

Nano Toxicity: Due to Drug Delivery and Environmental Exposure

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Abstract

Nanotechnology is undergoing a vast expansion in materials science, Research and Development. Nano scientists are focusing on synthesis and development of nanoparticles, nanomaterials, and bio nano composite materials. The drug delivery is also a recent development where in bio nano materials are being used for diagnosis of the various diseases. The synthesis of nanomaterials at large scale causes health risk due to the exposure via inhalation, skin contacts and ingestion; based on the characterisation of bio nano materials. The use of bio nanomaterials in drug delivery as well as the environment exposure during the large-scale synthesis of nanomaterials, the bio nanomaterials into human body. The exact mechanisms, chemical reactivity and enzymatic reaction is not well understood, documented, and studied. Therefore, the intake bio nanomaterials via drug delivery or environment exposure amounts to health risk and need to be studied in detail.

Introduction

Nanosciences and Nanotechnology is the study and use of nanomaterials falls in the range of 0.1nm to 100nm which corresponds to 0.2nm- water molecule, 7nm-haemoglobin, 10-100nm - virus, -1µm - microbial cells and >2µm - protozoa. The synthesized and developed nanoparticles, nanomaterials, and Bio nanomaterials are being used in various fields. The recent advances in the field of material sciences include the synthesis of Bio nano material for use in drug delivery. Bio nanotechnology companies are designing drugs for various diseases such as heart disease, kidney stones, and cancer cosmetic generic products using a short fragment of DNA as a new type of drugs. These drugs are assembled in nano chips and as nanoparticles for delivering into human body and are effective in using the sick/diseased and healing the injuries. Bio nano products are diverged as bio chip and Nano medicine, bio nanotechnology products which include Nano medicine, nano material, micro detectors, Nano sensors and herbal medicine [1].

Drug nano crystals are particles made from 100% drug; typically, surfactants or polymeric steric stabilizers stabilize them. These particles possess a 100% drug loading in contrast to matrix nanoparticles consisting of a polymeric matrix (polymeric nanoparticles or a lipidic matrix i.e. Nano emulsions, liposomes |

or lipid nanoparticles. Thus, the high loading makes them very efficient in transporting drug to or into cells, reaching a sufficiently high therapeutic concentration for the pharmacological effect [4-8].

Health Risk

The scientific evidence demonstrates the potential for nano material to be toxic to the humans or the environment; therefore, synthesis of nanoparticles and bio nano composites and their use causes health risk due to intake - drug delivery and environment exposure that need to be studied before making the wider application of bio nanomaterials. The smaller a particle, the greater it's surface area to volume ratio and the higher its chemical reactivity and biological activity. The extremely small size of nanomaterials also means that they are more rapidly taken up by the human body than larger sized particles. Nanomaterials can enter into the body through inhalation, ingestion or skin contacts. Nanomaterials are able to cross biological membranes and access cell tissues and organs. The greater chemical reactivity of nanomaterials results in increased production of reactive oxygen species, including free radicals. Reactive oxygen species and free radical product is one of the primary mechanisms of nanoparticles toxicity. Other properties of nanomaterials that influence toxicity

include chemical composition, shape, surface structure, surface charge, aggregation and solubility and the presence or absence of functional groups of other chemicals [9-11].

Mode of entry of Nano particle:

The Nano particle ranges between 1nm to 100nm which can enter into the body through inhalation, skin contact and ingestion. The synthesis of nano particle at large scale will cause exposure through these routes.

a. Inhalation:

Inhalation is the most important route for the intake of airborne nano particle. Depending on the size, particles are trapped in mucous layer and alveoli. For nano particle the position is more complex. Particles of 1 micron diameter or more tend to be deposited, but only those less than 7.0 microns, deposit deep inside the lungs. Those more than 7.0 micron deposit in the conductive airways. Particles in size less than 0.1 micron deposit in the alveolus. Most of the particles between 0.1 and 0 micron size are exhaled. The pattern and depth of breathing and irritant effects of inhaled material may alter the deposition of particles and may remain permanently within the lung tissue.

b. Skin contact

The large scale synthesis of nano particles in industry for wider application will cause exposure of nano particle through skin absorption; the penetration of nano particle through skin occurs via lipids and dissolved material. Lipid solubility and molecular size are the most important factors, so that higher lipid solubility and small molecular size enhance penetration through skin. Abrasion and irritation also encourage penetration. This route is particularly important for organic solvents and can occur in a number of ways.

- (i) Direct absorption through wounds or abrasions.
- (ii) Degreasing of the skin followed by absorption of the degreasing agents.
- (iii) Degreasing of the skin allowing absorption of other chemicals.
- (iv) Sensitisation, local and general.

c. Ingestion

Ingestion of nano materials during the process of synthesis may result from the contaminated object into the mouth. Ingestion of toxic substance along with food in the workroom occurs where housekeeping is not good, or where workers are careless to nano particles in their clothes, or wash their hands with soap. If the toxic nano dust swallowed with food or saliva is not soluble in body fluids, it is eliminated directly through the intestinal tract. Toxic materials that are readily soluble in body fluids are absorbed in the digestive system and circulated by the blood. Compared with inhalation and

skin absorption, ingestion, plays a minor role in the absorption of toxic materials in industries [2-3].

Toxicity of Nanomaterials

The intake of bio nanomaterials in human body undergoes biochemical mechanism and enzymatic interaction and height cause. Toxicity of nano particles depending on nature of chemical used for the synthesis, type of precursor, concentration of precursor, duration of exposure, personal susceptibility, and mode of entry, size of nano particle, environmental factors, and threshold limit value.

Conclusion

The drug delivery is one of the routes for treating diagnosis using the bio nano material. The exact fate of bio chemical reactivity, enzymatic interaction is not well understood and studied and might lead to toxicity similar to that of exposure of nano material through inhalation, skin contact and ingestion. Therefore, synthesis of nano particle, bio nano composite, their use and environmental exposure need to be studied before making the wider application for the diagnosis of disease using bio nano materials. The detail of physico chemical characteristics, stability of nanomaterials and their specification to target organs as human body system need data base scientific research.

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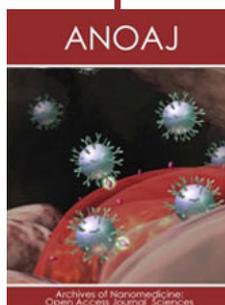
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