The Emerging Nanobiotechnology Era

Nida Tabassum Khan*, Namra Jameel

Department of Biotechnology, Faculty of Life Sciences and Informatics,

*Corresponding author: Nida Tabassum Khan, Balochistan University of Information Technology Engineering and Management Sciences, (BUITEMS), Quetta, Pakistan. Email: nidatabassumkhan@yahoo.com Contact: 03368164903

Citation: Khan NT and Jameel N (2018) The Emerging Nanobiotechnology Era. J Nanom Nanos Tech: JNNT-103

Received Date: 19 December, 2018; Accepted Date: 21 December, 2018; Published Date: 29 December, 2018

Abstract

Biological synthesis of nanoparticles is progressively gaining interest because of the reliability and cost effectiveness, of this biobased technology. Metallic nanoparticles produced using plant, bacteria, algae etc are stable and pharmacologically active than chemically fabricated ones. Besides these nanobiotechnology techniques are inexpensive, requires less energy consumption producing biodegradable byproducts which are non-hazardous for the environment.

Key Words: Phytonanotechnology; Phyconanotechnology; Pseudomonas stutzeri; Thiobacillus; Algae.

Introduction

Nanoparticles are extremely small entities with size ranging from 1 nm to 100 nm [1]. They can be categorized into numerous types according to their size, surface, shape and physicochemical properties [2]. Nanobiotechnology has attracted an excellent interest over the previous couple of years because of its potential impact on experimental operation/field like diagnostics, medicine, electronics, molecular, pharmaceutical, electronic etc [3, 4]. This technology deal with tiny nano structures which shows unique and considerably altered chemical, physical, and biological properties making them useful in applications such as imaging, drug delivery, medicine etc [5, 6, 7]. Besides using a more reliable, nontoxic, green experimental protocol for synthesis of nanoparticles is another bright aspect of nanobiotechnology[8].

Types of Nanoparticle Synthesis

The phenomena of nanoparticle synthesis takes place by means of biological or enzymatic reaction [9]. Microbes produce inorganic material either intra cellular or extracellular in nanoscale dimension with unique morphology [10]. Bacteria can endure and reproduce in high concentration of toxic metal ions due to their chemical detoxification potential [11]. Different bacteria uses different mechanism for the synthesis of nanoparticles such as efflux system, solubility alteration, toxicity reduction, biosorption oxidation, reduction, bioaccumulation, metal ions complexion and precipitation [12,13,14].

Nanoparticle Synthesis from Bacteria

Research has concentrated vigorously on prokaryotes as a method for incorporating metallic nanoparticles [15]. Currently numerous bacterial strains have been used to fabricate different types of stable metallic nanoparticles such as nanoparticles of palladium, gold, titanium, cadmium sulphide, silver etc [16, 17]. Because of their abundance and capability to resist unfavorable environmental conditions, bacteria is a good option [18]. By changing the pH of growth medium during incubation, nanoparticles of different size and shape is produced [19]. Therefore bacteria is one of the best candidates for nanoparticles synthesis. Example of some nanoparticle producing bacteria includes Pseudomonas stutzeri,
Pseudomonas aeruginosa, Thiobacillus, Ferrooxidean, Thio-oxidan and sulfolobus acidocaldarius [20, 21, 22, 23]

Properties of nanoparticles synthesized by Bacteria are as follows:

- Such nanoparticles exhibit antibacterial activity against both gram positive and gram negative bacteria [24].
- Such nanoparticles possess antitumor/anticancerous activity [25].
- Bacteria mediated biosynthesis of nanoparticles produces nanoparticles that act as diagnostic applicable biological tags and biosensor [26].
- Such nanoparticles are used in cosmetics, footwear, wound dressing, paints, plastic, thermal, electrical and water filter application [27].
- Such nanoparticles have high chemical and thermal Stability [28].

Nanoparticles Synthesis From Algae

Algae being abundant and widely available makes it a suitable source for the synthesis of nanoparticles such as iron, copper, silver, zinc and gold [29]. Such type of fabrication is termed as Phyconanotechnology [30]. Algae is a consistent source for the biosynthesis of nanoparticles due to their property of metal ions accumulation and reduction [31]. Additionally, is easy to handle and capable to fabricate nanostructures with better proficiency at low temperature [32].

Properties of nanoparticles synthesized by Algae are as follows:

- Algae mediated biosynthesis of nanoparticles produces nanoparticles that possess antibacterial, antiviral, antifungal and antiprotozoal activity [33]. For example copper oxide nanoparticle exhibits broad spectrum antibacterial potential [34].
- Besides these nanoparticles also display anti-inflammatory, antioxidant, wound healing and anticancerous potential [35]. For example silver nanoparticles synthesized using Sargassum vulgar e exterminate cancerous leukemic cells and cervical cells in humans [36].
- Examples of some algae used for the fabrication of nanoparticles include Fucus vesiculosus, Tetraselmis kochinensis, Sargassum muticum, Chlorella vulgaris, Plectonema boryanum, Chlorella pyrenoidusa, diatoms, Spirulina platensis, Ulva fasciata and Ulva reticulata [37, 38, 39, 40, 41, 42, 43].

Nanoparticles Synthesis from Plants

Plants and plant extracts seems to be the suitable nanofactories for the synthesis of various types of nanoparticles at large scale [44]. Such type of fabrication is termed as Phytonanotechnology [45]. Properties of nanoparticles synthesized by plants are as follows:

- Rate of plant mediated nanoparticles synthesis is much faster than using microbes, producing stable nanostructures of definite size and shape [46].
- Plant mediated synthesis of nanoparticles is an eco-friendly approach which do not employ the use of expensive harmful chemicals and does not raise any toxicity issue [47].
- Such synthesis method is cost effective and fiscal for large-scale fabrication of metallic nanoparticles [48].
- Plant mediated synthesis of metallic nanoparticles enable the researchers to fathom the cellular route of metal ion uptake and bioreduction [49].
- Examples of some plants and its extract that is capable of producing nanoparticles includes Neem, Pelargonium graveolens, Banana peel, Aloe vera etc [50, 51, 52, 53].

Conclusion

Thus nanobiotechnology is an innovative field which utilizes the use of different biological organisms such as plants, algae, bacteria, fungi etc to synthesize nano sized particles with unique properties to make them applicable in different technologies.

References


