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# Ecofriendly Synthesis of Gold Nanoparticles (GNPs) from Antarctic Bacteria for Therapeutic Use

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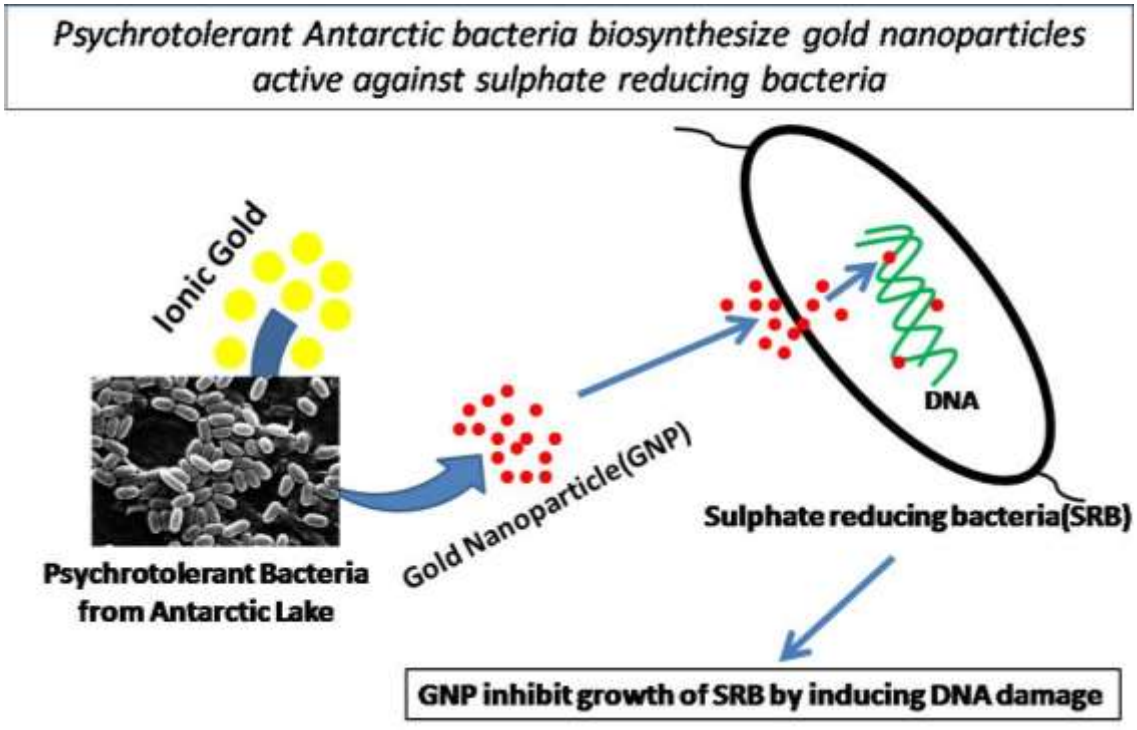
The National Center for Polar and Ocean Research (NCPOR) and the Goa University (GU) have successfully synthesized Gold Nanoparticles (GNPs) using an Antarctic Bacteria (Psychrotolerant Antarctic Bacteria) through a non-toxic low-cost ecofriendly way. These GNPs can have effective therapeutic use in anti-cancer, anti-viral, anti-diabetic and cholesterol-lowering drugs.

The NCPOR-GU study revealed genotoxic effect of gold nanoparticles on a Sulfate Reducing bacteria (SRB). The GNPs inhibited the growth of the SRB and its sulfide production by damaging the genetic information of the DNA of the bacterial cell. Genotoxicity describes the property of a chemical agent that is capable of damaging the genetic information of DNA and thus causing mutation of the cell, which can lead to cancer. The NCPOR-GU study found that gold (Au) nanoparticles have antimicrobial properties as they changed the genetic information of the DNA of the Sulfate Reducing Bacteria.



Nanoparticles (NP) have wide variety of potential applications in the field of biomedical, optical and electronics research. Metallic nanoparticles have been efficiently exploited for biomedical applications and among them gold nanoparticles (GNP) are found to be very effective in biomedical research.

**What is a Nanotechnology and nanoparticles?**

Nanotechnology is a technology that creates new and novel materials through controlled manipulation at a size range of 1 nm to 100 nm (1nm equal to $10^{-9}$ m)**.**

Any material with at least in one dimension smaller than 100 nanometers are called **nanoparticles (NPs)**. Nanoparticles have a high surface to volume ratio and provides tremendous driving force for diffusion, especially at elevated temperatures. Sintering, i.e. coalescing into solid or porous mass by means of heating without liquefaction can occur at lower temperatures at shorter time scales than larger particles. Gold nanoparticles are melted at much lower temperatures (300 $^{O}$C) than bulk gold (1064 $^{O}$C). Nanoparticles have been found to impart various desirable properties to different day to day products. For example, gold nanoparticles are found to have greater solar radiation absorbing ability than the conventional bulk gold and therefore make them better candidate to use in photovoltaic cell manufacturing industry.

**Why Gold Nanoparticles (GNPs)?**

GNPs have unique optical properties too. For example particles above 100 nm show blue or violet color in water, while the color becomes wine red in 100 nm gold colloidal particles. They can thus be used of therapeutic imaging. GNPs also have unique physicochemical properties. Their biocompatibility, high surface area, stability, and nontoxicity make them suitable for various applications in therapeutic use including detection and diagnosis of diseases, bio-labeling, and targeted drug delivery. As nano-carriers, GNPs are capable of transferring various drugs made out of peptides, proteins, plasmid DNAs, small interfering RNAs and chemotherapeutic agents to target diseased cells of the human body.

Gold NPs are also found very useful in electronics industry. Scientist have constructed a transistor known as NOMFET (Nanoparticle Organic Memory Field-Effect Transistor) by embedding GNPs in a porous manganese oxide as a room temperature catalyst to breakdown volatile organic compound in air and combining gold nanoparticles with organic molecules. NOMFETs can mimic the feature of the human synapse known as plasticity, or the variation of the speed and strength of the signal going from neuron to neuron. These novel transistors can now facilitate better recreation of certain types of human cognitive processes, such as recognition and image processing and have their application in artificial intelligence

NCPOR and GU have been using eco-friendly techniques to reduce gold ion to gold nanoparticles using Psychrotolerant Antarctic bacteria. Their experiment utilizes environmentally acceptable green chemistry procedures without the need of using synthetic chemical additives as stabilizing or reducing agents. Use of Psychrotolerant Antarctic bacteria thus is found to have special advantages like mild reaction condition to reduce gold ion to Gold Nanoparticles (GNPs) with a good dispersion capability. During the present study conducted by NCPOR-GU, 20-30nm sized spherical shaped GNPs could be synthesized in a controlled environment, which would provide an opportunity to use the GNPs as composite therapeutic agent in clinical trials.

Led by Dr. Kirti Ranjan Das of Environmental Impact Assessment cell of NCPOR, the research team comprised of Dr. Anoop Kumar Tiwari, Senior Scientist at NCPOR and Prof. Savita Kerkar of the Dept. of Biotechnology, Goa University. Their research paper has been recently published in the *Journal of Preparative Biochemistry & Biotechnology*. (**India Science Wire**)