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Plant-Mediated Synthesis of Cobalt Doped Ferric Oxide Nanoparticles from the Fruit Extract of *Elaeagnus Conferta Roxburgh* and their Characterization and Anti-Bacterial Activity

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ABSTRACT

In the current work, pointed out the synthesis of Cobalt doped Ferric Oxide nanoparticles via a simple precipitation method, using *Elaeagnus conferta roxburgh* fruit extraction. The synthesized Cobalt doped Ferric Oxide nanoparticles were studied by different techniques such as UV, FT-IR, XRD and SEM with EDX. Scanning Electron Microscopy (SEM) and Energy dispersive analysis. Scanning Electron Microscopy images revealed the roughly spherical shaped structure of 5%Cobalt doped Ferric Oxide nanoparticles having the particle size between 29 to 49 nm. The Anti-bacterial studies showed the inhibition zone of the bacterial growth on the *Elaeagnus conferta roxburgh* fruit extract.

Keywords: *Elaeagnus conferta roxburgh*, Cobalt doped Ferric Oxide nanoparticles, Surface functionalisation, Anti-bacterial activity.

1. INTRODUCTION:

Nowadays, medicinal plants are very important to hide the chemicals plants are the treasure to cure many diseases in the Human body, because plants cannot cause any side effect. Nanoparticles have the various medicinal applications. The fast growing technology is the Nanotechnology that can be used for several purposes has had an immense effect on medicine. The field of medicine in the Nanotechnology is known as the nanomedicine. Nanotechnology has various fields such as molecular biology, nanomedicine, biomaterial science etc. In the Nanomedicine, nanoparticles can be used more due to their size and that the particles should be spread easily through anywhere. In recent days, plants are the best medicine to cure any diseases [1]. *Elaeagnus conferta roxburgh* family (Elaeganaceae*)* is one of the plants that can be used as medicinal purposes. The plant *Elaeagnus conferta roxburgh*, can be used to cure many diseases in the Human body. The fruit from the plant can be intake normally. It contains many nutritional components such as sodium, Calcium, Potassium, Phosphorus, Manganese, Calcium, Vitamin-C. Fe_2O_3 Nanoparticles can be used because of non-toxic. It has the super paramagnetic properties. Green synthesis is the most preferable method to synthesis the nanoparticles because of it are non-toxic, and it does not affect the environment.

2. MATERIALS AND METHODS

2.1 Fruit Collection and preparation:

The Fruit of *Elaeagnus conferta* roxburgh was collected from Sathyamangalam, Tamilnadu, India. The fruits were washed with tap water followed by distilled water and dried under air at room temperature for 7 days. Then these dried fruits (20g) were taken in a glass beaker and distilled water was added and the mixture was stirred for 5 hours. Then the stirring was stopped and the solution was filtered and stored in a refrigerator for further use. The filtrate is used to synthesize 5% Cobalt doped Ferric Oxide nanoparticles.

Elaeagnus conferta roxburgh fruit

Elaeagnus conferta fruit powder

2.2 Synthesis of 5%Cobalt doped Ferric Oxide nanoparticles:

The initial components, such as ferric chloride, ammonia, and cobalt chloride, were bought from Merck in scientific grade and used as such without further processing. The extraction of *Elaeagnus conferta roxburgh* was completed using de-ionized water [2]. The mixture of iron solution and *Elaeagnus conferta roxburgh*, extraction was kept during the mixing procedure in order to obtain ideal iron hydroxide utilizing the chemical-precipitation method. A dropwise addition of aqueous ammonia solution stabilized the pH of the solution.

The 5% cobalt solution was diluted drop by drop using a burette, which is likely used as a dopant, and then held again for the process of mixing. Additionally, the supernatant solution was drained and thoroughly cleaned to remove any impurities. To remove contaminants and work on the crystallinity, the powder was parched using a hot plate and held at 600°C for 6 hours in a muffle furnace [3].

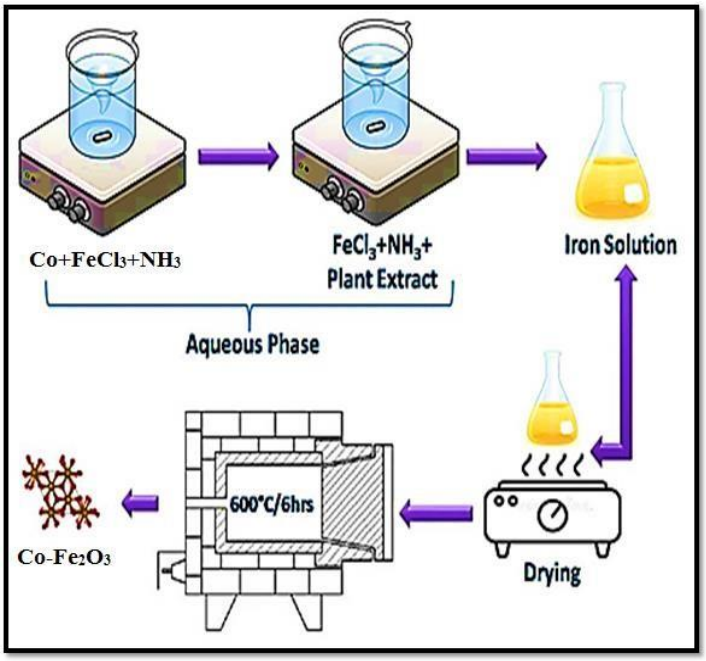

Fig 1: Synthesis of 5% Cobalt doped Ferric Oxide nanoparticles

2.3 CHARACTERIZATION

The 5% Cobalt doped Ferric Oxide nanoparticles were characterized by various techniques. The absorption spectra of the Cobalt doped Ferric Oxide nanoparticles were studied using UV-Visible spectroscopy. Surface functionalisation of *Elaeagnus conferta roxburgh*, Fruit extracts on the surface of 5% Cobalt doped Ferric Oxide nanoparticles were studied by FTIR (Schimadzu IR Affinity model 1s double beam spectrometer) with the wave number range of 4000 cm^{-1} to 400 cm^{-1}. The crystalline nature and phase identification were studied by XRD (Empyrean, Malvern Panalytical) method with CuKα (λ=1.54 A°) radiation. Surface morphology and particle size of the prepared nanoparticles were analyzed by Scanning electron microscopy technique (Carl Zeiss (USA)-model-Sigma with Gemini column). EDX performed to know about the estimation of the elemental composition of 5% Cobalt doped Ferric Oxide nanoparticles [5].

2.4 Anti-Bacterial study on the Cobalt doped Ferric Oxide nanoparticles:

Antibacterial activity of the sample was identified by using well diffusion method against the bacteria. Mueller hinton agar (39gm of media was dissolved in 1000ml of distiller water and sterilized under autoclave at 121^0C for 15 minutes) was prepared, and poured to petriplate for solidification, after solidification, 70µl of the bacterial culture (*E.coli*, *P.aeruginosa*, *S.typhi* and *S.aureus*) was swabbed using cotton swab and wells were made with corck borer followed by the sample was added (10, and 20µl). Antibiotic disc (Gatifloxacin–GAT-5mcg) was placed as a positive control and distilled water (20µl of D.W) was used as negative control, the plate was incubated 37^0C for 24 hrs. After incubation anti bacterial activity of the sample was measured based on the zone of inhibition in mm.

3. RESULTS AND DISCUSSION

3.1 UV-VISIBLE SPECTROSCOPY

The fruit extract of *Elaeagnus conferta roxburgh* 2(a) shows an absorption band around 261 nm which corresponds to the presence of alkaloids, flavonoids, phenolic compounds, amino acids and terpenoids. The UV-Visible spectrum of 5% Cobalt doped Ferric Oxide nanoparticles 2(b) revealed a strong absorption in visible region around 260-380 nm[6].

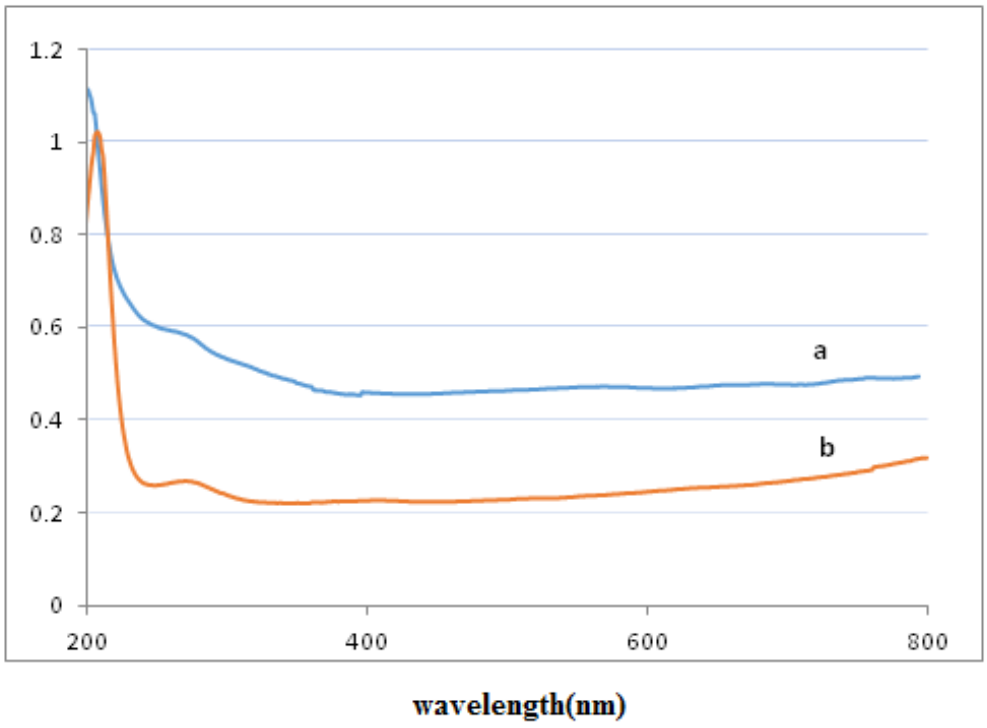

Fig.2 UV-Visible spectrum of *Elaeagnus conferta roxburgh* fruit extract 2(a) and Cobalt doped Ferric Oxide nanoparticles synthesized with *Elaeagnus conferta roxburgh* fruit extract 2(b)

The 5% Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract 2(b) shows strong absorption bands at 272nm confirms the formation of 5% Co-doped Fe_2O_3 nanoparticles and particles were stable.

3.2 FT-IR Analysis:

The synthesized 5% Co-doped Fe_2O_3 nanoparticles FT-IR Spectrum ranges from 400-4000cm^{-1} that identifies the presence of functional group and chemical bonds present in the compound [7]. In the 5% of doped cobalt nanoparticles reveals that the peak ranges 3244 cm^{-1} shows the presence of OH streching,1715 cm^{-1} shows the presence of C=O stretching, 2382 and 2343 cm^{-1} shows the presence of C=C stretching.

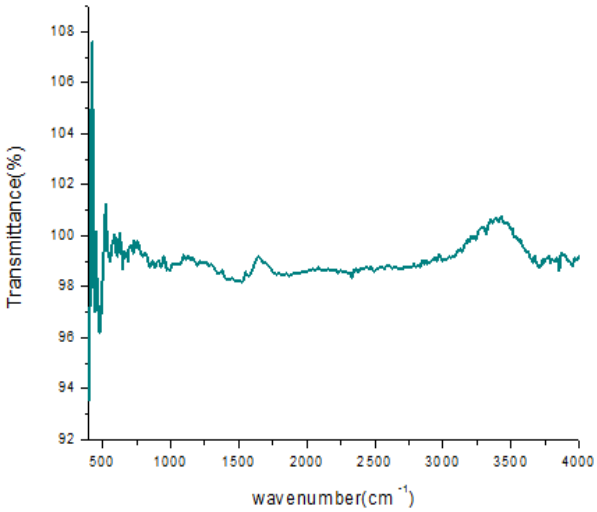

Fig.3 FT-IR spectra of 5% Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh*

3.3 SEM ANALYSIS

The morphology of 5% Co-doped Fe_2O_3 nanoparticles was determined using Scanning electron microscope. The SEM images of 5% Co-doped Fe_2O_3 nanoparticles shows that roughly spherical shaped nanoparticles with diameters ranging from 29-49 nm [8].

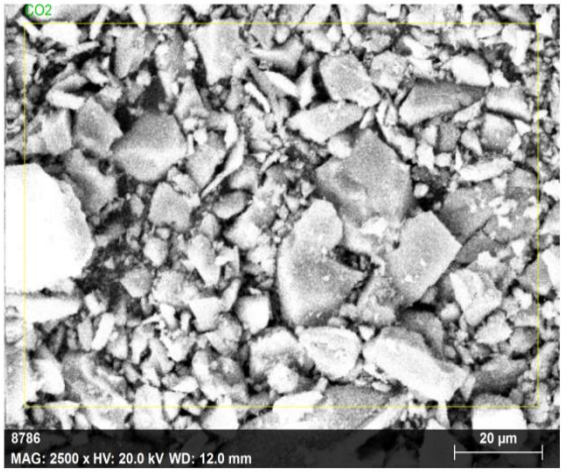

Fig.4 SEM image of 5% Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh* at different magnifications.

3.4 EDX

The elemental composition of synthesized 5% Co-doped Fe_2O_3 nanoparticles from the fruit extract of *Elaeagnus conferta roxburgh* was studied from EDX analysis figure5. In this figure, major peaks indicate the of the 5% Co-doped Fe_2O_3 synthesized NPs. However, some minor peaks of Aluminium, carbon and chlorine are also present which are attributed to the fruit extract used [9]. The elemental composition of the nanoparticles shows 18 weight per cent cobalt and 39 weights per cent Iron corresponding to 5% Co-doped Fe_2O_3 nanoparticles.

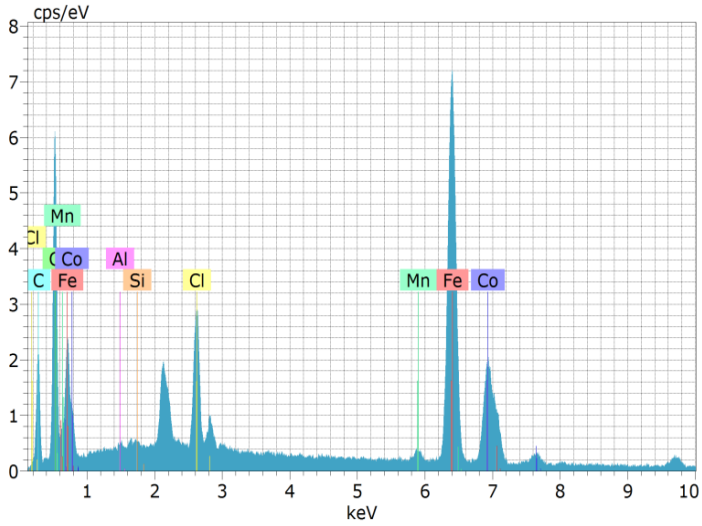

Fig.5 EDX image of 5 % Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh*

3.5 XRD

XRD analysis was performed to confirm the synthesis of 5% Co-doped Fe_2O_3 nanoparticles. To know the crystalline structure, XRD analysis was carried out and major peaks were observed at Braggs angles 16.8°,30.1°,43.8°and 60.1° corresponded to the lattice planes of (111),(220),(400) and (440) planes, confirming that the structure of synthesized 5% Co-doped Fe_2O_3 nanoparticles was single phase [10].

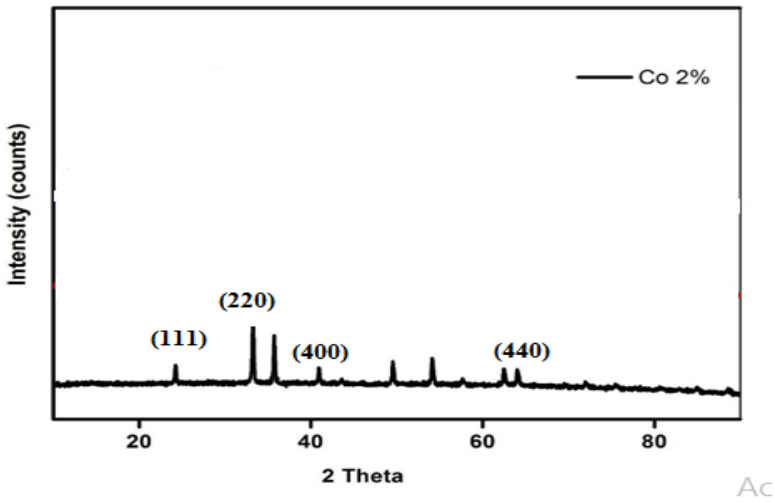

Fig.6 XRD image of 5% Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh*

4. Anti-Bacterial Activity:

Anti-bacterial activities of Co-doped Fe_2O_3 nanoparticles are presented in Table 1. 5% Co-doped Fe_2O_3 nanoparticles produced good anti-bacterial activity against *E.coli* [11].

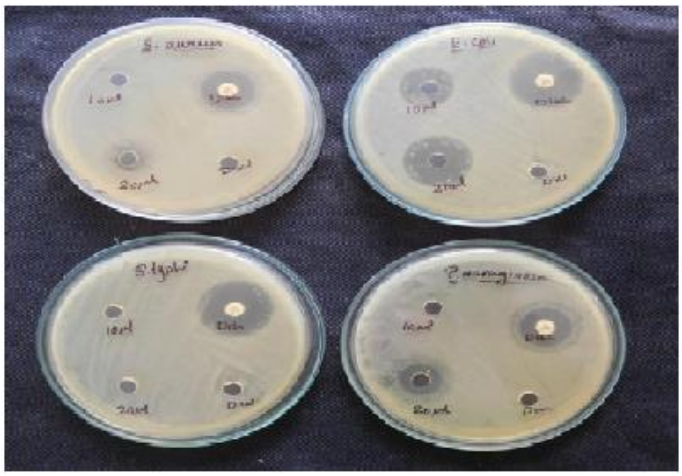

Fig.7 Effect of sample of 5%Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh*

Table 1. SD± Means of zone of inhibition obtained by sample of 5% Co-doped Fe_2O_3 nanoparticles synthesized from the fruit extract of *Elaeagnus conferta roxburgh*

Sample used	Zone of inhibition in mm			
	E.coli	***P.aeruginosa***	***S.aureus***	***S.typhi***
10µl	**5**	**1**	**Nil**	**Nil**
20µl	**7**	**4**	**2**	**Nil**
D.W	**Nil**	**Nil**	**Nil**	**Nil**
Disc	**7**	**5**	**5**	**6**

5. CONCLUSION

5% Co-doped Fe_2O_3 nanoparticles were synthesized by cost effective, biodegradable and ecological friendly green method by using the fruit extract of *Elaeagnus conferta roxburgh.* The prepared nanoparticles were analyzed by UV-Visible spectroscopy, FTIR, XRD and SEM techniques. These techniques showed successful synthesis of 5% Co-doped Fe_2O_3 nanoparticles. Anti-bacterial activity of synthesized Co-doped Fe_2O_3 nanoparticles was analyzed against gram negative bacteria *Escherichia coli*. It was found that by increasing concentration of 5% Co-doped Fe_2O_3 nanoparticles, anti-bacterial activity was increased.

6. REFERENCES

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