Original Article

Synthesis Of Nanoparticle Using Abutilon Indicum And Cassia Tora - An Ecofriendly Approach

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Abstract

Nanoparticles have extraordinary and attractive properties due to their small size, large surface area and superior reactivity. Green synthesis of nanoparticle is a cost effective and environment friendly method. Plant based nanoparticles can be used in agriculture, pharmaceutical and drug delivery.Cassia tora also called Senna Tora grows wildly in tropics is considered a weed in many places.It is used for treating skin diseases such as itching, ring worm and also for snake bites.In this work iron oxide nanoparticle are synthesized using green, cost effective fast and easy method by aqueous leaf extract of cassia Tora, which acts as a reducing agent. Plant mediated silver nanoparticle synthesis has been reported as a good alternative for physical and chemical methods nano scaled silver were synthesized from the plant extract of Abutilon indicum under atmospheric conditions through green synthesis of silver nanoparticle. A systematic characterization of silver nanoparticles and iron oxide nano particle was performed using UV, FT-IR, and antimicrobial studies. The novelty of this study is to comprehend a suitable biocompatible herbal reductant for biosynthesis of silver nanoparticles at a very cost-effective level and the results are quite encouraging.

Keywords: Abutilon indicum, Cassia tora, Biosynthesis, Nanoparticle, Eco-Friendly, Antibacterial Activity.

INTRODUCTION

Plants are rich sources of various medicinally important substances and they explore the huge diversity in therapeutic and clinical aspects of the society from ancient times. [1] Medicinal plants are a source of many potent and powerful drugs and used all over the world for the treatment of several chronic diseases. [2] Due to having wide biological and medicinal properties, high safety margins and lesser costs, there is a great demand of herbal medicines in both developed and developing countries as a source of primary health care. [3] Reporting more than 2000 species of medicinally important plants with high potential abilities for use in different traditional medicine systems, India has a rich culture of medicinal herbs and spices but chemically and pharmacologically studies for their medicinal potential are very few in literature. [4]

Cassia Tora

Cassia tora is a plant species in the family Fabaceae and the subfamily Caesalpinioideae. Its name is derived from its Sinhala name tora. [5] It grows wild in most of the tropics and is considered a weed in many places. Its native range is in Central America. [6] Its most common English name is sickle senna or sickle wild sensitive-plant.Other common names include sickle pod, tora, coffee pod and foetid cassia. It is often confused with Chinese senna or sicklepod, Senna obtusifolia. [7]

Abutilon Indicum

Abutilon Indicum, commonly called as “Thuthi” or “Kanghi” in hindi, is a native plant of South Asia. Nature is a best friend of our pharmacy field. Natural drugs are effective in action without side effects. Abutilon Indicum (Linn.) sweet (Malvaceae) commonly called ‘Country Mallow’ is a perennial plant up to 3 m in height. Medicinal plants are the nature’s gift to human beings to make disease free healthy life the Abutilon Indicum [8] genus of the Malvaceae family comprises about 150 annual or perennial herbs, shrubs or even small trees widely distributed in the tropical and subtropical countries of America, Africa, Asia and Australia. Some of the plants belonging to the species are amongst much acclaimed Ayurvedic herbs and in the recent past there has been a renewed scientific interest in exploring the specie.[9]

MATERIALS AND METHODS

Collection of Plant materials:

The fresh leaves of Cassia Tora were collected from Mundur, Palakkad on October 2020. The fresh leaves of Abution inducum (Indian plant) were collected from Selliampatty, Dharmapuri on November 2020. The leaves were packed instantly in bags to avoid decomposition of some bioactive compounds

Preparation of Cassia Tora leaf Extract

Ethyl Acetate Extract

The leaves of Cassia Tora were dried for 15 days and powdered. 30 grams of dried powder is extracted with 100 ml of ethyl acetate in a 250 ml conical flask.

Ethanol Extract: The Leaves of Cassia Tora were dried for 15 days and powdered. 30 grams of dried powder is extracted with 100ml of ethanol. It was kept in mechanical shaker for about 48 hours then it was filtered with the help of filter paper, and the filtrate is used for further analysis.

Green synthesis of Iron oxide nanoparticles

The fresh Cassia Tora leaves were washed with distilled water and dried for 1-2 weeks at room temperature. 5g of powdered Cassia Tora leaves are added to 50ml distilled water. Then the mixture was boiled for 20 min at a temperature of 60ºC and filtered using Whatman filter paper No.1.To 5ml of leaf extract add 5ml 0.1M $FeSO_4$ solution in 1:1 ratio. To promote the synthesis of nanoparticles the conical flask with reaction medium were exposed to the steam water bath. Till colour change take place after complete addition of extract the precipitate was separated by high speed centrifugation at 5000rpm.The bottom settled annealing of the remnants was separated and washed three times with distilled water and the supernatant was discarded and the bottom settled part was used for further characterization(10).

Preparation of Abutilon inducum extract:

The extracts were:

1. Abutilon inducum Ethanolic extract
2. Abutilon inducum Ethyl acetate extract
3. Abutilon indicum aqueous extract

Preparation of ethanolic extract

About 10 grams of the powdered sample was weighed and taken in a conical flask. To this 100 ml of 80% solution of ethanol in water was added and shaken well. The mouth of the conical flask was sealed air tight and the extract was left for 3 days. The flask was placed on a mechanical shaker for 10 hours for even distribution of concentration of solvents and the solution was filtered using a normal filter paper. The filtered extract was stored in a cool, dry place and tightly sealed to prevent any contamination. The extract is used for further research.

Preparation of ethyl acetate extract (TTEA):

About 10 grams of the powdered sample was weighed and taken in a conical flask. To this 100 ml of 80% solution of ethyl acetate in water was added and shaken well. The mouth of the conical flask was sealed air tight and the extract was left for 3 Days. The flask was placed on a mechanical shaker for 10 hours for even distribution the concentration of solvents and the solution was filtered using a normal filter paper. The filtered extract was stored in a cool, dry place and tightly sealed to prevent any contamination. The extract is used for further analysis.

Preparation of aqueous extract:

About 10 grams of the powdered sample was weighed and taken in a conical Flask. To this 100 ml of aqueous was added and shaken well. The mouth of the conical flask was sealed air tight and the extract was left for 3 Days. The flask was placed on a mechanical shaker for 10 hours for even distribution the concentration of solvents and the solution was filtered using a normal filter paper. The filtered extract was stored in a cool, dry place and tightly sealed to prevent any contamination. The extract is used for further analysis.

BIOSYNTHESIS OF SILVER NANOPARTICLES:

The silver nitrate was purchased from Laboratories, 10ml of plant extract were added to 90ml of silver nitrate ($AgNO_3$) and kept at room temperature. The color of the solution was change from yellow to brown color indicates the formation of silver nanoparticles in the solution.

RESULTS AND DISCUSSION

Preliminary phytochemical screening of the Cassia Tora leaves was carried out in the present study.The preliminary phytochemical analysis was used to detect the phytochemicals present in the particular plant.The extract was subjected to preliminary phytochemical screening using standard procedures.The preliminary phytochemical analysis of Ethyl acetate and Ethanol extract of Cassia Tora leaves was done.Cassia Tora Ethyl acetate extract reveals the presence of flavonoids, proteins, carbohydrate , glycoside, and steroid.Cassia Tora ethanol extract reveals the presence of proteins, carbohydrate, glycoside, steroid and tannins.

FT- IR result of Ethyl acetate extract of Cassia Tora leaves

The FT-IR results of Ethyl acetate extract of Cassia Tora leaves was observed. The different regions of FT-IR were observed. The peak at 3502.73 shows the presence of O-H stretching, 1735.93 shows the presence of C=O stretching, 1442.75 shows the presence of C=C stretching, and 725.23 shows the presence of C-H bending.

Table 1: FT-IR result of Cassia Tora Leaves ethyl acetate extract

Peak values	Functional groups
3502.73	O-H stretching
1735.93	C=O stretching
1442.75	C=C stretching
725.23	C-H bending

FT-IR results of Ethanol of Cassia Tora Leaves

The FT-IR results of Ethanol extract of Cassia Tora Leaves was observed. The different regions of FT-IR were observed. The peak at 3363.86 shows the presence of O–H stretching, the peak values at 2970.38, 2885.51 shows the presence of C-H stretching,1712.79 shows the presence of C=O stretching, 1658.78 shows the presence of C=C stretching and the peak at 501.49 shows the presence of C-Cl

Table 2: FT-IR result of Cassia Tora Ethanol extract

Peak values	Functional groups
3363.86	O–H stretching

2970.38	C-H stretching
2885.51	C-H stretching
1712.79	C=O stretching
1658.78	C=C stretching
501.49	C-Cl stretching

FT-IR result of aqueous of Cassia Tora leaves

The FT-IR results of aqueous extract of Cassia Tora Leaves was observed. The different regions of FT-IR were observed. The peak at 3271.27 shows the presence of O-H stretching, The peak at 1635.64 shows the presence of C=C stretching, 686.66 shows the presence of =C-H bending ,the peaks at 601.79, 563.21 and 501.49 shows the presence of C-Cl stretching .

Table 3: FT-IR result of Cassia Tora Aqueous extract

Peak values	**Functional groups**
3271.27	O-H stretching
1635.64	C=C stretching
686.66	=C-H bending
601.79	C-Cl stretching
563.21	C-Cl stretching
501.49	C-Cl stretching

FT-IR result of bio reduced Iron nanoparticle

FT-IR spectroscopy analysis was conducted to identify the biomolecules responsible for capping of the bio reduced iron oxide nanoparticle synthesized using plant extract. The peak at 3340.71 shows the presence of N-H stretching, The peak values at 2113.98 shows the presence of C≡C stretching,1643.35 shows the presence of C=C stretching and the peaks at 1188.15 ,1149.57 shows the presence of C-N stretching.

Table 4: FT-IR result of bio reduced iron nanoparticles

Peak values	**Functional groups**
3340.71	N-H stretching
2113.98	C≡C stretching
1643.35	C=C stretching
1188.15	C-N stretching
1149.57	C-N stretching

XRD Analysis

D = 42.07nm

The size of the particle of 42.07nm confirms that the synthesized particle is nano.

The XRD graph of iron nanoparticle is shown below

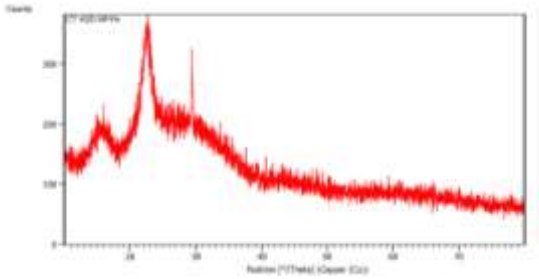

Fig 1.1: XRD graph of green synthesized iron nanoparticle

Anti-bacterial Activity

The Cassia Tora leaf extract and green synthesized iron nanoparticles was treated against the bacterial organisms like Escherichia coli , klebsiella pneumoniae and Pseudomonas. The leaf extract of Cassia Tora shows the zone of inhibition against Escherichia coli is 16 mm , klebsiella pneumoniae is 40mm and Pseudomonas is 20mm .Green synthesized iron nanoparticles shows the zone of inhibition against Escherichia coli is 15mm, klebsiella pneumoniae is 20mm and Pseudomonas is 15mm . The positive disc Ampicillin, having the zone of inhibition against Escherichia coli is 20mm, Pseudomonas is 20mm and no inhibition against klebsiella pneumoniae . On comparing these Cassia Tora leaf extract shows the maximum zone of inhibition against the bacterial organisms Escherichia coli , klebsiella pneumoniae and Pseudomonas and the FeNPs do not have appreciable antibacterial activity.

Table 5: Anti-bacterial activity of Cassia Tora leaf extract and green synthesized iron nanoparticle

Organisms	**Leaf extract**	**N.P**	**N.C**	**Ampicillin**
Escherichia coli	20mm	15mm	-	20mm
klebsiella pneumoniae	40mm	20mm	-	-
Pseudomonas	20mm	15mm	-	20mm

Preliminary phytochemical screening of the **Abution Inducum**

The presence of secondary metabolites are responsible for the unique physiological functions of the plant. On evaluation of ethanolic (TTE) and ethyl acetate (TTEA)was done.

FT-IR result of Ethyl acetate extract of Abution Inducum

The FT-IR results of ethyl acetate extract of Abution inducum was observed. The different regions of FT-IR were observed. The peak at 2885.51 shows the presence of C-H stretching, the peak value at 2137.13cm^{-1} shows the presence of-C≡C-stretching, the peak value at 3309.85cm^{-1} shows the presence of N-H stretching, the peak value at3340.71cm^{-1} O-H stretching, the peak value at 1273.02cm^{-1} shows the presence of C-H stretching, the peak value at 1087.85cm^{-1} shows the presence of C-O stretching, the peak value at 1041.56cm^{-1} shows the presence of C-N stretching,the peak value at 879.54cm shows the presence of=C-H bend.

Table 6. FT-IR result of Abution Inducum Leaves ethyl acetate extract

Absorption	**Group**	**Compound class**
2885.51	C-H stretching	Alkane
2137.13	-C≡ C-stretching	Alkyne
3309.85	N-H stretching	Amines

3340.71	O-H stretching	Alcohols
1273.02	C-N stretching	Aromatic amines
1087.85	C-O stretching	Ester
1041.56	C-N stretching	Aliphatic amines
879.54	=C-H bend	Alkenes

FT-IR result of Ethanol extract of Abution Inducum

The FT-IR results of Ethanol extract of Abutilon inducum leaves was observed. The different regions of FT-IR were observed. The peak at 3271.01cm^{-1} shows the presence of N- H stretching, the peak value at 3240.41cm^{-1} shows the presence of O-H stretching, the peak value at 1041.56cm^{-1} shows the presence of C-N stretching, the peak value at 933.55cm^{-1} shows the presence of =C-H bend, the peak value at 848.68cm^{-1} shows the presence of N-H stretching, the peak value at 516.92cm^{-1} shows the presence of C-Cl stretching.

Table7. FT-IR result of Abution Inducum Ethanol extract

Absorption	**Group**	**Compound class**
3271.01	N-H stretching	Primary, secondary amides
3240.41	O-H stretching	Alcohol
1041.56	C-N stretching	Aliphatic amines
933.55	C-H bend	Alkenes
848.68	N-H stretching	Primary, secondary amines
516.92	C-Cl stretching	Alkyl halides

FT-IR result of aqueous extract of Abution Inducum

The FT-IR results of aqueous extract of Abutilon inducum leaves was observed.The different regions of FT-IR were observed. The peak at 2885.51cm-^{1} shows the presence of C-H stretching, 1705.07cm^{-1} shows the presence of C=O stretching, 1396.46cm-1 shows the presence of C-F stretching, 1242.16cm^{-1} shows the presence of C-N stretching, 1049.28cm^{-1} shows the presence of CO-O-CO stretching, 887.26cm^{-1} shows the presence of C=C bending and 609.57 cm^{-1}shows the presence of C-Br stretching.

Table8. FT-IR result of Abution Inducum aqueous extract

Peak values	**Functional groups**
2885.51	C-H stretching
1705.07	C=O stretching
1396.46	C-F stretching
1242.16	C-N stretching
1049.28	CO-O-CO stretching
887.26	C=C bending
609.57	C-Br stretching

FT-IR result of biosynthesis of silver nanoparticles of aqueous extreact

FT-IR spectroscopy analysis was conducted to identify the biomolecules responsible for capping of the bio reduced silver synthesized plant extract. The peak value at 3332.99cm-1 shows the presence of N-H stretching, the peak value at 2106.27cm-1 shows the presence of -C≡ C-stretching, the peak value at 1643.35cm-1 shows the presence of N-H bend, the peak value at 1188.15cm-1 shows the presence of C-N stretching, the peak value at 678.94cm-1 shows the presence of C-H “oop”, the peak value at 563.21cm-shows the presence of C-Cl stretching.

Table9. FT-IR result of silver nanoparticles of aqueous extract

Absorption	Group	Compound class
3332.99	N-H stretching	Primary, secondary amides
2106.27	-C≡ C-stretching	Alkynes
1643.35	N-H stretching	Primary amines
1188.15	C-N stretching	Aliphatic amines

XRD result of biosynthesized silver nanoparticles aqueous extract

D = 15.81nm

The size of the particle of 15.81nm confirms that the synthesized particle is nano.

The XRD graph of iron nanoparticle is shown below

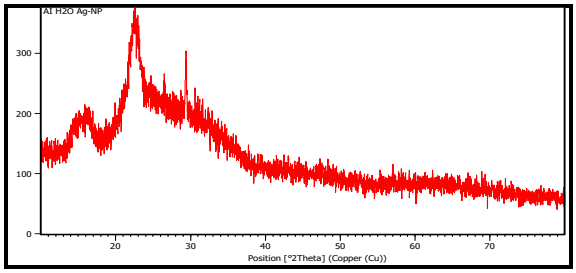

Fig.1.2 XRD graph of silver nanoparticles of aqueous extract

Table10. Crystallinity of the silver nitrate nanoparticles

Nano Materials	Totel intensity of Stronger peak (counts) (I_c)	Totel intensity of Boader peak (counts) (I_c)	%crystallinity, $\%_x = (I_c/(I_c+I_a))x\ 100$
Silver nanoparticles	100.00	71.19	58.41%

From the analysis, the percentage of crystallinity of silver nanoparticles is 58.41%.

Table11. Anti-bacterial Activity of biosynthesized silver nanoparticles of aqueous extract

S.No	Test parameter	Test methods	Results			
Screening for anti-microbial activity						
1.	Bacillus Subtilis	Lab Method	Zone of inhibition			**Unit**
			(Direct)		Gentamycin (10mcg/disc)	
			50ul	100ul		
			20.1	23.2	28	mm

Abutilon Indicum was treated against bacterial organism Bacillus Subtilis. Abutilon Indicum extract does not show any zone of inhibition against Bacillus Subtilis. Gentamycin shows a zone of inhibition of 28mm against Bacillus Subtilis. So on comparision gentamycin shows maximum zone of inhibition.

CONCLUSION

The results of this study highlight the potential of an eco-friendly method to synthesize nanoparticles. The use of plant leaves could be regarded as ecofriendly and economically feasible approach providing a new insight for waste recycling. Silver Nanoparticles were synthesized successfully in an easy and less time-consuming way using Abutilon indicum leaf extract and iron nanoparticle from the extract of Cassia Tora Leaves. As synthesized nanoparticles have been successfully implemented in the fields of medicine and environmental remediation. As synthesized nanoparticles have been successfully implemented in the fields of medicine and environmental remediation.

REFERENCE

1. Yadav, J. P., Kumar, S., Budhwar, L., Yadav, A., & Yadav, M. (2016). Characterization and antibacterial activity of synthesized silver and iron nanoparticles using Aloe vera. J Nanomed Nanotechnol, 7(384), 2.
2. Kokarneswaran, M., Selvaraj, P., Ashokan, T., Perumal, S., Sellappan, P., Murugan, K. D., & Chandrasekaran, V. (2020). Discovery of carbon nanotubes in sixth century BC potteries from Keeladi, India. Scientific Reports, 10(1), 1-6.
3. Sanderson, K. (2006). Sharpest cut from nanotube sword: Carbon nanotech may have given swords of Damascus their edge. Nature News, Published online: Nov, 15.
4. Sattler, K. D. (Ed.). (2016). Handbook of nanophysics: nanoparticles and quantum dots. CRC press.
5. Idris, M. N., Gwary, K. M., & Wang, X. (2015). Qualitative synthensisation of Nanoparticles using FTIR spectroscopic analysis. Journal of Emerging Trends in Engineering and Applied Sciences, 6(3), 166-181.
6. Hussain, I., Singh, N. B., Singh, A., Singh, H., & Singh, S. C. (2016). Green synthesis of nanoparticles and its potential application. Biotechnology letters, 38(4), 545-560.
7. Christian, P., Von der Kammer, F., Baalousha, M., & Hofmann, T. (2008). Nanoparticles: structure, properties, preparation and behaviour in environmental media. Ecotoxicology, 17(5), 326-343.
8. Seshan, K. (2002). Handbook of Thin Film Deposition Techniques Principles, Methods, Equipment and Applications, Second Editon. CRC Press.
9. Saxena, M., Saxena, J., Nema, R., Singh, D., & Gupta, A. (2013). Phytochemistry of medicinal plants. Journal of pharmacognosy and phytochemistry, 1(6).
10. Koomson, D. A., Kwakye, B. D., Darkwah, W. K., Odum, B., Asante, M., & Aidoo, G. (2018). Phytochemical constituents, total saponins, alkaloids, flavonoids and vitamin C contents of ethanol extracts of five Solanum torvum fruits. Pharmacognosy Journal, 10(5).