Green Nanotechnology: A State of the Art Review

Sunita Bishnoi
Department of Agriculture
Vivekananda Global University, Jaipur
Email ID:bishnoi.sunita@vgu.ac.in

ABSTRACT:Rising well-being and human health is the ultimate objective of any scientific progress. In order to achieve safe and efficient clinical therapies beyond traditional ones, innovative techniques are needed, and society requires new standards for new technology to move towards the advancement of clean and green technologies. Green nanotechnology is a branch of green technology using green chemistry and green engineering principles. It eliminates the use of energy and fuel by using, wherever possible, less materials and renewable inputs.In phytoformulation, green nanotechnology makes a major contribution to environmental protection by developing nano-materials and nano-products, without causing harm to human health or the environment. The reasoning behind plant usage in nanoparticle formulations is that they are readily accessible and have a high metabolite variability, such as vitamins, antioxidants, and nucleotides. For example, the controllable scale, shape, and surface properties of gold (Au) nanoparticles have attracted considerable attention. A number of nanoparticles of copper (Cu) and copper oxide (CuO) have also been synthesized from plant extracts.

KEYWORDS:Materials, Nanotechnology, Nanoparticles, Plant, Technology, Innovative engineering.

INTRODUCTION

Nanoparticles of titanium dioxide and zinc oxide are also important nano materials of metal oxide that have been synthesized from a variety of plant extracts. In order to increase their usefulness and nurture these nanoscale materials for commercialization, international and domestic legislation, government and private-party initiatives, regulations and policies are being carefully reviewed and updated[1].

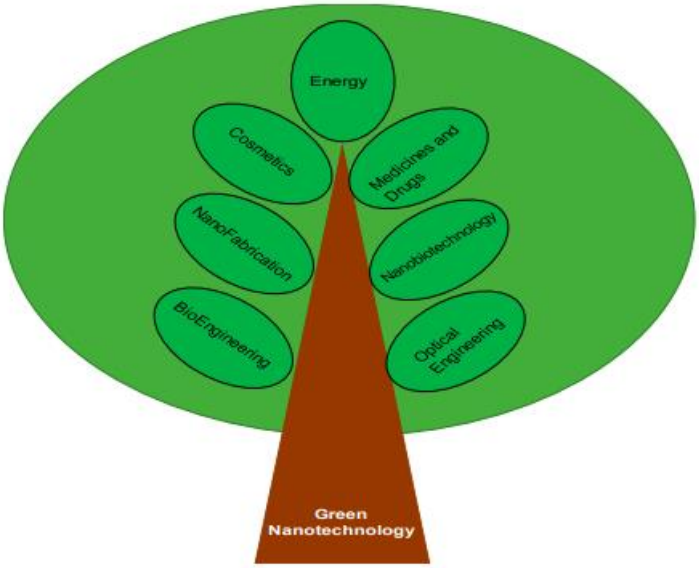

Figure 1: Depicts the branches of green nanotechnology[2]

To encourage the sustainable use of nanoscale materials, encouraging debates and government policies are required. We will explore the promise of the use of plant extracts in the development of nanotechnology in this study.

Table 1: Illustrates the herbal drug-loaded nanoparticles[3]

Formulation	Active Ingredients	Biological Activity	Method of Preparation
Curcuminoids solid lipid nanoparticles	Curcuminoids	Anticancer and antioxidant	Micro-emulsion technique
Glycyrrhizic acid loaded nanoparticles	Glycyrrhizin acid	Antihypertensive and anti-inflammatory	Rotary-evaporated film ultrasonication method
Nanoparticles of cuscuta chinensis	Flavonoids and lignans	Hepatoprotective and antioxidant effects	Nanosuspension method
Artemisinin nanocapsules	Artemisinin	Anticancer	Self-assembly procedure
Berberine-loaded nanoparticles	Berberine	Anticancer	Ionic gelation method
CPTencapsulated nanoparticles	Camptothecin	Anticancer	Dialysis method
Taxel-loaded nanoparticles	Taxel	Anticancer	Emulsion solvent evaporation

Table 2: Illustrates the selection of nanoparticles synthesized by various plants[4]

Plant	Nanoparticle	Size (nm)	Shape
Aloe vera	Au & Ag	50 to 350	Spherical, triangular
Aloe vera	In_2O_3	5 to 50	Spherical
Citrullus colocynthis	Ag	31	Spherical
Curcuma longa	Pd	10 to 15	Spherical
Diopyros kaki	Pt	15 to 19	Crystalline
Eucalyptus macrocarpa	Au	20 to 100	Spherical, triangular, hexagonal
Mangifera indica	Ag	20	Spherical, triangular, hexagonal
Rhododendron dauricum	Ag	25 to 40	Spherical
Psidium guajava	Au	25 to 30	Spherical
Pyrus sp. (Pear fruit extract)	Au	200 to 500	Triangular, hexagonal
Terminalia catappa	Au	10 to 35	Spherical

DISCUSSION

The shape and size of nanoparticles depend primarily on the variation in the composition and concentration of the different plants' active biomolecules and their interaction with the aqueous metal ions. In particular, aqueous metal ion precursors from metal salts are reduced in the chemical and biological synthesis of nanoparticles, which results in a colour shift of the reaction mixture and gives a quantitative indication of the formation of nanoparticles[5]. More importantly, nanoparticles synthesised from reducing agents can display general toxicity, causing serious concern for the production of processes that are environmentally friendly. Mixing a metal-salt solution with a sample of plant extract starts the process of the formation of nanoparticles[6].

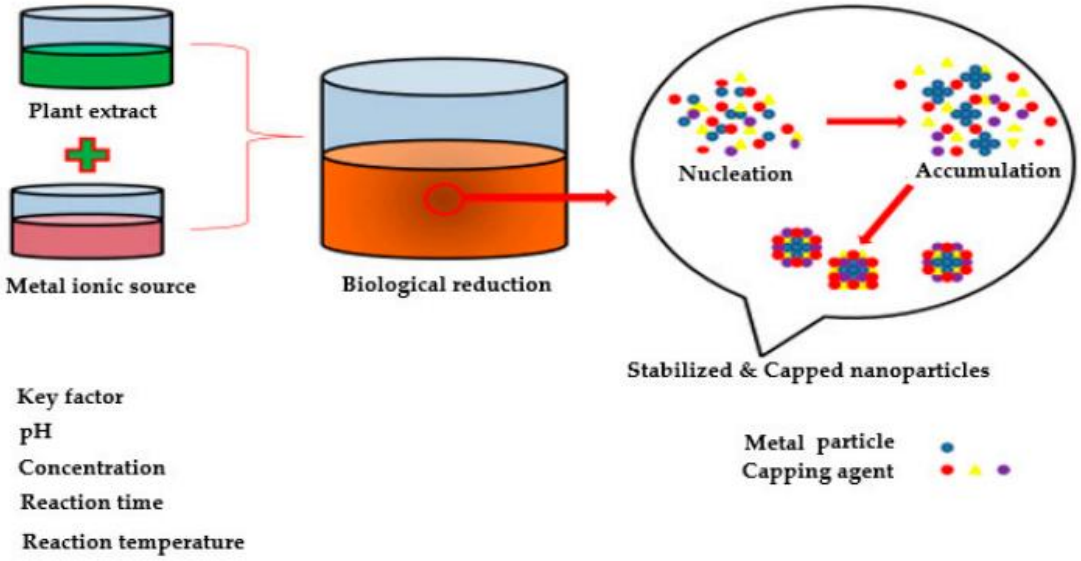

Figure 2: Depicts the biological synthesis of nanoparticles by utilizing the plant extracts[7]

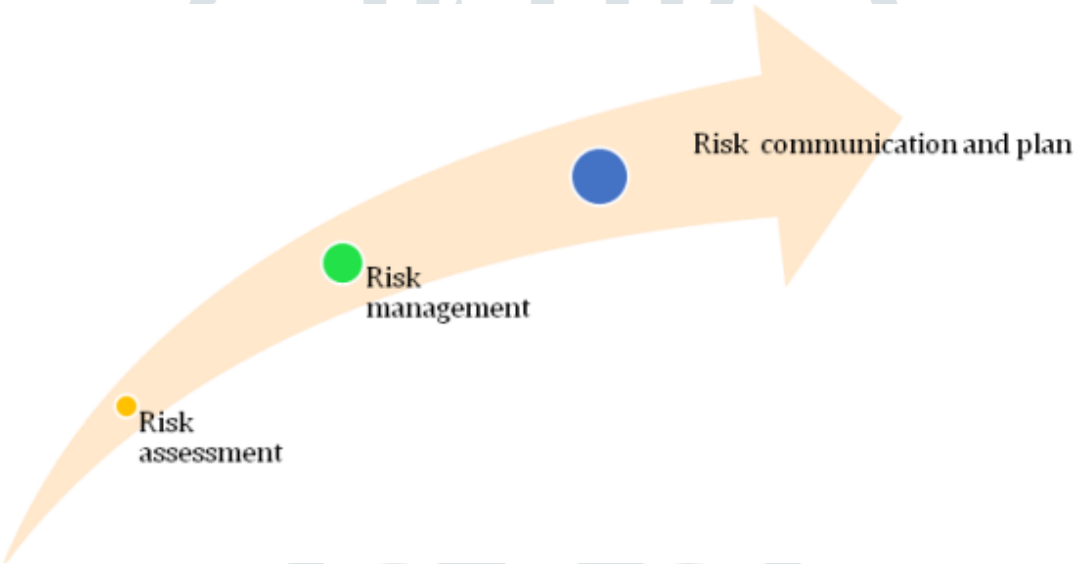

Figure 3: Illustrates the risk aspects of green nanotechnology[8]

Nanotechnology is cited as a crucial 21st century technology and has created a great deal of global excitement, but it has been slowed down due to inadequate awareness of nanotechnology-related hazards and less policies to handle new risks[9]. However, researchers continue to move forward, committing themselves to addressing obstacles ranging from management, development, finance, regulatory, and technological aspects. Green nanotechnology is a green technology division that uses green chemistry and green engineering principles, where the term "green" refers to the use of plant materials (Figure 1)[10]. Table 1 illustrates the herbal drug-loaded nanoparticles. Table 2 illustrates the selection of nanoparticles synthesized by various plants. Figure 2 depicts the biological synthesis of nanoparticles by utilizing the plant extracts. Figure 3 illustrates the risk aspects of green nanotechnology.

CONCLUSION

It will have the potential to become an industry with very strong green credentials as green nanotechnology becomes more commercialised. It can be said, as a general inference, that green nanotechnology requires challenging pharmaceutical industry work. Ultimately, however, in the area of nanotechnology, it increases the quality of life, encourages environmentally sustainable obligations and ethical principles.Danger communication is an important component of green nanotechnology in the field of sound origin and

sustainable development of public disclosure in general. In terms of making complicated technical and health information available, risk communication in languages that should be accessible and comprehensible to the general public should be made successful. Importantly, in order to establish acceptable expectations and attitudes, regulatory scientists, researchers, employee members, industry and government authorities should be engaged in dialogical progressive communication of possible green nanotechnology threats. This is particularly necessary in order to ensure that the distribution and promotion of mass media provides sufficient information on the advantages and challenges of green nanotechnology, shielding public opinion from optimistic prospects and unnecessary visibility in this regard.

REFERENCES

[1] K. Parveen, V. Banse, and L. Ledwani, "Green synthesis of nanoparticles: Their advantages and disadvantages," 2016, doi: 10.1063/1.4945168.

[2] A. Verma, S. Gautam, K. Bansal, N. Prabhakar, and J. Rosenholm, "Green Nanotechnology: Advancement in Phytoformulation Research," *Medicines*, 2019, doi: 10.3390/medicines6010039.

[3] M. Nasrollahzadeh, M. Sajjadi, S. M. Sajadi, and Z. Issaabadi, "Green Nanotechnology," in *Interface Science and Technology*, 2019.

[4] J. S. Duhan, R. Kumar, N. Kumar, P. Kaur, K. Nehra, and S. Duhan, "Nanotechnology: The new perspective in precision agriculture," *Biotechnology Reports*. 2017, doi: 10.1016/j.btre.2017.03.002.

[5] D. Bhattacharya and R. K. Gupta, "Nanotechnology and potential of microorganisms," *Critical Reviews in Biotechnology*. 2005, doi: 10.1080/07388550500361994.

[6] H. Jahangirian, E. G. Lemraski, T. J. Webster, R. Rafiee-Moghaddam, and Y. Abdollahi, "A review of drug delivery systems based on nanotechnology and green chemistry: Green nanomedicine," *International Journal of Nanomedicine*. 2017, doi: 10.2147/IJN.S127683.

[7] R. K. Sharma, S. Gulati, and S. Mehta, "Preparation of gold nanoparticles using tea: A green chemistry experiment," *J. Chem. Educ.*, 2012, doi: 10.1021/ed2002175.

[8] N. Roy, A. Gaur, A. Jain, S. Bhattacharya, and V. Rani, "Green synthesis of silver nanoparticles: An approach to overcome toxicity," *Environmental Toxicology and Pharmacology*. 2013, doi: 10.1016/j.etap.2013.07.005.

[9] S. Kumar, A. Gupta, and A. Arya, *Triple Frequency S-Shaped Circularly Polarized Microstrip Antenna with Small Frequency-Ratio*. International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)/ISSN(Online): 2320-9801, 2016.

[10] E. N. Kumar and E. S. Kumar, "A Simple and Robust EVH Algorithm for Modern Mobile Heterogeneous Networks- A MATLAB Approach," 2013.

- Gagandeep Singh Narula, Dr. Vishal Jain, Dr. S. V. A. V. Prasad, "Use of Ontology to Secure the Cloud: A Case Study", International Journal of Innovative Research and Advanced Studies (IJIRAS), Vol. 3 No. 8, July 2016, page no. 148 to 151 having ISSN No. 2394-4404.
- Gagandeep Singh Narula, Ritika Wason, Vishal Jain and Anupam Baliyan, "Ontology Mapping and Merging Aspects in Semantic Web", International Robotics & Automation Journal, having ISSN No. 2574-8092, Vol. 4, No. 1, January, 2018, page no. 01 to 05 .
- Gagandeep Singh Narula, Usha Yadav, Neelam Duhan and Vishal Jain, "Evolution of FOAF and SIOC in Semantic Web: A Survey", CSI-2015; 50th Golden Jubilee Annual Convention on "Digital

Life", held on 02nd to 05th December, 2015 at New Delhi, published by the Springer under Big Data Analytics, Advances in Intelligent Systems and Computing having ISBN 978-981-10-6619-1 page no. 253 to 263

- Balamurugan S, Visalakshi P, "Proposing New Strategy for Privacy Preserving Microdata Publishing With Conditional Functional Dependencies", Asian Journal of Information Technology Vol 15, Issue : 12, 2016
    - S Balamurugan, K Deepika, RS Venkatesh, R Poornima, Gokul Kruba Shanker, VS Kumar, "SUN Computing: Scalable Ubiquitous Nestle (SUN) Computing for Healing on the IoT", Asian Journal of Research in Social Sciences and Humanities, Volume : 6, Issue : 8, 2016
- RP Shermy, S Balamurugan, "Certain Investigation on Context Aware Knowledge Discovery Strategies for Healthcare Systems", Asian Journal of Research in Social Sciences and Humanities, Volume : 6, Issue : 8, 2016