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Chemistry

BIOSYNTHESIS AND X-RD ANANLYSIS OF ZINC NANOPARTICLES

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ABSTRACT The conventional methods of synthesizing nanoparticles using chemical method were found to be more expensive and involve the use of toxic, hazardous chemicals that are responsible for various biological risks. Hence, ecofriendly green or biogenic synthesis of nanoparticles becomes more attractive. Proposed study focuses on the synthesis of ZnO nanoparticles using the aqueous root extract of *Zingiber officinale* (ginger). Flavonoids are responsible for biogenic synthesis of ZnO nanoparticles. Presence of flavonoids in *Zingiber officinale* was confirmed by flavonoid test. The X-ray Powder Diffraction analysis shows the triclinic system of the Zincite nanoparticles. The structure, shape and size of the synthesized ZnO nanoparticles were analyzed by SEM which shows the average size of the nanoparticles i.e.48-109 nm and is an oval. So, the biogenic synthesis of ZnO nanoparticles by using Zingiber *officinale,* can be an alternative to chemical synthesis.

KEYWORDS : Biogenic synthesis, Nanoparticles, XRD, SEM.

Introduction:

ZnO nanocrystals are one of the most studies material. ZnO nanocrystals possess several favorable properties such as good transparency, strong room-temperature luminescence, high electron mobility, wide bandgap, chemical and photochemical stability[1] etc. These properties make them an interesting material for use in new light-emitting devices, solar cells, biosensors, and photocatalysts[2].

ZnO nanocrystals have been synthesized by various methods like by physical, biological & chemical method etc. The conventional methods of synthesizing nanoparticles using chemical method were found to be more expensive and involve the use of toxic, hazardous chemicals that are responsible for various biological risks[3].

To avoid the use of toxic chemicals, nanoparticles are synthesized by using plants known as the 'Green synthesis' or 'biogenic synthesis. This type of biosynthesis is less toxic, cost effective, environmental friendly. The use of non-toxic materials like plant extract & bacteria for synthesis of silver nano particles offers numerous benefits of pharmaceutical application[4]. Synthesis of ZnO nanoparticles using lemon juice[5] have been reported by various researchers. Bio-synthesis of gold nanoparticles by plant alfalfa have been reported by Gardea Torresdey[6] et al. Hence biogenic synthesis of nanoparticle was found to be more attractive, as conventional methods are more expensive and non-ecofriendly.

Materials Used:

Zinc acetate dihydrate ($Zn(CH_3COO)_2{\cdot}2H_2O$) (LR Grade), Sodium acetate(CH_3COONa) and Zinger extract etc.

Zinger extract is made in distilled water. Fresh ginger was peeled off and then 5 gm of zinger was crushed in a mortar and pestle by slowly adding 25ml of distilled water. The extract was filtered using Whatman No.1 Filter paper. The extract was stored at 4°C for further use. The extract is tested for presence of flavonoids by adding a drop of very dilute sodium hydroxide, after few minutes it shows yellow precipitate.

Experimental:

50 ml of 0.01 M Zinc acetate dehydrate and 5cm^3 of root extract was added slowly by continuous stirring by magnetic stirrer. Then1.0 M sodium acetate was added slowly and maintain the pH 8. After reaching pH 8, the mixture was stirred for 2 hours. Pale white precipitate was formed, centrifuged at 10,000 rpm for 10 minutes. The nanocrystals were washed twice by using distilled water and dried at room temperature[7].

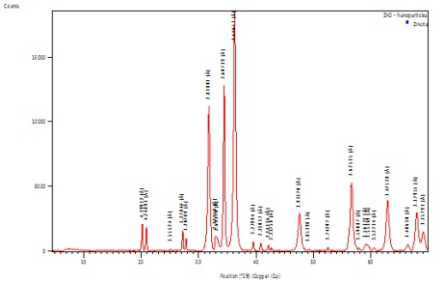
Results and discussion:

The shape, size and system of the synthesized ZnO nanoparticles were analyzed by SEM and X-ray diffraction pattern.

X-ray diffraction Studies:

Single crystal X-ray crystallographic investigation is the most precise source of information regarding the structure of the complex. X-ray diffraction is a non-destructive and analytical method for identification and quantitative analysis of various crystalline forms of sample. This study also gives an idea about the system of the compound present in the sample. X-ray diffraction of synthesized oxide nanoparticles is shown as follow-

X-ray diffraction pattern of zinc oxide nanoparticles indicated that the zinc oxide is crystalline and in the form of Zincite. Above figure indicates high crystalline nature. There are total 15 reflections between 20.1852 to 69.1196 (2Θ in deg.) with maximum at 2Θ = 69.11deg. corresponding to value of d = 1.3613A and miller indices (h k l) 1 1 2. The main peaks of the sample have been indexed by using computer software by trial and error method keeping in mind characteristics of various symmetry systems could be obtained between observed and calculated 2Θ and $\sin^2\Theta$ values. The method also yielded h k l (miller indices) values. A comparison of values of 2Θ and $\sin^2\Theta$ for the nanoparticles reveals that, there is good agreement between the calculated and observed values of 2Θ and $\sin^2\Theta$ based on assumption of triclinic structure[8] for nanoparticles. The small difference is observed in d-spacing can be attributed to difference in unit cell dimensions. The values for lattice constants are a = 5.5294 A, b = 4.9329 A and c = 3.7718 A; α = 103.725D, β = 93.948D and γ = 111.371D; the unit cell volume V^3 = 91.69 In conjugation with these lattice parameters the condition such as $a \neq b \neq c$ and of $\alpha \neq \beta \neq \gamma$ required for the sample to be triclinic were tested and found to be nearly equal to it. The detail data is predicted in the table 1.



Scanning electron Microscopy study: The size and shape of nanoparticles were studied by SEM. Following figures of SEM shows the average size of the nanoparticle being 30-50 nm and are oval.

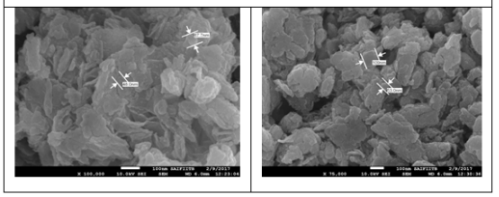
Conclusion:

There is no any use of hazardous toxic chemicals in the preparation of ZnO nanoparticles. Hence the present study of biogenic synthesis of ZnO nanoparticle is ecofriendly, very simple and efficient than the conventional method. The SEM analysis shows oval shape of ZnO nanoparticle with an average size of 30-50nm. The X-ray diffraction study shows crystalline nature of the nanoparticles with triclinic system of zincite with minimum 15 reflections. This means flavonoids from ginger extract helps to synthesize nanoparticles. Such biogenic nanoparticles like nanoparticles synthesized from chemical method are expected to have various applications in various fields.

Table of X-Ray Diffraction study:

Sr. No.	d-spacing A°		h k l	Sin2 θ		2θ°	
	Observe	Calculated		observe	calculated	observe	Calculated
1	4.4086	4.4086	0 1 0	307.1	307.1	20.19	20.19
2	4.4256	4.2560	-1 1 0	329.2	329.2	2091	2091
3	3.2839	3.2839	0 -1 1	553.0	553.0	27.20	27.20
4	3.2132	32132	-1 0 1	577.6	577.6	27.81	27.81
5	2.8227	2.8227	1 1 0	748.4	748.4	31.75	31.75
6	2.6981	2.7281	-2 0 1*	801.2	801.2	32.89	32.89
7	2.6983	2.7053	-1 -1 1	819.1	814.8	33.26	33.17
8	2.6117	2.5995	-1 -1 1	874.2	882.5	34.40	34.56
9	2.4827	2.4827	2 0 0	967.4	967.4	36.24	36.24
10	2.4776	2.4711	0 1 1*	971.4	476.5	36.32	36.42
11	1.9185	1.9256	2 0 1	1620.2	1608.3	47.47	47.47
12	1.6292	1.6287	1 -2 2	2246.6	2248.1	56.59	56.59
13	1.4788	1.4732	-2 2 2	2726.7	2747.7	62.96	62.96
14	1.3830	1.3823	3 -3 1	3117.8	3120.8	67.89	67.89
15	1.3613	1.3595	1 1 2	3217.9	3226.3	69.11	69.22

Figure 3: SEM analysis:



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