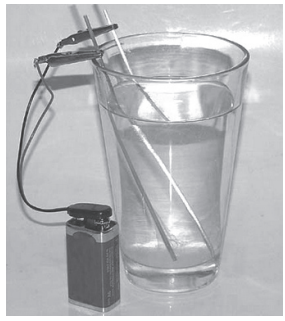


Fig. 9: Colloidal Silver Home Generator

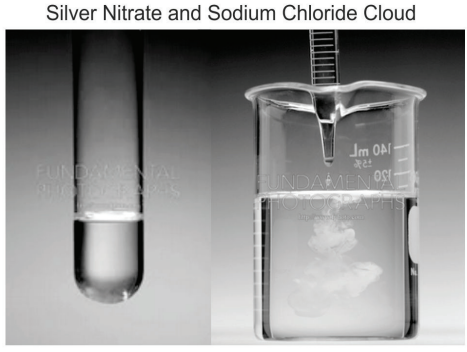


Fig. 10: Clear Silver Nitrate and Sodium Chloride Cloud

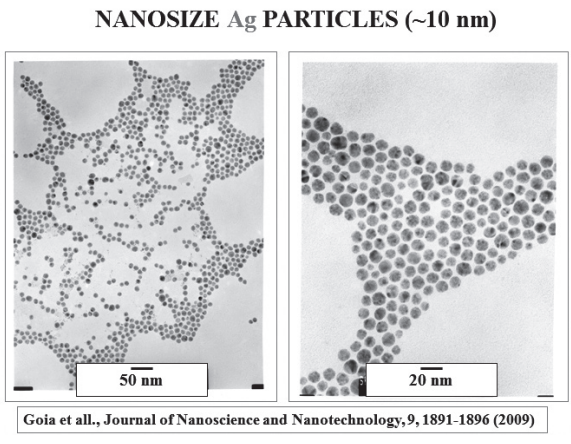


Fig. 11: Nanosize Ag Particles (~ 10 nm)

DEGREE OF DISPERSION

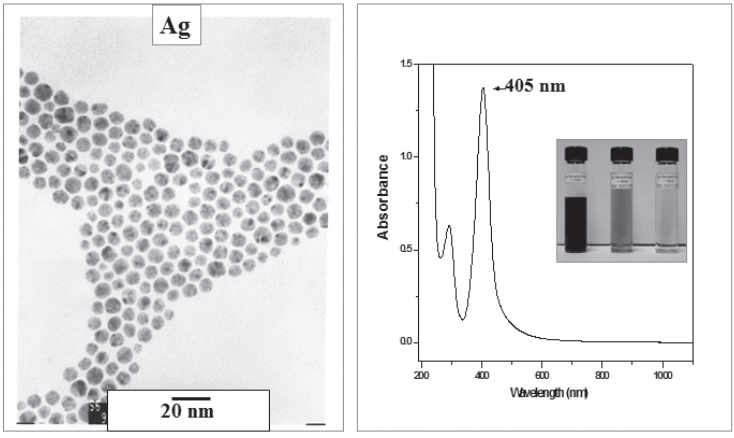


Fig. 12: Nanoparticles: Degree of Dispersion

HIGHLY DISPERSED METALLIC PARTICLES

Key features	- Uniform - Well dispersed (Non-agglomerated) - Low level of impurities (organic/inorganic) - Good dispersion (tailored for specific media)

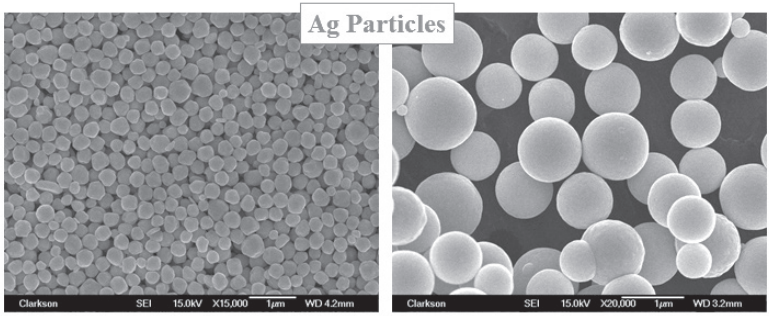


Fig. 13: Highly Dispersed Metallic Silver Nanoparticles

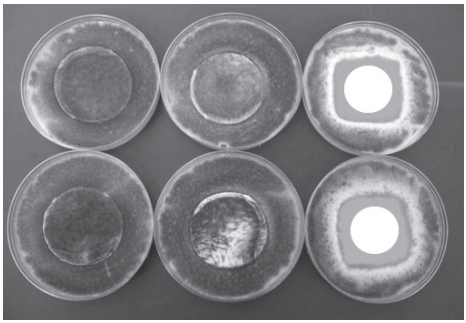


Fig. 14: Silver Patches in Bacterial Plates

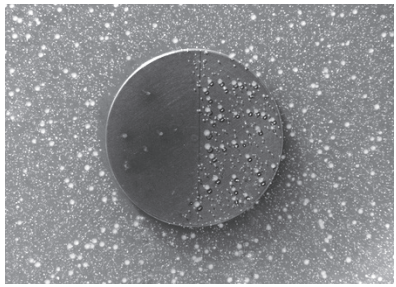


Fig. 15: Bacterial Growth on Stainless Steel Silver Treated vs Untreated

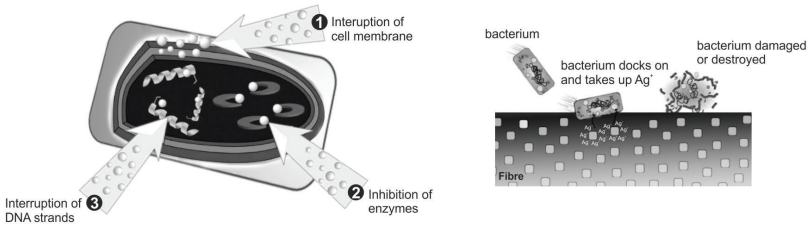


Fig. 16: Silver Ion Mechanism of Action

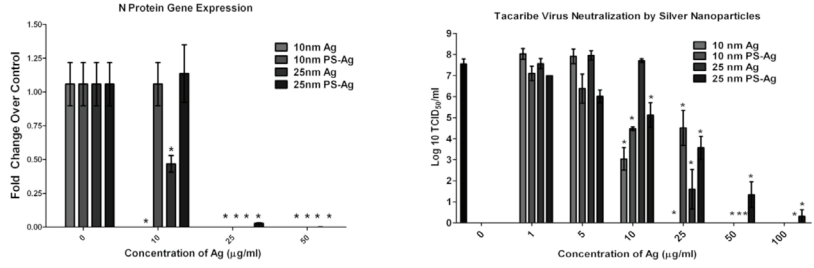


Fig. 17: Tacaribe Virus Neutralization by Silver Nanoparticles

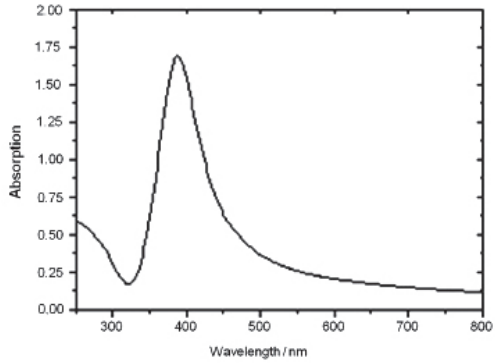


Fig. 18: Resonant Frequency Of Silver NP

SILVER NANOPARTICLES

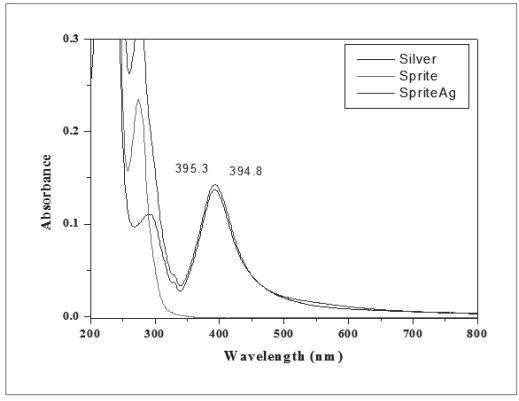


Fig. 19: Silver Nanoparticles Stability in Sprite

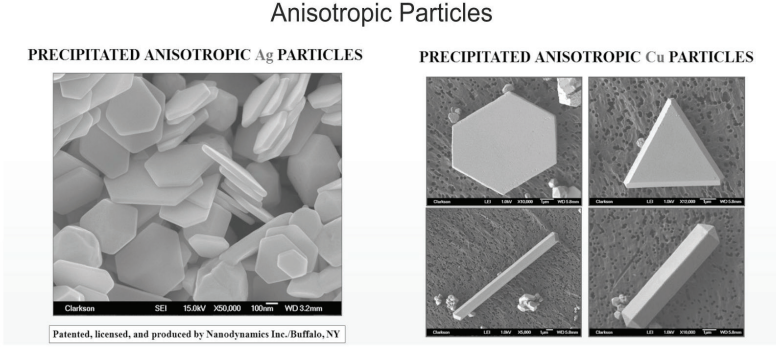


Fig. 20: Anizotropic Nanoparticles

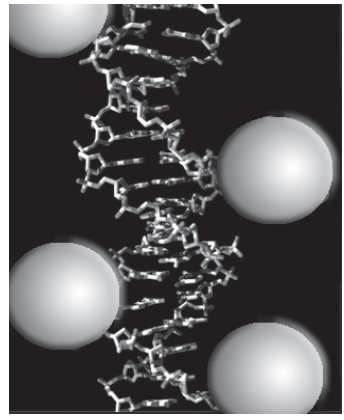


Fig. 21: Nanoparticles Linked to DNA

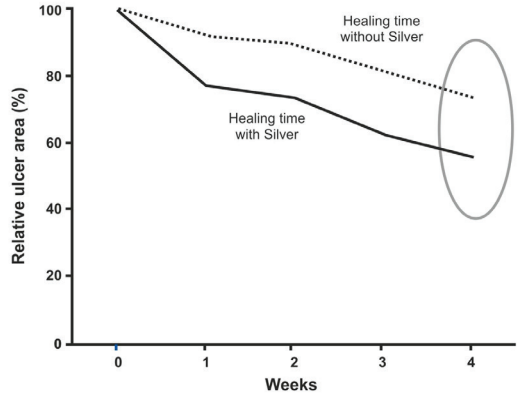


Fig. 22: Wound Healing Time

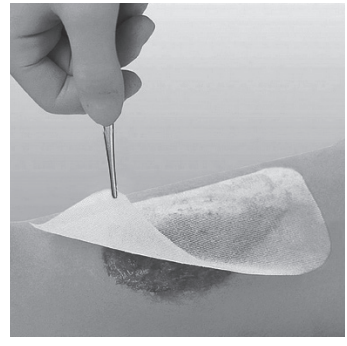


Fig. 23: Wound With Silver Dressing

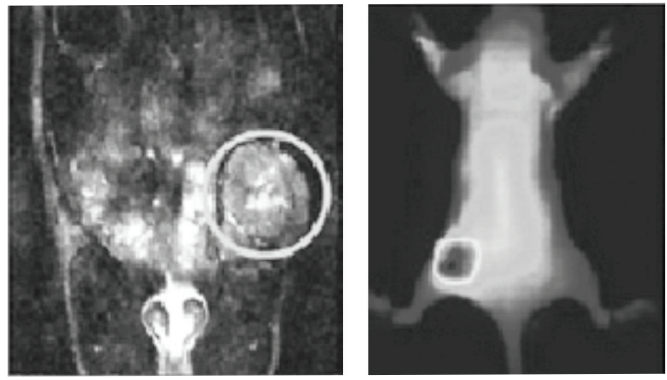


Fig. 24: Nanoparticles in Medical Diagnostics

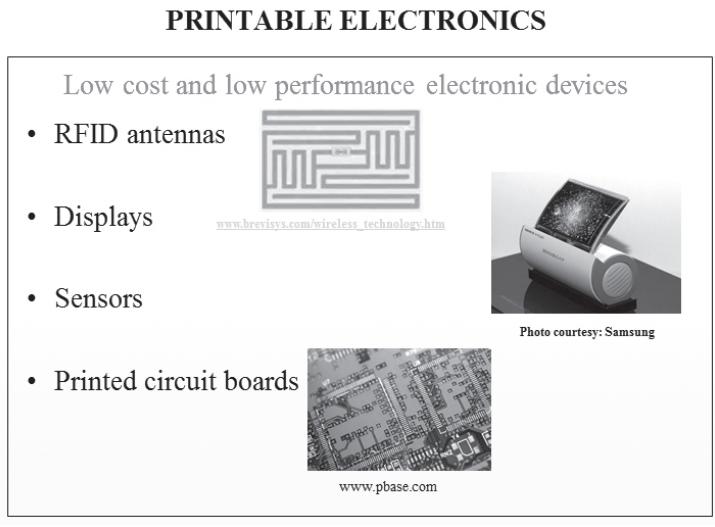
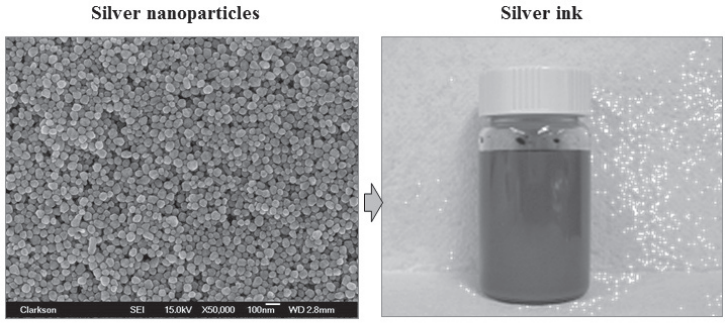


Fig.: 25: Nanoparticles in Printable Electronics

INKJET PRINTABLE ELECTRONICS



Andreescu, D.; Eastman, C; Balantrapu, K; Goia, D. V; Journal of Materials Research (2007), 22(9), 2488-2496

Fig. 26: Nanoparticles and Inkjet Printable Electronics

DEGREE OF DISPERSION

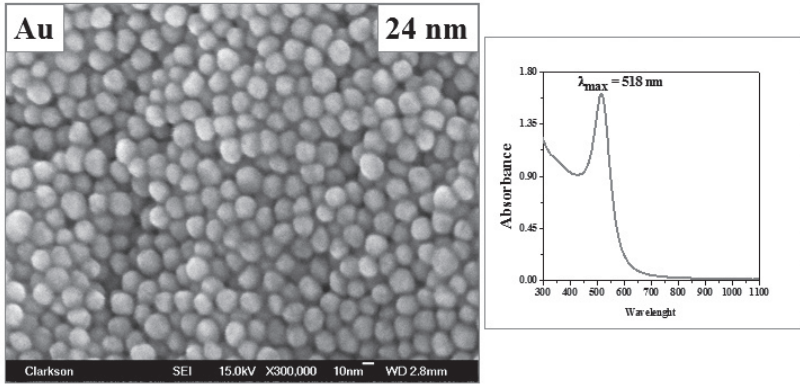


Fig. 27: Nanoparticles and Inkjet Printable Electronics

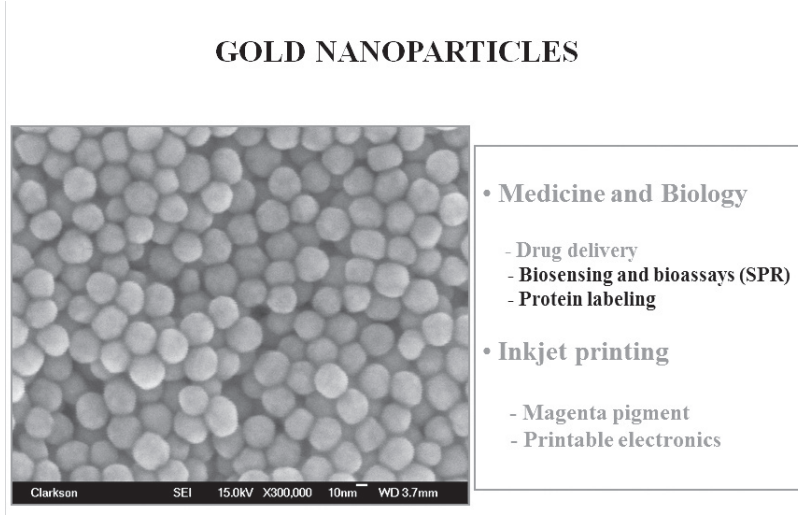
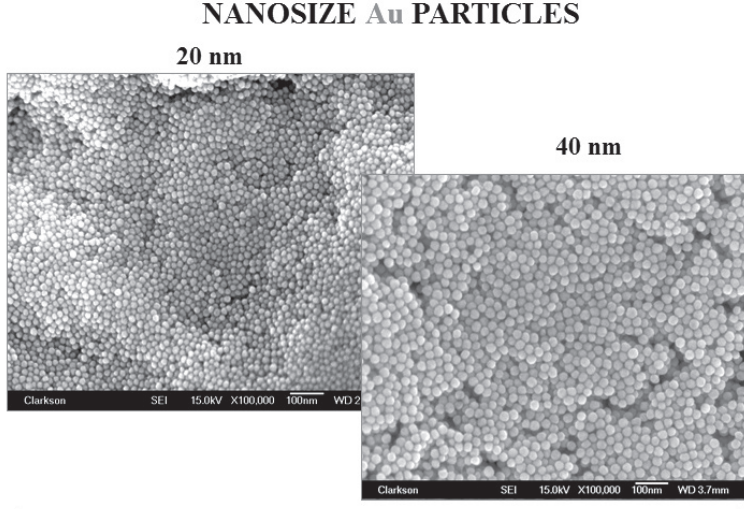


Fig. 28: Degree of Dispersion of Gold Nanoparticles



B.J. Morrow, E. Matijevic, D. V. Goia, *J. Col. and Interface Sci.* 335 (2009) 62

Fig. 29: Nanosized Gold Particles

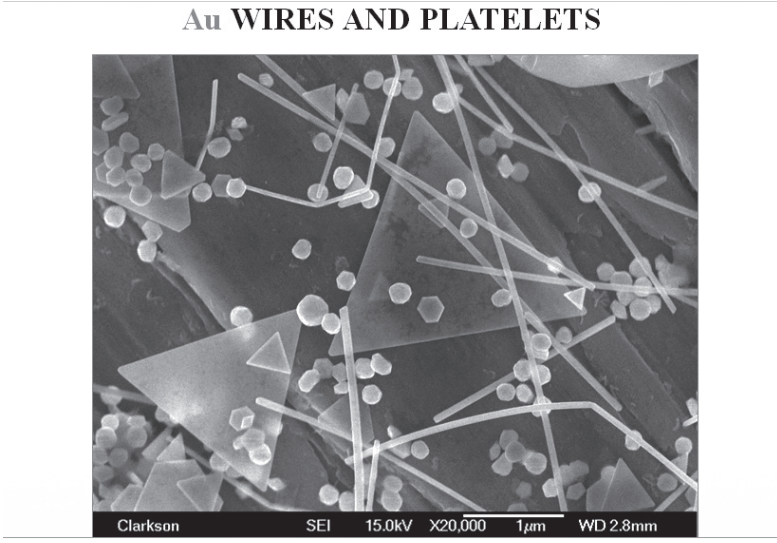


Fig. 30: Gold nanowires and Nanoplatelets

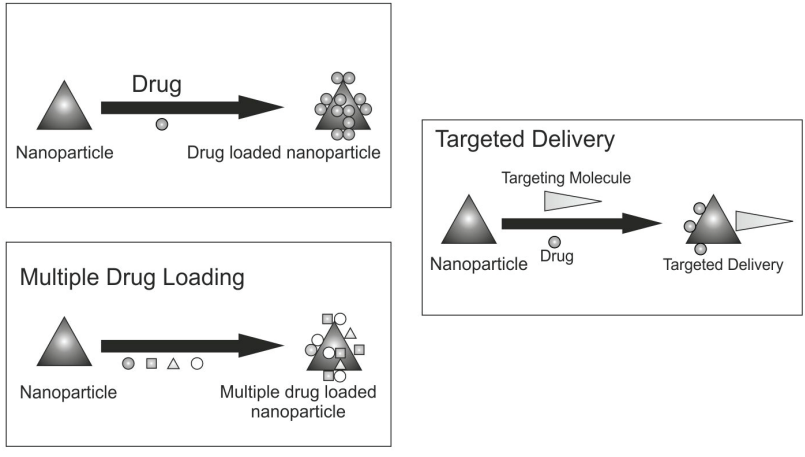


Fig. 31: Gold Nanoparticles in Drug Delivery