**GREEN SYNTHESIS AND CHARACTERIZATION OF TRIMETALLIC ALLOY NANOPARTICLES**

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**ABSTRACT**

Crystallized Manganese (Mn), Nickel (Ni), Zinc (Zn) tri-metallic nanometal alloy have been prepared and stabilized using plant extracts of *Caparis Zylanica* leaves in an aqueous system. Aqueous solutions of Mn+2, Ni+2, Zn+2 ions are in 1: 1: 1 ratio of Mn-Ni-Zn alloy was treated with a filtered solution of *Caparis Zylanica* leavesextract for the formation of Mn-Ni-Zn tri-metallic alloy nano particles (Mn-Ni-ZnNPs). Analysis of the feasibility of the biologically synthesized bio-functional nanometal alloy from plant leaves extract is particularly noteworthy. The colloidal suspensions obtained were in stable condition for 2-3 weeks. The composition, morphology, size and structure of the nanoparticles were determined by UV-Visible spectroscopy (UV-Vis), Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM).

**Key words**: Trimetallic alloy nanoparticles, *Capparis zeylanica*, UV-Visible, FTIR, SEM.

**I. INTRODUCTION**

Nanotechnology is a science that can stand encompasses the empathetic of the central physics, chemistry, biology and knowledge of nanometer-scale matters [1]. Nanoparticles are mainly divided into two sorts known as organic and inorganic nanoparticles. Organic nanoparticles are nanoparticles which comprises carbon nanoparticles such by way of fullerenes, carbon nanotubes, etc. Though inorganic nanoparticles encompasses compelling nanoparticles, noble iron nanoparticles such as Silver, Gold [2] semi-channel [3] and Zinc oxide [4]. Metallic nanoparticles like silver [5], gold [6], Copper [7] are viewing a good practical belongings. So it is used as an indispensable tool for the researchers to their biomedical requests. Green chemistry is biosynthesis of nanoparticles using plant extract [8]. Due to wide delivery of the plant and safety fashionable handling this biosynthesis can remain regarded as a monetary way [9]. Processes active for production nanoparticles using plant extracts are readily ascendable and for the maximum part, fewer expensive [10]. In judgment to the fairly expensive methods based on bacteriological processes [11], nanoparticles produced from plant extract, because of their curative properties, could be used in drugs, targeted drug transfer and cosmetic claims [12].

Furthermore, in judgement with chemical besides corporeal methods, green synthesis has many beneﬁts such by way of environmentally friendly, cost effective, and simply scaled up for large gauge synthesis. The increasing need of conservational friendly nanoparticles takes attracted countless researchers to use green fusion methods of many metal nanoparticles [13] due to their interesting and amazing properties with a variety of applications over their bulk material[14].Considering the photochemical reduction, chemical reduction methods, electrochemical reduction, warmness evaporation etc., the life method is extra advantageous [15]. In this life method, the plant extract has been used as reducing agent and topping agent for the synthesis of nanoparticles [16] due to their dipping properties [17]. About properties such as size, distribution, and morphology of the particles are clearly gotten from the nanoparticles [18].

In this present investigation, *Capparis zeylanica* Linn own to the family of capparidaceae commonly known as Indian caper, is a climbing scandant shrub found throughout India and been used as a ‘Rasayana’ drug in the traditional medicine. This plant extract was used as reducing agent for the synthesis of Mn-Ni-Zn nanoparticles [19]. The plant extract mainly consists of fatty acids, alkaloids and flavonoids. *Capparis zeylanica* Linn was reported to hold antioxidant, antimicrobial, anti inflammatory and immune stimulant activity [20].

**II. MATERIALS AND METHODS**

**A. MATERIALS**

**Plant**

*Capparis zeylanica* leaf was collected from Thirumayam, Pudukkottai, Tamilnadu, India.

**Chemicals**

The metal salt solutions used were 0.1M Manganese sulphate-MnSO4, 0.1M Nickel chloride-NiCl2, 0.1M Zinc sulphate-ZnSO4

**General Information of Plant**

*Capparis zeylanica* is an evergreen climbing shrub producing stems 2-5 meters long, occasionally to 10 meters. The plant is harvested from the wild for local use as a medicine and occasionally as a food. Beautiful flowers, which are essentiality a spreading spray of pink-white stamens and appear solitary in leaf axils. The flowers turn dark pink while fading.

**B. METHODS**

**Preparation of Extract**

The bottom up bio synthesis method is used. The extract was prepared by modifying the method reported by [21].The *Caparis zeylanica* leaves were washed several times with water and rinsed with deionized water for the removal of impurities. 10g of sliced *Capparis zeylanica* leaves was weighed then boiled with deionized water for 10 minutes and was filtered using Whatman No.1 filter paper. The filtrate was collected in clean, dry conical flask and kept for further use.

**Table.1. General Information of plant**

|  |  |  |  |
| --- | --- | --- | --- |
| **Caparis zylanica leaf** | **Leaf Powder** | **Scientific Classification** | |
| C:\Users\admin\Downloads\WhatsApp Image 2022-05-27 at 4.30.46 PM.jpeg | C:\Users\admin\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Word\WhatsApp Image 2022-05-24 at 1.11.13 PM (2).jpeg | **Kingdom** | Plantae |
| **Phylum** | Tracheophyta |
| **Class** | Magnoliopsida |
| **Order** | Capparales |
| **Family** | Capparaceae(caper family) |
| **Genus** | Capparis |
| **Species** | Capparis zeylanica.L |
| **Common name** | Ceylon coper,Indian caper |
| **Tamil name** | Adondai, Karrottai |

**Synthesis of Mn-Ni-Zn Nanoparticles**

The tri metal alloy of Mn-Ni-Zn nanoparticle was prepared by mixing 1:1:1 ratio of their 0.1M salt solutions which is of Manganes sulphate, Nickel chloride and Zinc sulphate. 25ml of each of these salts were mixed together. Then 25ml of extract was added and a colour change was observed from pale yellow to reddish and then turned darker and kept at room temperature which indicates formation of Mn-Ni-Zn trimetallic alloy nanoparticles. Then the solution was centrifuged at 6000 rpm for 15min and the sample was sent for characterization tests which are UV-visible spectroscopy, FTIR, SEM.

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| Fig.1.Synthesis of Nanoparticles |

**Characterization**

The UV-Visible spectral measurements were used to confirm the formation of Mn-Ni-Zn nanoparticles by using PERKIN ELMER-UV-WIN spectrophotometer instrument in the range between 200-800nm [22]. FTIR experiment to be carried out to determine the biomolecules present in the leaf extract responsible for the reduction of Mn-Ni-Zn ions with 400-4000cm-1 of spectra range. The sample was centrifuged at 9000 rpm for 15min, then dried and ground with KBr pellet and analyzed on PERKINELMER-FTIR model. The sample were prepared on a carbon coated grid by just dipping a very small amount of the prepared Mn-Ni-ZnNPs on grid, by using blotting paper the extra solution was isolated, then the sample were allowed to dry for SEM analysis using Suprazeis with resolution of 1nm at 30kV with 20mm Oxford EDS detector.

**Phyto Chemical Screening**

Qualitative phytochemical of [23] the following tests were performed on extracts to detect various phytochemicals present in them.

**Table.2. Phyto chemical Screening analysis of plant material**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **Specific Test** | **Reagent Composition** | **Observed Color** | **Inference** |
| Detection of Flavonoids | Ferric chloride Test | Solution when treated with a drop of Ferric chloride | Blackish red color | Presence of Flavonoids |
| Detection of Alkaloids | Mayer’s Test | Extract mixed with ammonia and then with chloroform solution. Dil HCl was added. Acid layer with a few drops of Mayer’s reagent. | Creamy white precipitate | Presence of Alkaloids |
| Detection of Tannins | - | 5ml of extract, FeCl3 was added. | Deep blue (or) greenish black color | Presence of Tannins |
| Detection of Glycosides | Keller killani’s Test | Dissolved the extract in water with glacial acetic acid, FeCl3,Con.H2SO4 | Brown ring | Presence of Glycosides |
| Detection of Steroids | Salkowski’s of Steroids | 2ml of extract, 2ml of chloroform was added, followed by 3ml of H2SO4. | Reddish brown color | Presence of Steroids |
| Detection of Phenols | - | Extract was dissolved in 5ml of distilled water. Few drops of neutral 5% FeCl3 solution was added. | Dark green color | Presence of Phenolic Compound. |
| Detection of Saponins | - | A pinch of dried powdered plant was added to 2-3 ml of distilled water. The mixture was shaken vigorously | Formation of foam on surface | Presence of saponins |
| Detection of Carbohydrates | Molish Test | Powdered plant extracts 1ml of napthol solution.con. H2SO4 was added to the sides of test tube | Purple (or) reddish Violet color | Presence of Carbohydrates |
| Detection of Proteins | Xanthoprotein Test | Few mg of powder 1ml of Con.HNO3 was added. It was then boiled and cooled | White precipitate | Presence of Proteins |
| Detection of Amino acid | - | 3ml of test solution and 3 drops of 5% Ninhydrin solution were added in test tube and heated in water bath for 10 minutes. | Purple (or) bluish Color | Presence of Amino acid |

**III.RESULTS AND DISCUSSION**

**A. UV-Vis Spectroscopy Analysis**

The change in colour of the mixture from pale yellow to reddish brown within few minutes indicates the formation of metal alloy Mn-Ni-Zn nanoparticles. On allowing the solution for a day, it becomes darker solution than previous colour. UV-Visible spectroscopy analysis of plant extract and Mn-Ni-Zn nanoparticles was confirmed and shown in Figure 2.a and Figure 2.b.When the plant extract was added into the Mn-Ni-Zn solution the pale yellow color was obtained. After 20 minutes, the colour changes from pale yellow to dark reddish brown. The absorption spectra of Mn-Ni-Zn nanoparticles formed in the reaction mixture was obtained by the UV-Vis analysis at the range between 200-800nm, the Mn-Ni-ZnNPs has sharp absorbance with highest peak at 268nmprogressively decreased while increased [24]





**B. FTIR Analysis**

FTIR measurement was done to identify the reducing, capping and stabilizing capacity of *Capparis zeylanica* leaf extract. The FTIR analysis was done for both plant extract and Mn-Ni-Zn NPs. In Figure 3a, aqueous plant extract shown the peaks at 1636cm-1 , 2119.75cm-1 , 3331.76cm-1, 592cm-1 the peak at 2119.75cm-1 shows the bondsdue to corresponds in alkynes [25] and 3331.76cm-1 corresponds to O-H stretching of carboxylic acid stretching like galic acid, acetic acid and gibberllic acids;1636cm-1 C=O stretching [26], 592cm-1 C-Cl stretching, peak at 1636cm-1 was a strong absorption peak which indicates the characteristics IR absorption of polysaccharides shows the bonds due to C=O stretching of amines [27]. Whereas the Mn-Ni-Zn nanoparticles present in the solution shows the peak at around 1637, 2123.39, 3331.73, 592.5cm-1in figure 3b. The peak at 2123.39cm-1 corresponds to alkyne stretching of phenolic compound, where as other peaks 3331.73cm-1 obtained in Mn-Ni-Zn metallic alloy nanoparticles due to O-H stretching of hydroxyl groups [28, 29]. Particularly the plant leaves contained the chemical constituents of phenolic compounds, alkaloids and fatty acids such as thioglycoside, β-carotene, glycocapparin, α-amyrin are acting as capping and reducing agents [30].





**C. Scanning Electron Microscopy (SEM) analysis**

The surface morphology of Mn-Ni-ZnNPs was analyzed by scanning electron microscope it was performed by EVO-18 CAREL ZEISS model an operating on the voltage of 10 kV and for operation need a very small amount of dry powder sample put on a grid and removed excess sample with the help of blotting paper. Shape and morphology of the synthesized nanoparticles were identified by scanning electron microscope analysis. Then nanoparticles were examined under various magnifications of X10,000, X25,000, X35,000 and X45,000 SEM images of the synthesized Mn-Ni-ZnNPs are shown in Fig.4. It was shown that spherical and relatively uniform shape of the Mn-Ni-Zn trimetallic alloy nanoparticles in the range 253-350 nm.

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| Fig.4. SEM images of Synthesized Mn-Ni-Zn nanoparticles | |

**IV.CONCLUSION**

In the ﬁeld of nanotechnology, improvement of reliable and ecopleasant techniques for the synthesis of metallic alloy nanoparticles is top need. The objective of this work is‘Green’ synthesis of Mn-Ni-Zn nanoparticles with the aid of a simple method. The Mn-Ni-Zn alloy nanoparticles have been efficaciously synthesized with the aid of using *Capparis zeylanica* plant leaves as first time, which offers price effective, easy and proficient manner for synthesis of Mn-Ni-ZnNPs. The traits of the received Mn-Ni-Zn alloy nanoparticles have been studied using UV-Vis, FTIR, SEM evaluation techniques. The experimental effects showed that the synthesized Mn-Ni-Zn nanoparticles are strong with a median length of approximately 253-350 nm.

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