Particle Size Distribution Of Silver Nano Particles Synthesised By Rudanti Fruit Extract

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Abstract

Nano technology is the modern concept of science. At the Nano scale range, the manipulation of materials changes the physical, chemical properties of the materials. Due to the versatile physicochemical properties, Nano technology widely used in various fields such as optics, medicine, bio technology, catalysis. For the synthesis of nanoparticles, biological green method is most suitable and eco-friendly than other methods due to cost, inefficient and toxic by product. Due to the non-toxic, self-inorganic agent properties compared to other salt, Silver plays a vital role in the form of Nano particles. It has the wide range of applications in the field of medicine, high sensitivity bio molecular detection, catalysis, bio sensor. The formation of silver Nano particles by plant extract provide more stable and the faster synthesis rate than the microorganism. The size and shape of the formed silver nano particles are very important for the excellent optical characteristics of silver Nano particles. In this article, the particle size distribution of silver nano particles formed by the fruit extract of Rudanti is represented by a histogram which is obtained by applying the image analyzing tool to the TEM image of silver nano particles.

Key words:

Green technology; Silver nano particles; TEM; Particle size distribution

1. INTRODUCTION

Nanotechnology is the way of the future and is a technology that a lot of people think will bring a lot of benefit for all who will be using it. To develop the innovative methods to produce new products, to substitute existing production equipment and to reformulate new materials and chemicals with improved performance, Nanotechnology, is a new research area that enhances a broad range of technologies carried out on the nanometer scale.

Nanotechnology is the synthesis of nanoparticles which exhibit different sizes, shapes and morphology. Nano particles are particles that exist on a nanometer scale (i.e below 100 nm in at least one dimension [1]. The synthesis of nanoparticles were achieved by various methods such as conventional chemical reduction, electro chemical, photo catalytic reaction, laser ablation and green method. The biological green method is being eco-friendly than other methods due to cost, inefficient and toxic by product. Most properties of nanoparticles are size-dependent [2].

2. GREEN TECHNOLOGY

To minimize the negative impacts of technological applications on human health and environment, society is moving towards a greener future. Green technology is the synthesis of producing Nano particles by naturally occurring sources and their products. i.e

i) Microorganism utilization such as algae, fungi and bacteria.
ii) Plants and plant extracts usage
iii) Templates utilization such as membranes, viruses and DNA [3].

3. SILVER NANO PARTICLES

Silver have the wide range of application in the form of Nano particles due to the non-toxic, self-inorganic agent properties compared to other salt. Silver nanoparticles have unique optical, electrical, and thermal properties and are being incorporated into products that range from photovoltaic to biological and chemical sensors. It provides better contact with microorganism due to their extreme large surface area. The formation of silver nano particles by plant extract provide more stable and the faster synthesis rate than the microorganism. The reducing agent of the plant acts as the stabilizing and capping agent [4].

3.1. RUDANTI

The Scientific name of Rudanti is Cressa cretica. It is a small, shrubby; diffuse erect and shrub reaching upto 38cm in height. Rudanti has acrid, bitter, thermo genic, alterant, anthelmintic, expectorant, carminative, digestive, stomachic, anti-bilious, expectorant, antimicrobial, bronchodilatory, anti-inflammatory, antioxidant, antitussive, antifungal, antibacterial and emetic properties. It is the very useful plant in the treatment of bronchitis, respiratory infections, tuberculosis, phthisis, breathing troubles and asthma [5].

(Fig 1: Rudanti fruit)

3.2. SYNTHESIS OF SILVER NANOPARTICLES

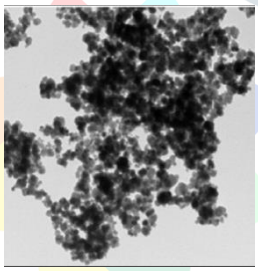
Using mortar and pestle, 2gm of Rudanti fruit was crushed and it was mixed with 100 mL distilled water in a 250 ml beaker. It was heated in a microwave oven for 30 minutes. Using Whatman filter paper no 41, prepared fruit extract was filtered and collected in a beaker.

50 ml of the prepared fruit extract was added in a beaker which contains 250ml of 1mM of $AgNO_3$ solution. Now the mixture was heated in microwave oven for 3 minutes and after 3 minutes, distilled water was mixed to maintain a constant volume (300ml). Up to 30 minutes, the process was continued. The formation of silver nanoparticles was indicated by the color changes to dark brown. To avoid errors, the nanoparticles were diluted due to high optical density [6].

4. SILVER NANOPARTICLE CHARACTERIZATION

4.1. TEM

For detecting, measuring and characterizing the nanoparticles, various techniques were employed such as AFM, TEM, SEM, XRD, and PCS. In transmission Electron Microscopy, a high energy beam of electrons interacts with a sample and forms an image on a photographic plate or specialist camera due to the interaction between electrons and atoms. [7].



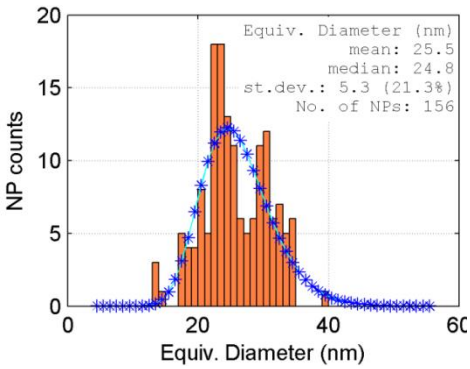
(Fig 2: TEM image of synthesized silver nanoparticles)

For particle size analysis, TEM image of silver nano particle is taken and manual and automatic techniques are used. Based on the use of a marking device moved along the particle to obtain a linear dimensional measure of the particle added up and divided by the number of particles to get a mean result in Manual technique [8].

A typical way to present the particle size and its distribution is in the form of a number-frequency histogram. A histogram is a bar graph that illustrates the frequency of occurrence versus the size range [9, 10].

5. PARTICLE SIZE DISTRIBUTION OF SILVER NANO PARTICLES

From TEM image, the particle size distribution of silver nanoparticles is successfully done by Pebbles & Pebble - Juggler software which is the most user-friendly image analyzing tool which implements an accurate, unbiased, and fast method. Fitting of intensity models to the TEM image which gives the particle size distribution of the projected nano particle shape [11].



(Fig 3: Number frequency histogram showing particle size distribution of silver nanoparticles formed by rudanti fruit extract in linear scale. The particle size distribution is based on the image analysis of 156 nano particles)

6. RESULTS AND DISCUSSIONS

From TEM micrograph, the histogram of particle size distribution is analyzed by Pebbles & Pebble- Juggler software in Manual and automatic mode and it indicates that the average size of spherical nanoparticle is 25.5 nm in diameter for 156 silver nano particles from 284 fitted silver Nano particles formed by Rudanti fruit extract.

Distribution of the synthesized silver Nano particles has different diameters in the range of 15 - 40 nm for 156 silver nano particles [12].

CONCLUSION

The reduction of silver ions by rudanti fruit extracts was resulted in the formation of stable silver nanoparticles. The image analysis study of TEM is helpful to deciphering the particle size distribution of silver nano particles was formed by Rudanti fruit extract are in the range of 16nm - 40 nm size for 156 silver nanoparticles. The optical properties of spherical silver nanoparticles are highly dependent on the nanoparticles diameter. Smaller nanoparticles primarily absorb light and have peaks near 400 nm, while larger spheres exhibit increased scattering and have peaks that broaden and shift towards longer wavelengths.

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