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Study of nanotoxicity: Current need

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Nanotechnology has potential to improve almost all aspect of human life. With the advent of nanotechnology a number of engineered nanoparticles have made their importance in our day to day life. But history has taught us that the development of every new technology is accompanied by risks. Hence it is highly required to study all possible risk factors associated with any technology. This article is a glimpse of the toxic effects of nanoparticles and emphasizes on detailed effects on nanoparticles on human health and environment.

Revolution in nanotechnology is necessitating large scale production of nanoparticles. Nanomaterials have great potential in improving the consumer and industrial products, address critical energy needs, enhance security systems and improve the medical fields. This potential of nano-materials is significantly dependent on unique physical properties (e.g. magnetic, optical, mechanical and electrical) and quantum mechanics (e.g. electron configuration and confinement). From both research as well as educational perspectives nanotechnology is attracting worldwide attention [1]. Development of nanotechnology has led industries to be involved in nano- technology related activities which consequently enhanced production and demand of engineered nano materials (ENMs) embedded in consumer products [2,3]. With any new technology identification of potential health risks is a prerequisite for a proper assessment of the usefulness and safety of the new chemicals, materials and products that are developed or may be developed. The revolution in the field of nanotechnology is becoming new source of environmental and human hazard through inhalation, ingestion, skin uptake or injection of ENMs at work place or consumer products. Current researches have shown that nanoparticles may cause adverse effect on human health at the portal of entry as compared to the bulk materials of the the form of nanoscale materials, tools and devices. Nanomaterial associated risks may arise during nanomaterial fabrication, handling of nanomaterials in subsequent processing to create derivative products, product usage and as a result of post usage or waste disposal practices [4]. Current production capacities for C_{60} fullerene are in excess of 2,000 tons per year while carbon nanotube production capacity in 2006 was in hundreds of tons per year. These volumes are small compared with the production of more conventional TiO_2 nanoparticles, silica nanoparticles and other materials with a longer history of commercialization. Such tremendous productions for products that incorporate these materials lead to the nanomaterial appearance in air, soil and organisms.

Activities related with nanotechnology will affect social, economic and environmental dimensions of our world. Many of these impacts will be beneficial in medical science. In addition efforts are underway to explore uses of nanomaterials in applications such as catalysis, membrane separations, adsorption etc. [5]. In spite of these innovations in nanomaterial industry there is need to consider impacts of nanomaterials on environment and human health because many past technologies have generated public cynicism as some of the consequences, often environmental, have become apparent. Studies related to carbon based nanomaterials, referred to as fullerenes, have reported that the soccer ball shaped fullerene molecules are powerful antioxidants, comparable in strength of vitamin E, while some studies have reported fullerenes to be toxic for tumor cells, cleave DNA and inhibit bacterial growth [6-11].

Currently market is flooded with more than 1300 consumer products that employ ENMs in many different ways [12]. Notwithstanding, the rapid growth of nanotechnology, assessment of potential health and environmental risks is lagging behind [13]. The main reason for difficulty in risk prediction is the physiochemical transformation of ENMs, which eventually changes their properties, fate and impact once released into the environment. In addition the concern that human exposure to some types of ENMs inadvertently, can lead to significant health hazards [14] is consistently growing. Human exposure to ENMs during different stages of the life cycle of products based on nano-materials may affect in various ways for instance during synthesis, fabrication, use and dispose. The highest risk for human exposure is during the synthesis of ENMs and the fabrication of ENM containing products. Human exposure to ENMs may occur via inhalation, dermal exposure or ingestion by swallowing [15]. In order to assess the risk involved with ENMs it is highly required to completely understand their toxic effects and fix the level of human exposure [16, 17].

Newly developed nanotechnology is expanding very rapidly. As in every new technology benefits will be conferred and risks will be encountered. The prime aim of nano-toxicologists is prior determination of risks to avoid any big damage to the mankind as well as environment. Though nano-toxicology is a new, but essential field, a focused and thorough research is required to deal with future hazards generated by engineered nano materials.

Notes and References

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