

A Protocol for The Biosynthesis of Nanoparticles by Plant Extracts

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Abstract: The study summarized the most important biological methods in the manufacture of nanoparticles with high benefits, the most important of which is the vegetative or green biosynthesis of these nanoparticles using plant extracts and without side effects, as is the case in traditional methods.

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Introduction

Nanobiotechnology are names that pointed to the connection of nanotechnology and biology (Ehud, 2007; Nussinov and Aleman., 2006; Raja, 2016). Nanomaterials have many applications in many scopes as environmental, food, remediation, agriculture and health care (Karp and Soccol., 2021).

General properties of nanomaterials (Saleh and Gupta, 2016): These nanoparticles have specific physical, chemical and biological characters paralleled to their big, which are largely to their structure and higher surface-area-to-volume percentage.

Types of nanoparticles (Khan et al., 2017; Crucho and Barros, 2017): Nanoparticles may be arranged into many categories according to the many physical features as size, morphology and chemical properties (Fig.1).

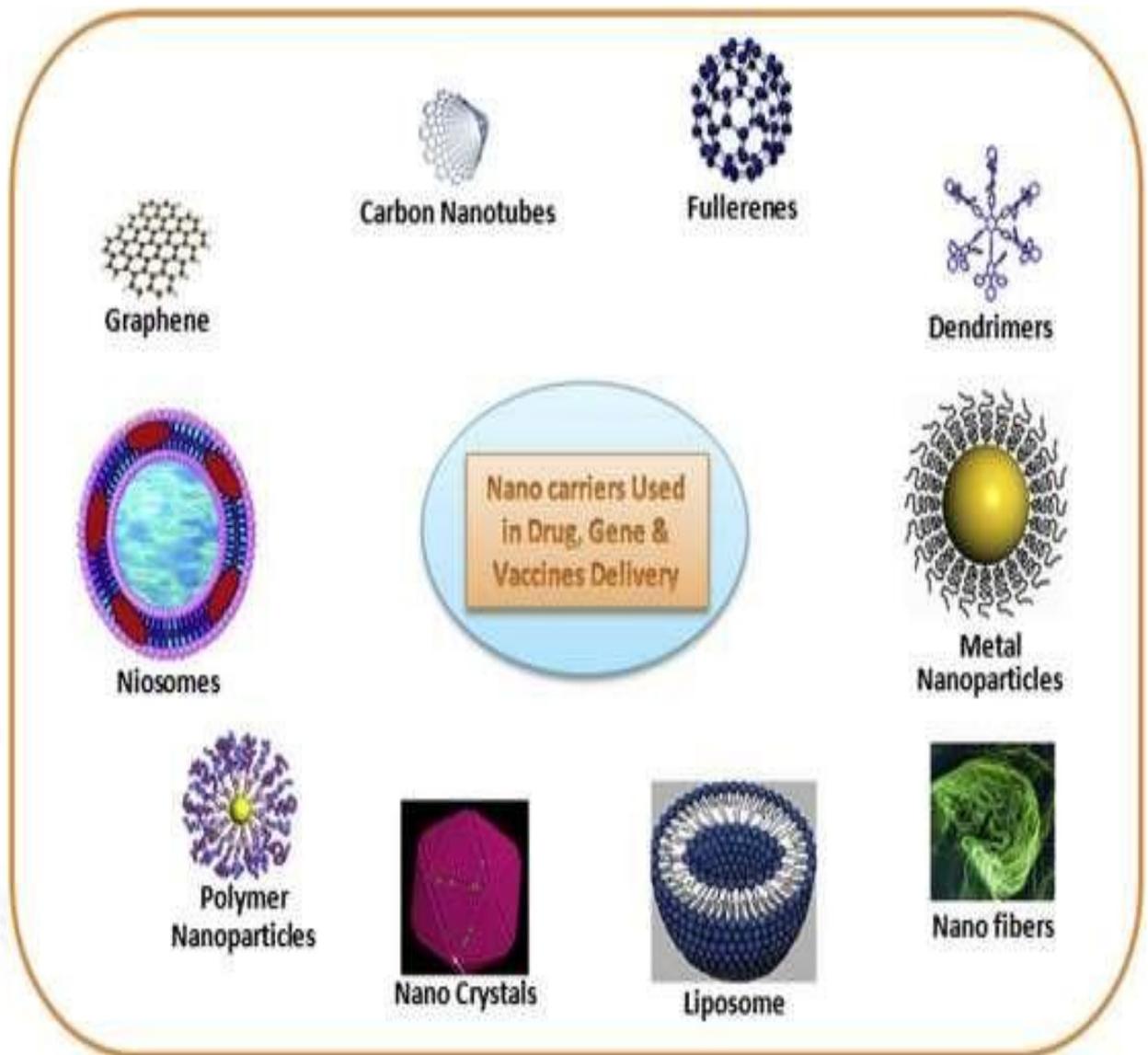


Figure. 1: Modern types of nanoparticles (Kumar et al., 2016)

Applications of nano biotechnology in agriculture

The engineered nanoparticles manipulated in the agriculture, containing herbicides and chemicals. Earlier Nano capsules containing herbicides have been described have the ability to enter across the outer layer of tissues, causing the gentle and produce of the medical compounds which minimize environmental pollution through agricultural. Several researches were pointed to the positive applicate of nanoparticles, which stimulate the growth of plants (Thangavelu et al., 2019). Nanoparticles based applications caused benefits compared to other nanoparticles found on different plant types with less toxicity (Thangavelu and Krishnan, 2016; Requal et al., 2009). AgNPs explain increased content of chlorophyll and ascorbate when they treated leaves of Asparagus. Also showed increased the vegetation length, leaf features, protein and chlorophyll contents of bean plant (Hediat, 2012).

Plant extract as a source of herbal medicine benefit of human health

They have aided as a benefit source of active materials for many pharmaceutical and many important medicines that have been isolation and characterized from plants. The end product of any isolation program is a drug, some type of pharmacological evaluation must necessarily be used to director the isolation methods to obtained the pure bioactive component (Kumar et al.,2017). The active substance content of plant extracts may different related to genetics of plants and to climatic features, the time of gathering and the extraction methods. Flavonoids may be somewhat accountable for their pharmaceutical effects. For examples extracts of Ginkgo biloba contain terpenes and flavonoids (Srivastava and Chaturvedi, 2014). Also, Centella asiatica extract are able to stimulate collagen synthesis in connective tissue (Ramelet., 2011; Dobrucka, 2019).

Synthesis of metal nanoparticles by plant extract

Today there are advanced study to manipulated of plant extracts in some fields as reductants and stabilizers to biosynthesis of them which has the functions of environmental friendliness, safe, and more constant in size than the supplements synthesis though the classical ways (Nune et al., 2009; Bao et al, 2021).

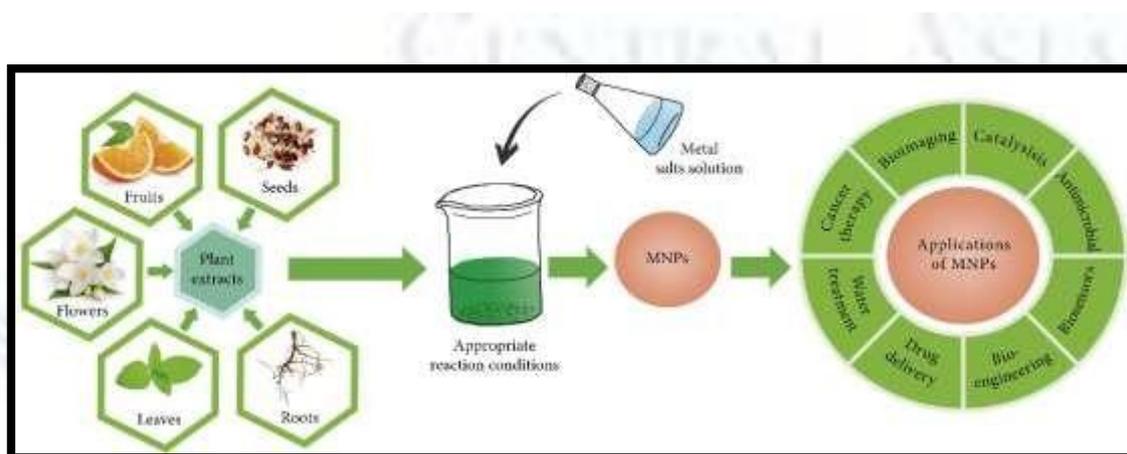


Figure. 2: Diagram for synthesis of metal nanoparticles by plant extracts (Yousaf et al.,2020).

Chemical mechanisms of using plant extract to synthesize metal nanoparticles.

Numerous active compounds as terpenoids, phenols, flavonoids, proteins, alkaloids and quinines found in plant extracts which have act as a reducing agent to produce MNPs also they have antioxidant properties (Veisi et al., 2019) thus act as a key in the green synthesis of them which can be represented by three phases : the reduction phase, growth phase, and termination phase (Naseer et al., 2020 ; Wang et al., 2021 Dinesh et al., 2020).

Examples of using plant extracts to synthesized nanoparticles:

Synthesis of silver nanoparticles:

They were synthesized using many types of extracts (Sundar et al., 2019; Pang et al., 2020; Yousaf et al., 2020). Jiang et al., 2016 prepare AgNPs through hawthorn fruits as reducing and stabilizing agents

to silver nitrate. Another study prepares AgNPs by used bark aqueous extracts of the *Catharanthus roseus* as the precursor compound to reduce silver nitrate (Nishanthi et al., 2019; Rohaizad et al., 2020).

□ Synthesis of copper nanoparticles

It is an essential material and a main element of several enzymes and proteins. Today the researchers used copper nanoparticles (Cu-NPs) because they have many advantages as easy accessibility, not expensive and good catalytic features (Chandra et al., 2014, Zhao et al., 2020) which enable it to be commonly used in biomedicine and solar energy conversion (Chen et al., 2012 ; Das et al., 2020). Pinto et al., 2019 used a *Eucalyptus globulus* bark extracts to prepare CuNPs by reduce copper chloride dihydrate. Many studies proved the ability to prepare CuNPs through reduced copper salts by used several extracts of flower, leaf, seed, fruit, and bark (Sajadi et al., 2016; Adhikari, 2019).

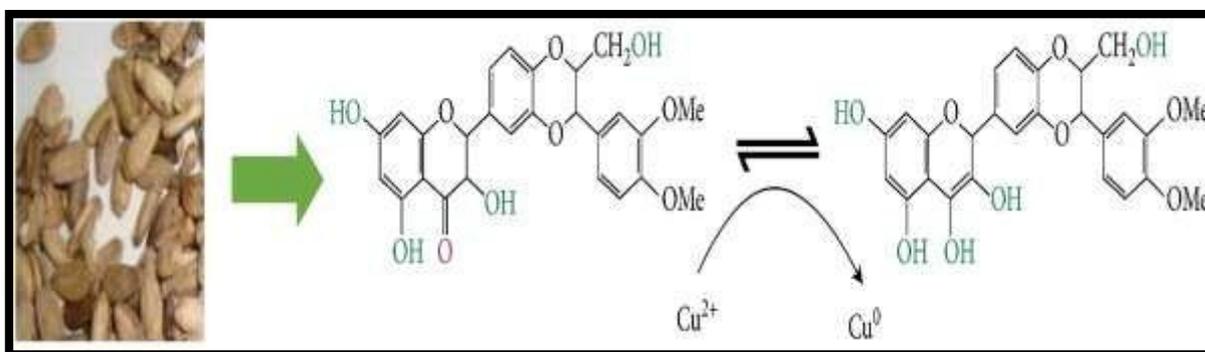


Figure 3: Mechanism of Cu-NP synthesis using *Silybum marianum* L. seed extracts (Sajadi et al., 2016)

Aim of the study

Recently, the plant-extract-proposed the specialized ways for the preparation of MNPs, that suitable to the application fields to aid us in better use this green synthesis method.

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