Synthesis of Silver Nanoparticles From Murraya Koenigii Extract for Purification of Waste Water

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***Abstract*—Nanoparticles have a promising action in a variety of areas and fields. Plant based nanoparticle synthesis become advantageous over chemical synthesis. The curry leaf extract was prepared from fresh curry leaves by boiling it for 3 minutes, 5 minutes and 10 minutes separately. Freshly prepared leaf extract was added to 1mM silver nitrate solution and the reaction takes place at room temperature which leads to the synthesis of silver nanoparticals. The synthesized silver nanoparticles were characterized by UV-spectrometrys. The UV- spectra of silver nanoparticles formed in the reaction media has absorbance peak at 435 nm. Silver nanoparticles with an average size of 146 nm were synthesized. The silver nanoparticles showed antibacterial activity against Bacillus species, E.coli, Staphylococcus species, Klebsiella species and Micrococcus species. It has been demonstrated that curry leaf extract is capable of producing silver nanoparticles that shows good stability in solution, under the UV-Visible wavelength nanoparticles shown quiet good surface Plasmon resonance behavior. The synthesized silver nanoparticles were characterized by UV-spectrophotometers. This green synthesis method is alternative to chemical method, since it is cheap, pollutant free and eco-friendly. The results showed that Curry leaf plays an important role in the reduction and stabilization of silver to silver nanoparticles. Further, these synthesized silver nanoparticles from Curry leaf shows antibacterial activity on both Gram positive and Gram negative bacteria.**

***Index Terms*—curry leaves, nanoparticles,**

I. INTRODUCTION

Engineered nanomaterials in the range of 1-100 nm in size possess novel physical and chemical properties that have been used to create unique devices. The distinctive quantum properties of nanomaterials strongly influence their physico-chemical properties, conferring an electrical, optical and magnetic property which is not present in their corresponding bulk counterparts. Biological fictionalization of nanomaterials has come to be of significant interest in the recent years due to the potential for developing sensitive imaging and signaling pathway detection systems (Oberdorster *et al.*, 2005). The bio-fictionalization of nanomaterials' surfaces can result in aqueous soluble materials which can be further modified with active molecules making them compatible, active, specific capture field agents and useful in biological systems. While all of this seems promising it is still unknown how engineered nanomaterials of different size, structure, and geometries interact with cells and the molecular events involved in nanoparticle-membrane receptor binding, endocytosis and subsequent signaling activation.

Silver's (Ag) extremely small size and large surface area allow for different properties than the bulk material.

Nano-silver possesses a high extinction coefficient, high surface plasmon resonance and anti-microbial properties which are less toxic then the bulk form. In the future, nano-silver's high surface plasmon resonance has a possibility for many color based biosensor. The high surface plasmon resonance is beneficial for sensors, because silver has a typical excitation wavelength and when something disrupts the surface the excitation wavelength changes and we are able to detect what has been bound. Currently silver nanomaterials have a variety of uses in everyday (Lesniak *et al.,* 2005) consumer's lives such as: nanosilver infused storage containers, nanosilver coated surfaces ofmedical devices to reduce hospital related infections, bandages, footwear and countless household items which claim to be anti-microbial. Nanosilver is a popular additive in many health products due to its unique ability to fight infectious diseases, slow the growth of bacterium, mold and germs. While all of these properties appear to make nanosilver the new "wonder-drug" of the nanotechnology world. New applications of nanoparticles and nanomaterials are emerging rapidly. Nanocrystalline silver particles have found tremendous applications in the field of high sensitivity biomolecular detection and diagnostics, antimicrobials and therapeutics, catalysis and micro-electronics. However, there is still need for economic, commercially viable as well environmentally clean synthesis route to synthesize silver nanoparticles. A number of approaches are available for the synthesis of silver nanoparticles for example, reduction in solutions, chemical and photochemical reactions in reverse micelles, thermal decomposition of silver compounds, radiation assisted process, electrochemical, sonochemical, microwave assisted process and recently via green chemistry route. With the development of new chemical or physical methods, the concern for environmental contamination are also heightened as the chemical procedures involved in the synthesis of nanomaterials generate a large amount of hazardous byproducts. Thus, there is a need for 'green chemistry' that includes a clean, nontoxic and environment-friendly method of nanoparticle synthesis. As a result, researchers in the field of nanoparticle synthesis and assembly have turned to biological systems for inspiration. Biological methods of synthesis have paved way for the "greener synthesis" of nanoparticles. Due to slower kinetics, they offer better manipulation and control over crystal growth and their stabilization. This has motivated an upsurge in research on the synthesis routes that allow better

control of shape and size for various nanotechnological applications. The use of environmentally benign materials like plant extract, bacteria, fungi and enzymes for the synthesis of silver nanoparticles offer numerous benefits of eco-friendliness and compatibility for pharmaceutical and other biomedical applications as they do not use toxic chemicals for the synthesis protocol (Bhainsa *et al.*, 2006).
Green synthesis provides advancement over chemical and physical method as it is cost effective, environment friendly, and safe for human therapeutic use . Easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals. Antimicrobial capability of silver nanoparticles allows them to be suitably employed in numerous household products such as textiles, food storage containers, home appliances and in medical devices. The most important application of silver and silver nanoparticles is in medical industry such as topical ointments to prevent infection against burn and open wounds.
Silver nano particles are reported to have many therapeutic uses.

II. MATERIALS AND METHODS

A. *Sample collection*

Curry leaves were collected from Pallam, Thrissur district of Kerala state, India. The fresh leaves were collected in poly ethylene zipper bags, later washed two times with distilled water. The samples are then oven dried at 60°C for 24 h. The dried samples were powdered using a blender and stored in air-tight polyethylene bottles until further analysis.

Fig.1 Curry leaf

B. *Extraction method*

Curry leaf extract was prepared with 10 g of fresh curry leaves taken in 3 separate beakers each. It was thoroughly washed with tap water and then with distilled water for at least 2 times and cut into small pieces. The chopped leaves were boiled in 75ml of distilled water for 3 minutes in 1st beaker, for 5 minutes in 2nd beaker and for 10 minutes in 3rd beaker separately.
The leaf broth was then cooled and filtered. It was then stored at 4°C after covering the beaker with aluminum foil for further use. The obtained curry leaf extract which appeared light green in color was stored 4°C for further use.

Fig.2 extracted solution

C. *Synthesis of sliver nanoparticiles*

Stock solution was prepared by dissolving 1M sliver nitrate ($AgNO_3$) and volume made up to 250 ml with distilled water. 5 ml of curry leaf extract of different concentration (3 min boiled, 5 min boiled and 10 min boiled separately) was added to 100 ml of 1M AgNO3 solution and allowed to react at room temperature

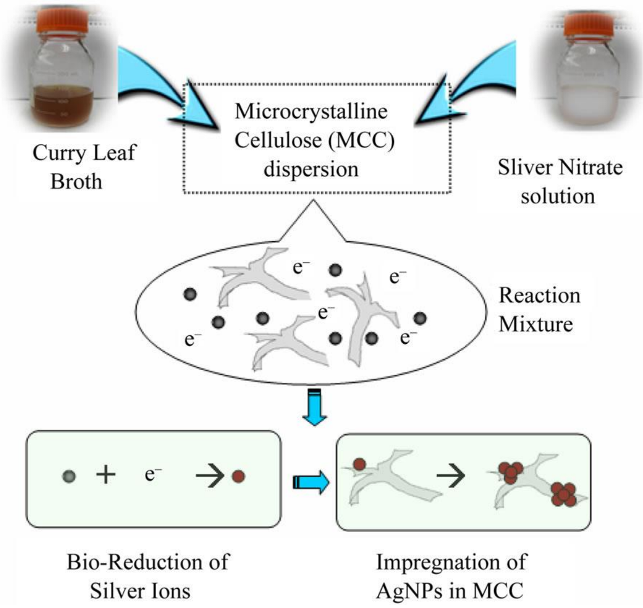

Fig.3 Reaction of silver nanoparticle

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D. *Characterization of silver nanoparticles*

The periodic scans of the optical absorbance between 385 and 500nm with a UV- spectrophotometer performed to investigate the reduction rate of silver ions by curry leaf extract. The reaction mixture was diluted 20 times and used for UV- spectrophotometry. Deionised water was used to adjust the baseline

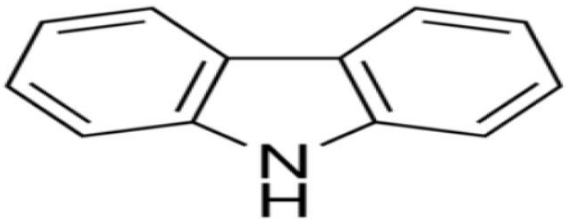

Fig.3 Structure of carbazole in curry leaves

III. RESULTS AND DISCUSSIONS

The water quality parameters mentioned are tested for the different sample solutions. The sample water parameters are checked and are given below. The water samples are treated with silver nano particle and the parameters of the treated water is checked. Adsorbance of sample with curry leafe extraction at various time is also plotted.

TABLE I
Water quality parameters of the samples

Sl.No	Parameters	Unit	Value	
			Before treatment	After treatment
1	pH	-	9.8	7.5
2	Turbidity	NTU	320	1.1
3	T.D.S	Mg/L	175	124
8	Total Hardness	Mg/L	200	160
14.	B.O.D	Mg/L	450	235

A. pH

pH is a numeric scale used to specify the acidity or basicity of an aqueous solution. It is approximately the negative of the base 10 logarithm of the molar concentration, measured in units of moles per liter, of hydrogen ions. More precisely it is the negative of the base 10 logarithm of the activity of the hydrogen ion. Solutions with a pH less than 7 are acidic and solutions with a pH greater than 7 are basic. Pure water is neutral, at pH 7 (25 °C), being neither an acid nor a base. The pH value can be less than 0 or greater than 14 for very strong acids and bases respectively. Here the pH is reduced. For irrigation purpose the pH should be within 6.0-8.5. So this effluent water after treatment can be used for irrigation purpose on the basis of pH.

B. TDS

Total dissolved solids(TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granular (colloidal sol) suspended form. Generally the operational definition is that the solids must be small enough to survive filtration through a filter with two-micrometer (nominal size or smaller) pores. Total dissolved solids are normally discussed only for freshwater systems, as salinity includes some of the ions constituting the definition of TDS. The principal application of TDS is in the study of water quality of stream and lakes, although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects) it is used as an indication of aesthetic characteristics and as an aggregate indicator of the presence of a broad array of chemical contaminants.

C. Hardness

Water hardness is a tradition measure of the capacity of water to precipitate soap. Hardness of water is not specific constituent but is a variable and complex mixture of cations and anions. It is caused by dissolved polyvalent metallic ions. In fresh water the principal hardness causing ions are calcium and magnesium which precipitate soap. Other polyvalent cations also may precipitate soap, but often are in complex from frequently with organic constituents, and their role in water hardness may be minimal and difficult to define. Total hardness is defined as the sum of the calcium and magnesium concentration, both expressed as $CaCO_{3,}$ in mg/L. So it needs proper treatment before discharge in to surface water. The hardness of the sample after treatment is obtained as 160mg/L and which is under the desirable limit of drinking water standards.

D. Biochemical oxygen demand (BOD)

Biochemical oxygen demand also called biological oxygen demand) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature. The BOD value is expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water. Here the sample BOD value decreases

Fig.4 Sample before treatment

Fig.5 Sample after treatment

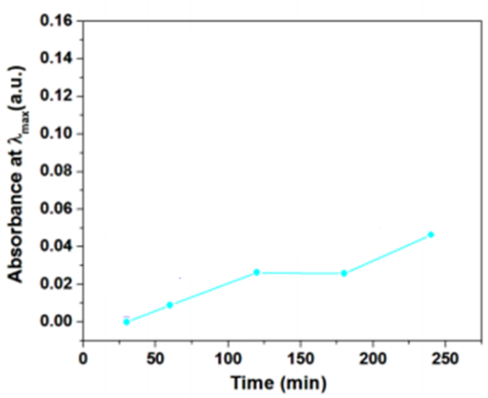

Fig.6 adsorbance v/s time of sample with curry leaf extract

From the fig6.6 it is cleared that addition of curry leaf broth to the silver nitrate solution, silver nanoparticles began to form within 15 minutes and the reaction neared completion at 2 h.

IV. Conclusions

The aims of the project were to synthesis of silver nanaoparticle, extracted from curry leaf and use this extraction to purify polluted water. Following the addition of curry leaf broth to the silver nitrate solution, silver nanoparticles began to form within 15 minutes and the reaction neared completion at 2 h, as shown by the UV-spectrophotometry Curry leaf is efficient for removing the bacteria, viruses and fungi from waste water.

Also it reduces the turbidity, pH, hardness, BOD etc from waste water. And it is proved that cheaply available natural curry leave can used to treat polluted water.

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