



Application of Nanotechnology in Medical Textiles & its Impact on Environment

Kamalja Mahesh Deelip, Khatik Salman Faruk.

[1][2] RC Patel Institute of Pharmaceutical Education & Research, Dhule, India.

Maheshkamalja17@gmail.com, khatiksalman6@gmail.com.

Abstract

Nanotechnology is a budding field with a wide range of applications into a number of spheres. One of these applications is the use of Nanotechnology in the field of Medical Textiles. The most common use is the use of fibers treated with the Nano synthesized materials so as to enhance the antimicrobial activity of the fibers. The nanomaterial has both positive and negative impacts on the environment and its organisms. In the present paper, the application of Nanotechnology in Medicated Textiles & the footprints it leave on the environment have been discussed. The impact of nanotechnology on environment can be described into two main aspects: Innovation in Nanotechnologies helpful to improve the environment, another aspect is the type of pollution that Nano technological materials might cause if released into the environment. Hence, there is a need of researches to be carried out to optimize the use of nanotechnology which will prove to be beneficial for the environment & its organisms.

I. Introduction

Nanotechnology is defined as ‘the use of various materials in the form of particles of size ranging at least from 1 to 100 nm. The small size of the particles provides a larger surface area because of which there is greater bioavailability of the drugs and other substance and also assures sustain release of drugs. The fibers encoated with such nanoparticles shows greater antimicrobial activity. For example, the silver, Curcumin nanoparticles impregnated on woven cotton showed enhanced antimicrobial activity against bacteria such as Escherichia Coli, Staphylococcus aureus & Klebsiella Pneumonia. Along with this, the use of Zinc oxide particles were found to be useful in blocking the UV rays from reaching to the skin. These particles are used either in the form of creams or incorporated into the fabrics so as to produce clothes which will deflect the harmful ultra violet rays. Contradictory to the benefits of Nanotechnology to the environment, it also has several toxic effects to the environment & its organisms. This negative impact is termed as Nano-pollution. Nano pollution is the waste generated through manufacturing process of Nano devices or by using Nano products if not properly released into the environment. Eco toxicological effect of Nano particles and its potential for bioaccumulation in plants and microorganisms is a current topic for research, as nanoparticles are considered to present novel environmental impacts. U.S government has spent US\$710 million in 2002 on nanotechnology research; \$500,000 was spent on assessment of impact of nano particles on environment. The capacity for Nano particles to function as a transport mechanism also raises concern about the transport of heavy metals and other environmental contaminants. Two main concerned areas can be identified. First, in their free form nano particles can be released into the air or water during production, or production accidents, or as waste by-product of production, and ultimately accumulate in the soil, water, or plant life. Second, in fixed form, where they are part of a manufactured substance or product, they will ultimately have to be recycled or disposed of as waste. Scrinis identified about Nano pollution, and argues that it is not currently possible to precisely predict or control the ecological impacts of the release of these Nano-products into the environment. A May 2007 Report to the UK Department for Environment, Food and Rural Affairs noted concerns about the toxicological impacts of Nano particles in relation to both hazard and exposure. The report recommended comprehensive toxicological testing and independent performance tests of fuel additives. Hazards of Nano particles have been identified by Uskokovic in 2007. Concerns have drawn attention about Silver Nano technology which was used in appliances like air purifier and washing machine manufactured by Samsung.

II. Nanotechnology in medicinal textiles

Textiles on contact with human body due to generation of temperature and humidity provide suitable substrate for microorganisms to grow. However the use of antimicrobial agents is avoided due to their toxic effects thus there are increase in application of Nano particles and their composites as an alternative. The use of materials prepared by nanotechnology is expected to increase over the next few years. Nanotechnology can provide high

durability for fabrics because nanoparticles provide large surface area to volume ratio and high surface energy, thus presenting better affinity for fabrics, leading to an increase in durability of the function.

III. Bamboo rayon-copper nanoparticle composites

Due to awareness of health and hygiene antibacterial textiles are gaining importance. Other polymer containing compounds are much prone to microbial attacks and thus their use in textiles is restricted. Natural fibers are excellent medium for the growth of microorganisms as their growth requirements are fulfilled. Metal Nano particles are mostly used for their antibacterial activities but are less durable hence there are few limitations. Bamboo rayon fabric grafted with acrylic acid can be used as backbone to immobilize copper Nano particles. Bamboo rayon-copper nanoparticle composites show antibacterial activity against both Gram positive as well as Gram negative bacteria. Also are durable till 50 washings. The release studies show that there is lower release of such Nano particles in aqueous media showing better immobilization of Nano particles on grafted bamboo rayon. Such modified fabrics can be used to avoid infections due to infected clothes in hospitals. Also they are economic with effective antibacterial activity. Bioactive compounds from herbal plants like Curcumin longa and Datura metel can be extracted, standardized and their Nano particles can be prepared by certain methods. These types of fabrics show very high antibacterial activities of cotton fiber when compared to other fibers as the treatment of fibers with such substances proves to be an absorbent which is capable of keeping away the fabrics from the microbial contaminations. Moreover, these are substances are economic, biodegradable and can be obtained anywhere.

IV. Health implications of nanotechnology

In manufacturing of different products Nano fibers are used from aircraft wings to tennis rackets. Pulmonary diseases like fibrosis may be caused through inhalation of airborne Nano fibres and Nano particles. Researchers have found that Nano particles settled in the brain and lungs if animals breathed in that atmosphere, which leads to increases in biomarkers for inflammation and stress response and those Nano particles, induce skin aging through oxidative stress in hairless mice. A research at UCLA's School of Public Health found lab mice consuming nano titanium dioxide shown DNA and chromosome damage to a degree linked to all the big killers of man, namely cancer, heart disease, neurological disease and aging. Recently a major research was published in *Nature Nanotechnology* suggests some forms of carbon Nano tubes – a poster child for the nanotechnology revolution – could be equally harmful like *asbestos*. It is inhaled in sufficient quantity. *Anthony Seaton* from Institute of Occupational Medicine in Edinburgh Scotland said some of the materials must be handled carefully because they have potential to cause diseases like mesothelioma. A newspaper article reports has found that workers of paint factory developed serious diseases related to lungs and Nano particles were found in their lungs.

V. Environmental remediation

Nano remediation is used widely for the treatment of ground water. It is also helpful in the wastewater treatment with extensive research. Nano remediation has also been tested clean-up of soil and sediment clean-up. Even more preliminary research is exploring the use of Nano particles to remove toxic materials from *gases*. Some other methods of Nano remediation like the use of Nano zero valent iron for purification of groundwater have been deployed on clean-up sites. Nano remediation is an emerging industry, around the world 44 clean-up sites of Nano remediation technologies had been documented, predominantly in the United States. During Nano remediation, a Nano particle agent must be brought into contact with the target contaminant under conditions that allow a detoxifying or immobilizing reaction. This process typically involves a pump-and-treat process or in situ application. Other methods remain in research phases.

VI. Conclusion

There is a long list of the positive aspect of nanotechnology for discussion like life-saving developments in medicine, overcoming the world's current environmental problems, other beneficial effects presented in this website and of course other positive additions which have not been mentioned on this website. We must mention that there are new developments everyday which have yet to be documented and made accessible for public. It is equally important to mention the negative effects of nanoparticles should be overlooked before they are released. Other points of thought in the positive/ negative discussion are mentioned below. A study in 2007 details how cost effective Nano materials can be created which is not only safer, but also perform better than conventional materials. *Green Nanotechnology: It's Easier than You Think*, was written by the Washington D.C. think tank, the Woodrow Wilson International Centre for Scholars. A free online study which is based on a series of dialogues with scientists, policymakers and industry representatives about green nanotechnology. On the instrumental level, concerns include the possibility of military applications of nanotechnology as well as enhanced surveillance capabilities through Nano sensors. In future researchers are working on the possibility of nanotechnology being used to develop chemical weapons and because they will be able to develop the chemicals from the atom scale up, but the critics fear that chemical weapons manufactured using Nano particles will be more dangerous than present chemical weapons. Believe it or not there is a very real fear out there that one

day this world will be controlled by robots. This is not as far removed as one might think as robots are becoming freakishly independent. For creation of robots the credit goes to nanotechnology, because without that it would have been an impossible task.

References

- [1]. Gyorgy Scrinis, Nanotechnology and the Environment: The Nano-Atomic reconstruction of Nature, Chain Reaction 97, 23–26, 2007.
- [2]. Vuk Uskokovic, Nanotechnologies: What we do not know, Technology in Society 29: 43–61, 2007.
- [3]. Royal Society and Royal Academy of Engineering, Nanoscience and nanotechnologies: opportunities and uncertainties, 2004.
- [4]. Crane, R. A, T. B. Scott, Nanoscale zero valent iron: Future prospects for an emerging water treatment technology, Journal of Hazardous Materials, 211–212, 2012.
- [5]. Mueller, Nicole C, Jurgen Braun; Johannes Bruns; Miroslav Cernik; Peter Rissing; David Rickerby, Bernd Nowack, Application of nanoscale zero valent iron (NZVI) for groundwater remediation in Europe, Environmental Science and Pollution Research 19 (2), 550–558, 2012.
- [6]. Mauro Ferrari, Cancer nanotechnology: opportunities and challenges, Nature Reviews Cancer 5, 161–171 (March 2005)
- [7]. Omid C. Farokhzad, Robert Langer, Impact of Nanotechnology on Drug Delivery, ACS Nano, 2009, 3 (1), pp 16–20.