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Green Chemistry for Nanotechnology: Opportunities and Future Challenges

Preeti Nigam Joshi*

Combichem Bioresource Center, National Chemical Laboratory, Pune, India

Editorial

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***For Correspondence**

Preeti Nigam Joshi, Combichem Bioresource Center, National Chemical Laboratory, Pune, India, Tel: +91-20-2590-2400

E-mail: ph.joshi@ncl.res.in

Nanotechnology is a paradigm for emerging technologies and much talked about area of science. It is the technology of future and has revolutionized all fields of medicine, agriculture, environmental and electronics by providing abilities that would never have previously dreamt of. It is a unique platform of multidisciplinary approaches integrating diverse fields of engineering, biology, physics and chemistry. In recent years, nanotechnology has seen the fastest pace in its all aspects of synthesis methodologies and wide applications in all areas of medicine, agricultural, environmental, and electronics. It is the impact of nanotechnology approaches that new fields of nanomedicine, cancer nanotechnology, nanorobotics and nanoelectronics have been emerged and are flourishing with the advances in this expanding field. Nanotechnology holds the potential for pervasive and promising applications and getting significant attention and financial aids also. Although there are different definitions of nanotechnology, in broad prospective, nanotechnology can be described as designing or exploiting materials at nanometer dimensions (i.e., one dimension less than 100 nanometers). At nanoscale, substances have a larger surface area to volume ratio than conventional materials which is the prime reason behind their increased level of reactivity, improved and size tunable magnetic, optical and electrical properties and more toxicity also.

Despite of significant progress in nanotechnology and rise of many commercialized products involving nanomaterials [1], toxicity and hazards associated with them are still not fully addressed and nanotoxicology is a cause of concern in all areas of nano applications. The impact of nanoparticles exposure and risks associated with them on environment, human health and safety are still unanswered and a meager data is available on toxicological studies of nanoparticles. The two major challenges-poor understanding of new hazards introduced by nanotechnology and lack of regulatory policies related with nanotechnology applications are prime hurdles in wider nanotechnology implementations in areas related with human life. To overcome some potential hazards associated with nanotechnology, gradually a concept of 'Green Chemistry' is arising.

Basically green chemistry is the eco-friendly way to produce materials with reduced usage and generation of hazardous substances from biodegradable, safe materials and if not fully, few issues associated with nanotoxicology and hazards can be dealt up to a good extend with green approaches of synthesis. "Green synthesis" or "Green Nanotechnology" is a new platform to design novel products that are benevolent to human and environment health and has huge potential to revolutionize large scale nanosynthesis procedures [2]. These green synthesis approaches for nanomaterials are supposed to benefit environmental and biomedicine segments of nanotechnology applications in future.

This new concept can be seen as a bench mark for clean and sustainable nanomaterials. Basic pillars of green chemistry are utilization of less toxic, safe biodegradable and cost effective sources, energy efficient reactions and inherently safer chemistry. Nanotechnology is gradually being benefited by these green and ecofriendly synthesis features and witnessing a steady process. Many reports have come on nanoparticles synthesized from plants, microbes or other natural resources [3]. Although green nanotechnology shows a bright picture of clean, ecofriendly and safe future, it has the challenge to not only deal with the possible toxicity issues but to prepare a new ground for sustainable nanomaterials production while considering environmental and health aspects. The quality of nanomaterials produced from green synthesis route is similar to their chemical counterparts and one can play with the properties of nanomaterials by controlling the reaction conditions like temperature, pH etc. in a same manner. Still this area has its own barriers and challenges to deal with. As per the report by ACS Green Chemistry Institute [2], the key challenges in green nanotechnology are:

(i) Technical barriers

(ii) Handling of toxicity of nanomaterials

(iii) Regulatory policies for synthesis and

(iv) Industrial deployment of scale up procedures.

This ecofriendly emerging area of clean nanosynthesis is far from realization and transition from concept to reality is still a major concern. Excellent applications on green synthesis of nanomaterials for different applications from solar to energy storage and from nanosensing to nanomedicine have been reported by researches worldwide [4,5]. On one side greener approaches paved the way for sustainable and safe nanotechnology for future, lack of clear design guidelines for production, rapid toxicology and analysis protocols to determine the safety of nanomaterials and unclear demand of end-market restricts the wider application and commercialization prospects [2].

Apparently many challenges and issues seem to be associated with green nanotechnology but that doesn't diminish the potential of this new sustainable approach. It can be understood by these lines "Two roads diverged in a wood, and I took the one less traveled by and that has made all the difference" by Robert Frost from "The Road Not Taken" [6]. Green nanotechnology is the road less traveled but has the ability to change the face of traditional nanomaterials production. This cocktail of nanotechnology and green chemistry will gradually attain the right pace with technology advancements and can be considered as the future of sustainable nanosynthesis. As correctly said by Dr. James Hutchison "Green chemistry is a terrific way to do nanotechnology responsibly" Every new system takes time to establish and green nanotechnology is still in its nascent stage and a lot more is needed to transform the face of conventional synthesis procedures into greener way and industrial deployment of green synthesis protocols for commercial production of nanomaterials. More understanding of underlying reaction mechanisms of green approaches, better characterization techniques and data analysis will construct a solid foundation for ecofriendly and sustainable nanotechnology via green synthesis.

REFERENCES

1. Kessler R. Engineered Nanoparticles in Consumer Products: Understanding a New Ingredient. Environ Health Perspect 2011; 119: A120–A125.

2. Kira JM, et al. ACS Green Chemistry Institute. Green Nanotechnology challenges and opportunities 2011; 1-32.

3. Mishra V, et al. (2013) A Review on Green Synthesis of Nanoparticles and Evaluation of Antimicrobial Activity. Int J Green Herb Chem 3: 81-94.

4. Genuino H, et al. (2012) A Review of Green Synthesis of Nanophase Inorganic Materials for Green Chemistry Applications. Handbook of Green Chemistry, Paul Anastas (edt), John Wiley and Sons, USA.

5. Ingale AG and Chaudhari AN (2013) Biogenic Synthesis of Nanoparticles and Potential Applications: An Eco- Friendly Approach. J Nanomed Nanotechnol 2013; 4: 165-172.

6. Karn B (2008) Research on Nanotechnology Applications: Green Nanotechnology for Past, Present, and Preventing Future Problems. NanoECO, Monte Verità, Switzerland.