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Effect of Physical Parameters on Green Synthesis of Gold Nanoparticles using Zea Mays Extract

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Abstract: ***Gold nanoparticles (AuNPs) were produced by green synthesis method by utilization of Zea Mays Extract as the reducing and stabilizing solution. Selected parameters like Time, Temperature, pH, Light and Concentration effects on the preparation of gold nanoparticles was analyzed by UV- Visible Spectroscopy (UV-Vis.). The size was measured through Dynamic Light Scattering (DLS) and also confirmed by Transmission electron microscopy (TEM) techniques, it is also observed that all the reaction time, Temperature, Concentration and reaction time are very essential parameters which should be noticed with high precession during the synthesis of Gold nanoparticles.***

Keywords: Green synthesis, Gold nanoparticles, physical parameters effect.

I. INTRODUCTION

Nowadays, nanoparticles (NPs) have drawn glorious thought in view of their significant properties on different fields, for example, restorative, sensor, optical, electronic, furthermore, Biomedical application [1].The size of nanoparticles depends upon many parameters but the reducing agent and the pH of the solution are main important parameters [2]. Gold nanoparticles were prepared in fluorescent light [3] and at different reaction temperature [4]. Some Microorganisms were used for the synthesis and nucleation, of the metal nanomaterials. Many microorganisms are used in intracellular or extracellular synthesis process of metal nanoparticles. Cell filtrate is very important to control the polydispersity and size of the nanoparticles in extracellular synthesis. The cell filtrate in synthesis method is more efficient then intercellular synthesis techniques [5]. The gold nanoparticles were synthesized through various extract like endemic plants [6], plants mediated, Ginkgo Biloba leaf extract, Pistacia Atlantica. Recently, it was reported that selected pathogenic bacteria's resistance has been increased against the synthetic drugs. The seeds and fruits which contain the Carbohydrates can be used as stabilizer and also a reducing agent, leading to the formation of noble metal nanoparticles. it was also observed that water soluble nanoparticles showed great antimicrobial applications .

The main purpose of this research is to prepare cost-effective, small size and eco-friendly gold nanoparticles by using Zea Mays extract as reducing and stabilizing agent and also the effect of physical parameters on the green synthesis of AuNPs were investigated.

II. MATERIALS AND METHODOLOGY

A. Preparation of extract

The detailed study on the green synthesis of gold nanoparticles was carried out from Zea Mays extract; Zea Mays was purchased from local market Allahabad, and Gold(III) chloride or Chloroauric acid(HAuCl4) was purchased from [Sigma-Aldrich, USA: 99.99%], deionized water was purchased by Scientific India. Mature Zea Mays granules were dried in direct sunlight then washed thoroughly with deionized water. The Zea Mays granules were ground into a fine powder then 100gm fine powder was mixed with 500ML deionized water and boiled for 50 minutes at 60^0 C and then centrifuged at 5000 rpm for 15 minutes and separated through filter paper (Whatman no. 1). The Zea Mays extract solution was used after 1 hour of preparation. The separated solution was used as reducing and stabilizing agents for the further research work.

B. Green synthesis of AuNPs

For the preparation of the green gold nanoparticles, 10ml of Zea Mays extract solution was add to the 100 ML of 1 mM Gold Chloride solution. The mixture was stirred at 60^0 C and 500 rpm by using magnetic stirrer. The colour changes from yellow to red ensure the formation of green gold nanoparticles. The reduction of green synthesized gold nanoparticles was investigated by analyzing samples taken from solutions at fixed time period, pH, Temperature, Light conditions, Concentration and analyzing through UV- Vis. Spectroscopy. The maximum wavelength and absorbance were recorded for each sample through UV-Vis spectra [10].

C. Characterization of Green Gold nanoparticles

Ultraviolet visible spectrometer (Systronics double beam spectrophotometer 2202, India) was used to identify the absorption intensity in the range of 300-700 nm.

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(TEM- JEM-2100, JEOL, Japan) was used to observe microstructures of green AuNPs and DLS. FTIR (Perkin Elmer Spectrum 2, Germany) was used to identify the functional groups present in the suspension.

III. RESULTS AND DISCUSSION

Fig.1 showed the UV-Visible spectra of the green gold nanoparticles which were confirmed through the colour change from light yellow to ruby red colour.

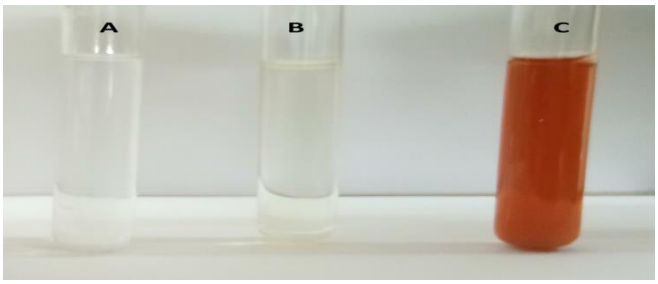

Fig.1 Visual observation of Gold nanoparticles (AuNPs), (A) Zea Mays Extract (B) Chloroauric acid (C) Gold nanoparticles (AuNPs).

A. Time Effect

Fig.2 showed that no reduction was noticed in the first 10 min (SPR) peak was observed 540nm after 15min of reaction, And almost constant after 90 min up to 720min, which confirmed the completion of reaction. The colour change is the clear indication of formation of AuNPs when 1mM $HauCl_4$ was mixed to Maize extract at different time slots. The surface plasmon resonance peak of solution was noticed that the intensity of the colour change is proportional to the reaction time of the solution as the reaction time increased the absorbance also increased. In the beginning there was no change in colour but it starts instantly after 10 minutes of the reaction till 12hrs of reaction time.

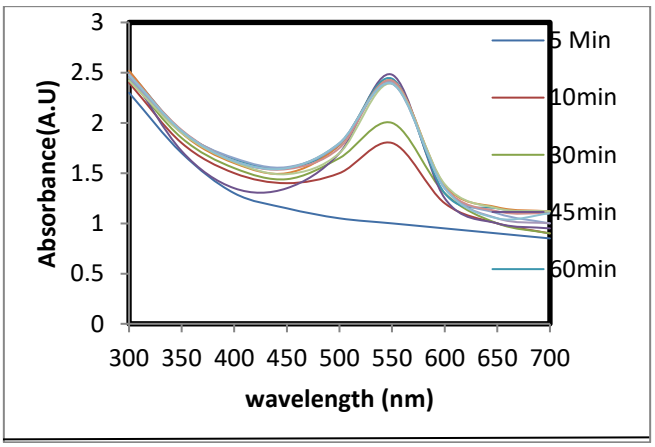

Fig. 2- UV-Visible spectra if AuNps synthesized by Zea Mays (Maize) extract after the different time reaction.

B. Concentration Effect

Fig.3 showed the Concentration-effect the synthesis of AuNPs, different samples of the concentration of Chloroauric acid (0.5mM, 1mM, 2mM and 5mM) were prepared and analyzed through UV-Vis and max absorbance peak was observed at the 1mM solution. The synthesis of the AuNPs increase as the concentration of the Tetrachloroauric acid increased. The surface plasmon resonance peak and its sharpness increased at high concentration and showed the increased in the Gold nanoparticles size and the absorbance peak was higher at normal concentration. The production of green AuNPs was little slower at low concentration and high at high concentration .

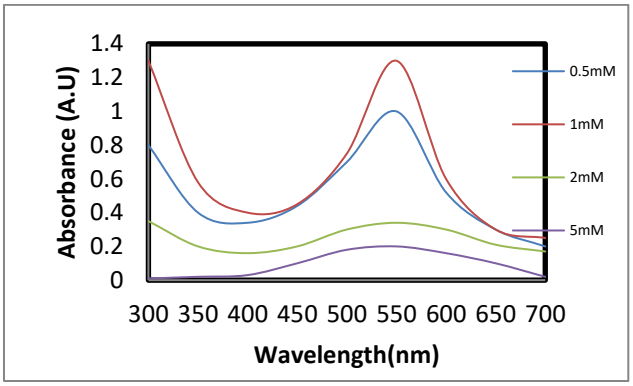

Fig.3 UV-Visible spectra if AuNPs synthesized by Zea Mays (Maize) extract at different Concentration of Chloroauric acid ($HAuCl_4$).

C. Effect of pH

pH play an significant character in the synthesis of NPs showed in Fig. 4. In this study, the pH influence the green synthesis of gold nanoparticles was studied in the range from 3 to 11. For the analysis of synthesis of gold nanoparticles visual observations and UV-Vis was used for the effect of pH, It was observed that at pH=6 to 7 the colour starts changes from yellow to red colour; pH controlled the shape, size and stability of AuNPs.. Initially at pH=3,4 and 5 the synthesis of the AuNPs was very slow and as the ph was further increased and it reaches at pH=6 to 7 the reaction was very high but as the pH increased further the absorbance value decreased as pH increased.

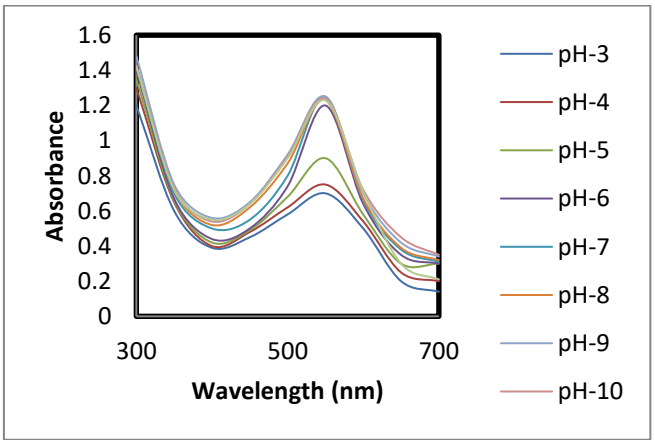

Fig.4 UV-Visible spectra if AuNPs synthesized by Zea Mays (Maize) extract at different pH levels.

D. Effect of Light

AuNPs were prepared in different light conditions and it was observed by visual observations and through UV-Vis spectrometer the process of AuNPs in sunlight was rapid in comparison to normal light, UV light, Tube light, Moon light and in dark room.

AuNPs were prepared in various light conditions to see the effect on biosynthesis on gold nanoparticles such as Dark, UV lights, Moonlight, Control and Sunlight.

It was observed in Fig.5 that the synthesis process of gold nanoparticles was rapid under the sunlight. The sample did not showed any colour change in dark throughout the night. The reaction sample showed small absorbance in UV light and it increased continuously in moonlight, control and in sunlight. The maximum absorbance peak was observed in sunlight at 550 nm. The range of the AuNPs also results of the intensity of the light. If the intensity of the light is high then the size of the particles will be smaller and the reduction rate will be high.

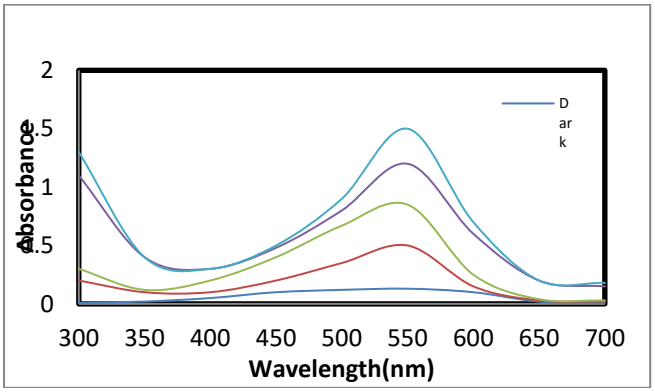

Fig.5 UV-Visible spectra if AuNPs synthesized by Zea Mays (Maize) extract in different light conditions.

E. Effect of Temperature

Temperature decides the formation of AuNPs. The multiple samples were prepared at different temperature conditions such as 0^0c, 5^0c,30^0c,45^0c,75^0c and 90^0c and the highest SPR peak recorded at 75^0c which was shown in figure Fig.6 and also noticed that SPR peak increased as temperature increased because as temperature increased the nucleation of Gold nanoparticles is also increased. At higher temperature the range of the AuNPs becomes smaller, which indicates through the sharpness of absorbance peak.

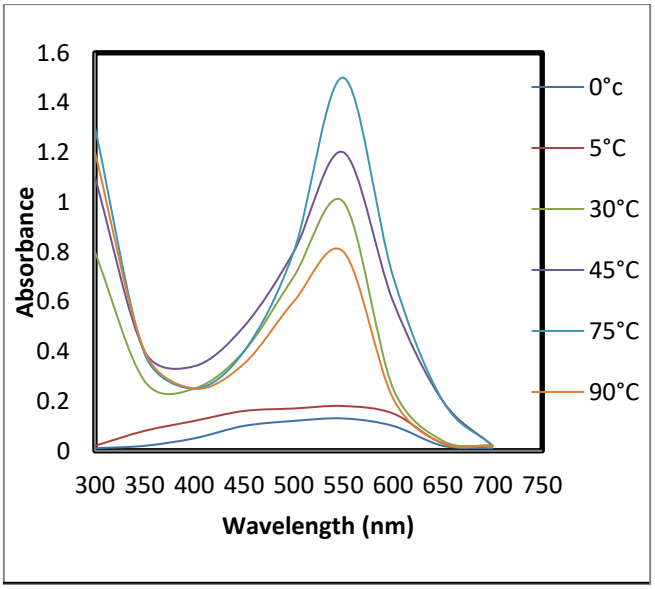

Fig.6 UV-Visible spectra if AuNPs synthesized by Zea Mays (Maize) extract at different temperature Conditions

F. Dynamic Light scattering

A DLS technique was used to analyze the size distribution of tiny particles within the range of nanometer 2-500nm in mixture solution and it depends on the character of light with the gold nanoparticles. Physiochemical properties are very important for the investigation of biological activities of gold nanoparticles through dynamic light scattering [7].among all the techniques which can be used for the measurement of size distribution, DLS is very important method for size. In this method a laser light enters through the suspension and gives the information of the suspended gold nanoparticles. The size analysis by DLS is always greater than the size measured by the Transmission electron microscopy due to the Brownian motion[8].

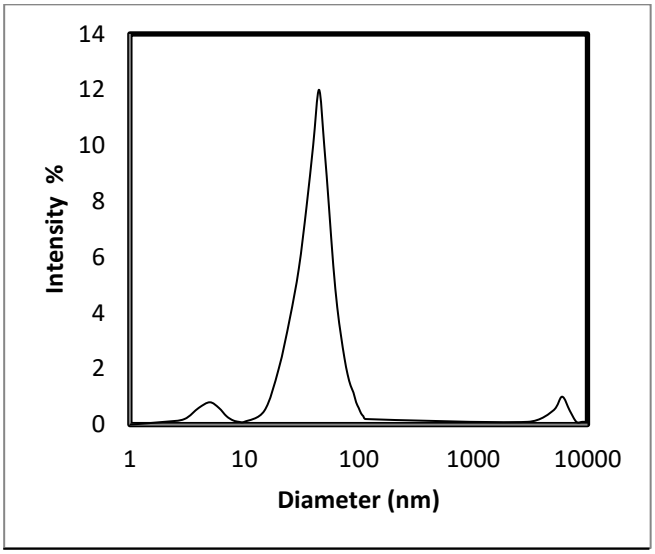

Fig.7 Dynamic Light scattering spectra for the measurement of the size of (AuNPs)

G. TEM Analysis

The range and shape of the green AuNPs was analyzed through TEM (Fig.7) and results showed that the green AuNPs were in spherical shape and the size range of AuNPs from 6-50 nm. According to the literature the gold nanoparticles were confirmed by TEM was 30 nm [8,9].

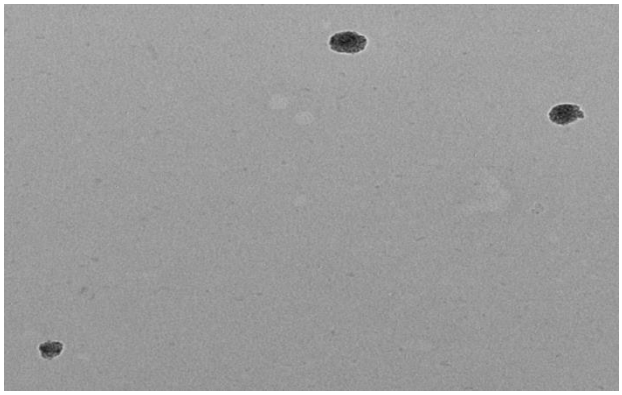

Fig.8 TEM image of AuNPs synthesized from Zea Mays extracts (50 nm).

IV. CONCLUSION

After the investigation of various physical parameters like Time, pH, Temperature, Light and Concentration the results showed that these parameters plays an important role for the preparation of green gold nanoparticles. The reaction became stagnant after 90 minutes. The highest absorbance peak was observed between the pH=6 to 7 in sunlight at the concentration of 1mM solution but as the heat given to the solution the temperature increases at 75^0c the absorbance peak was maximum. According to the TEM and DLS observation the size range of the green AuNPs is 6-50 nm.

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