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World without Antibiotics: Nanotechnological Approaches

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Editorial

From the time Sir Alexander Fleming identified penicillin, antibiotics ruled over the microbial world nearly 90 years; however, now many bacterial species developed resistance to not only to classical natural antibiotics but even latest newly generated synthetics antibiotics and have become "Super Bugs". Antibiotic resistance poses a major threat to clinical medicine and public health. Antibiotics are not only taken for the treatment of classical infections but It is taken by us without the infection and that too in overdose through meat we eat. According to one estimation, 33 tons of antibiotics used per year to keep animals (used for milk and meat) to keep them healthy. In response to the global threat posed by antibiotic resistance surveillance of antibiotic resistance started by many organisations. Without going in details the mechanism of their resistance to the anti bacterial drugs lets accept it that now it is not possible to control bacterial population with antibiotics.

We have to manage the infectious diseases and therefore have to find alternative(s) to antibiotics. Nanotechnology is a rapidly growing and nanomaterials are increasingly becoming a part of our daily lives. The applications of these have a wide range starting from capturing energy to modern medicine. Nanotechnology is showing much promise to replace antibiotics; many nanotechnological products are in vogue, however still they are not being used in clinical practice that much. The graphene oxide and ZnO nanoparticles showed much promise to replace antibiotics. It is stable as well non toxic. It wraps around the bacteria, puncturing its membrane, thus the broken membrane prevents the bacteria from growing. The bacteria lose their complex structure and disintegrate and finally, they are killed. Since graphene is just carbon -- a building block of life -- its cytotoxicity against human cells is much lower compared to any drug-based antimicrobial therapy.

Unique properties of silver nanoparticles are seen as a leader in the fight against pathogenic microbial activity. Silver nanoparticles are effective against a broad spectrum of Gram-negative and Gram-positive bacteria, including some antibiotic-resistant strains, The group of Gram-negative bacteria, against which the biocidal activity of silver nanoparticles has been confirmed, Recent studies have shown that the use of silver nanoparticles in combination with certain antibiotics such as penicillin G, amoxicillin, erythromycin, clindamycin and vancomycin, creates a synergic effect in the fight against *Escherichia coli* and *Staphylococcus aureus* . Research has shown that silver nanoparticles can also be an effective weapon in the fight against viruses and certain fungi. On controlling their sizes (>2) nm of the gold nanocluster surprisingly also acquire high wide-spectrum antimicrobial activity.

Nanoparticles are increasingly used to target bacteria as an alternative to antibiotics. Nano science can offer various accurate, economical and less time-consuming methods, which will help to avert microbial spread and its consequences. The antibacterial activity of nanoparticles is poorly understood. Nevertheless, in Ayurveda from time immemorial silver and gold ashes (Nano particles) were given as preventive doses for many diseases including infectious ones; however, further toxicological studies can add to the confidence. Currently accepted oxidative stress induction, metal ion release, and non-oxidative mechanism are fairly established for killing microorganisms by nano products. Furthermore, it is also difficult for bacteria to develop resistance because of killing mechanisms are quite different than that of antibiotics.

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