IRON OXIDE NANOPARTICLES: A REVIEW

Project Thesis submitted in fulfillment of major project of

BACHELORS OF TECHNOLOGY

IN

BIOTECHNOLOGY

By

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UNDER THE SUPERVISION OF

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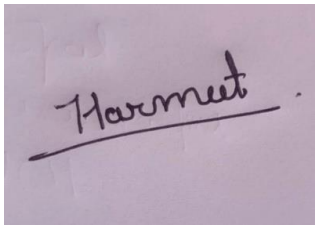
SOLAN

DECLARATION

I hereby declare that the major project work entitled" **IRON OXIDE NANOPARTICLES: A REVIEW** " has been submitted to the Department of Biotechnology and Bioinformatics, Jaypee University of Information Technology, Waknaghat have carried out under guidance of my supervisor **DR. ABHISHEK CHAUDHARY .**



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SUPERVISOR'S CERTIFICATE

This is to certify that the major project work titled "**IRON OXIDE NANOPARTICLES: A REVIEW**" by **HARMEET SINGH** during their 8th semester in May 2021 in fulfillment for the project thesis in Biotechnology of Jaypee University of Information Technology, Solan has been carried out under my supervision. This work has not been submitted partially to any other University or Institute for the award of any degree or appreciation.

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At this juncture, with profound sense of gratitude I express my forever gratefulness towards **Dr sudhir syal** the HOD **of "**DEPARTMENT OF BIOTECHNOLOGY AND BIOINFORMATICS" for his sincere support. I would also like to take this opportunity and thank **Dr. Abhishek chaudhary ,** for being a lot more than just a supervisor and going beyond the call of duty in my guidance, support, advice, and motivation throughout. He has been the source of inspiration of come what may; these issues cannot bring you down. Sincere thanks for his insightful advice, motivating suggestions, invaluable guidance, help and support in successful completion of this major project and also for his constant encouragement and advice throughout my project work.

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In gratitude,

Harmeet (171804)

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ABSTRACT

In modern times nanotechnolgy and nanoscience has played a great role in the advancement of the human well being and bringing revolution in the technology. Nanomaterials plays a bigger role in almost every field like medicines , pharma industry, cosmetic industry ,textile industry ,food industry and many others.The purpose is to synthesize nano patrticles from a environment friendly teechnique with little involvemet of chemical so that it can be less toxic and can be produced at a faster rate .Different plant and biomaterial exploitation for the nanomaterial synthesis is considered as a best method in green nanotechnology. Bacteria ,fungi ,algae and plant like biomaterials are used for the production of low cost ,energy efficient and non toxic environment friendly nanoparticles.This review provides the introduction to nanotechnology and how nanoparticles can be sythesised generally and later on the synthesis of iron nano particles from green synthesis and a chemical reduction method various techniques like uv visible spectroscopy and dls have been used for the characterization of iron nanoparticles.

KEYWORDS- Iron nanoparticles, Green synthesis ,Dynamic light scattering,nanotechnology.

CHAPTER 1 -

INTRODUCTION

Norio taniguichi coined the term nanotechnology in 1974 in University of tokyo. Earlier many examples of Nanotechnology are there but they are not scientifically proven for example- - In 1857 Faraday prepared gold colloids , Lycurgus Cup is another example of Nanotechnology . In ancient times Chinese also used to practice nano Technology

NANOTECHNOLOGY-

It deals with the understanding and control of matter at dimensions between approximately 1 and 100 nanometre.orThe characterization,design, application and production of structure with at least one dimension less than 100 nanometre or equal to 100 nanometre

A nanometre is hundred billionth of a metre

UNIQUE PROPERTIES OF NANOPARTICLES-

1-High surface to volume ratio.

As surface area to volume increases size decreases and the surrounding particles can interact more as surface to volume is large which makes them faster lighter and and can get into small places

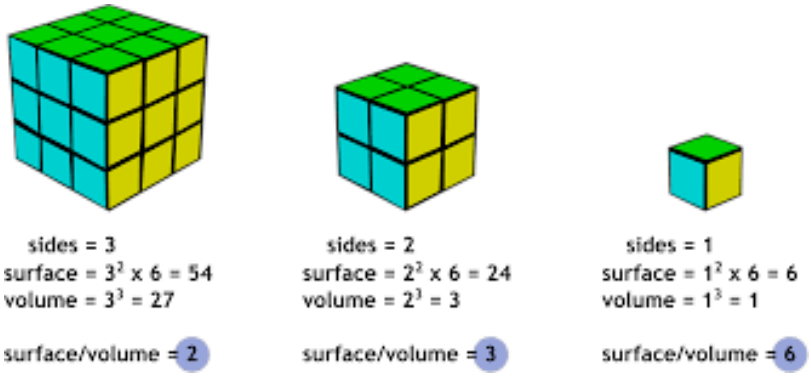

FIG 1- Surface area increases as size decreases (small size big impact) [3]

2-Ultra small size (equal to 100 nm or less)

3-Physical appearance

4-Composition presence of biochemical moieties on surface (peripheral coating of functional groups)

Material properties can vary with size for example gold can behave as nonmetallic in nano size while metallic normally.

(While going from macro to micro other properties also change like optical activity, conduction strengthening etc colour can also change light emissions)

TYPES OF NANOMATERIALS-

1-<u>Carbon based nanomaterials</u> –

Nanomaterials containing carbon are generally found in hollow tubes spheres,ellipsoids .

The carbon based nanomaterials also include fullerenes,carbon nanotubes,carbon black ,graphene and carbon onions.

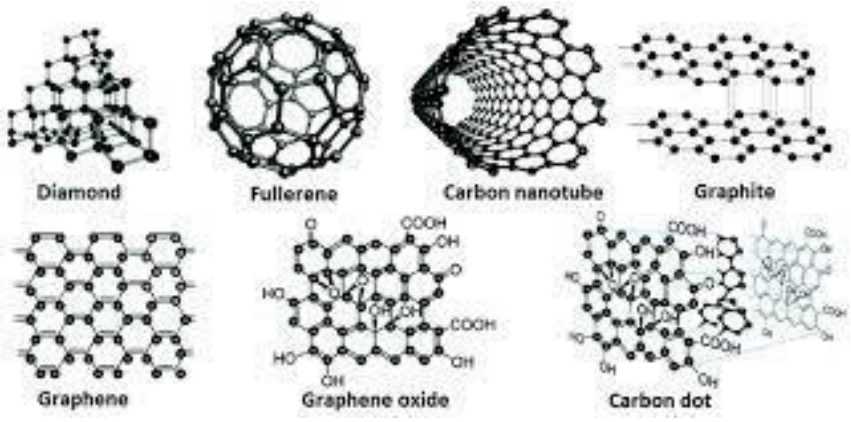

FIG 2- Examples of carbon based nanomaterials.[4]

.2-Inorganic-based nanomaterials-

Metals and metal oxides nano particles ans nano sized materials are also inclusive in nano material .semiconductors such as silicones, metal oxides such as ti02, and zinc oxide nano particle and au or ag can also be synthesised through nano material

3-Organic-based nanomaterials:

Nano material is mostly made out of organic matter which excludes carbon based or inorganic based nano material. Organic nano material is transformed by the usage of non covalent interaction or self assembly and design.this transformation can be desired into dendrimers, micelles and liposomes structures also polymer nanoparticle.

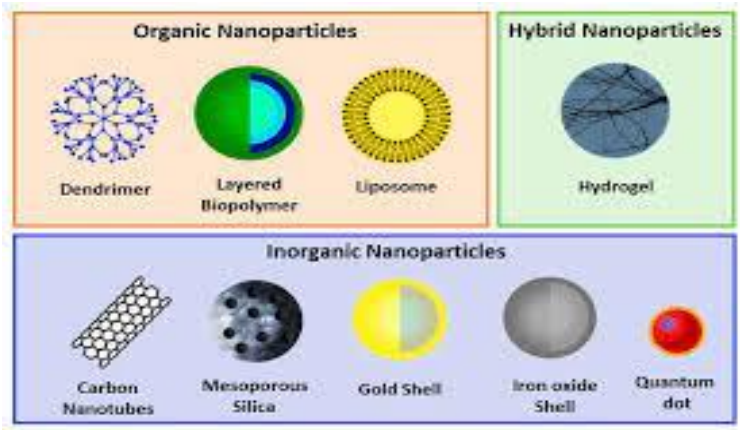

Fig3- Example of Organic and inorganic based nanoparticles [5]

4-Composite-based nanomaterials:

These are multiface nanoparticle. One face of the nanoscale dimension with nanosized materials can either combine nanoparticles together or can combine nanoparticles with larger, bulk type or complicated structure resulting such as metal organic framework.

Classification of nanomaterial based on there dimension

In the year of 2007 two scientists Pokropivny and Skorokhod invented new way of classification of nanomaterials in which recently developed composites are addded such as 1D,0D ,3D,3D nanomaterials.

Nanomaterials classification based on there origin

A new schemed classification for nanomaterial was found by pokropivny and skorokhod in the year 2007. It included 0d, 1d, 2d and 3d nanomaterial which were recently added based on origin.

Natural nanomaterial- biological species or anthropogenic activities produce the natural nanomaterial in nature. The availability of artificial surfaces with nanoscale templates and exclusive micro and also technological applications is efficiently prominent.

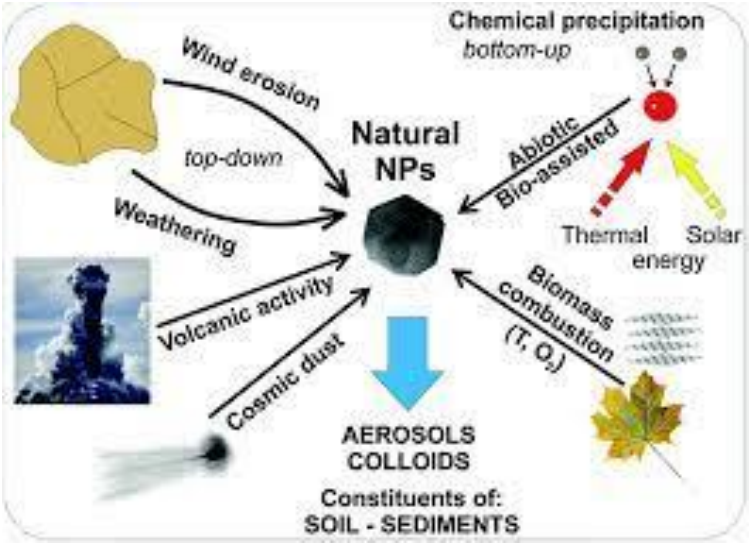

Fig4- Various processes for formation of natural nanomaterials. [6]

Synthetic (engineered) nanomaterials-

These nanomaterials are generally produced by exhaust of the vehicle,smoke and mechanical grading and are produced by three methods biological,chemical and hybrid methods.

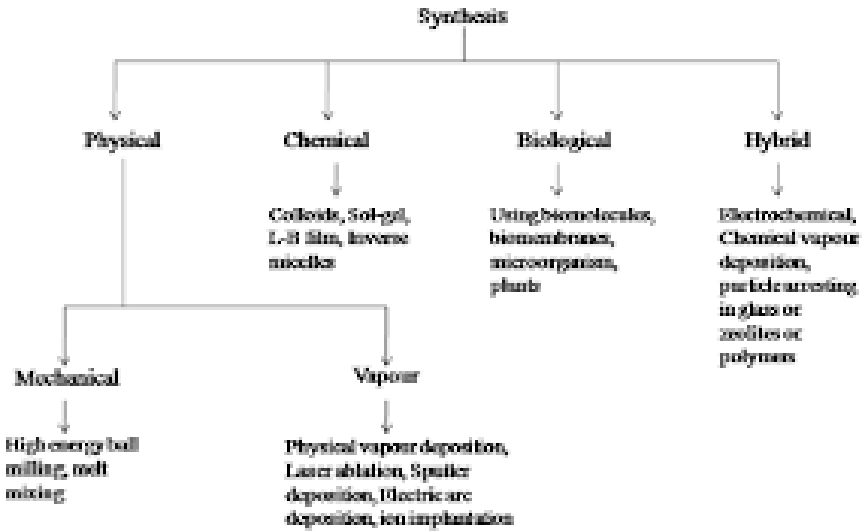

Fig5- Different methods for synthesis of synthetic nanomaterials [7]

APPLICATIONS OF NANOTECHNOLOGY

Application of nanotechnology can be done in all sorts of industrial sectors.

Areas of application are -

Electronics

Silicone may soon be replaced by carbon nanotubes for making much efficient microchips and devices ,also more conductive quantum nanowiresfor a flexible touchscreen, graphene properties are ideal.

.

Energy

Solar panels are made with the help of newly developed semiconductors that helps in producing double electricity frim converted sunlight and it was made by kyoto university.Stronger and lighter wind turbines are made nanotechnology also helps in reducing the cost ,helps in improving the fuel effeciency and also the energy was saved due to thermal insulation in some nanoparticles.

Biomedicine

The treatment of cancer and neurodegenerative diseases can also be facilitated by early diagnosis with the help of some nano material and there properties.

Environment

Nanofiltration system ,nanobubbles and ions are some of the environmental friendly applications for heavy metals,wastewater and air purification respectively. Chemical reaction can also be made more efficient and less polluting by nanocatalyst.

Food

Pathogens in food can be detected by biosensor and the food production can be improved by nanocomposites, they increase thermal resistance and mechanical and decrease oxygen shifted in packaged food product.

Textile

Wrinkle free or stainless fabric can also be developed by nanotechnology. Motorcycles, helmets or sports equipment can even be refined by much more stronger, lighter and durable material

ADVANTAGES AND DISADVANTAGES OF NANOTECHNOLOGY

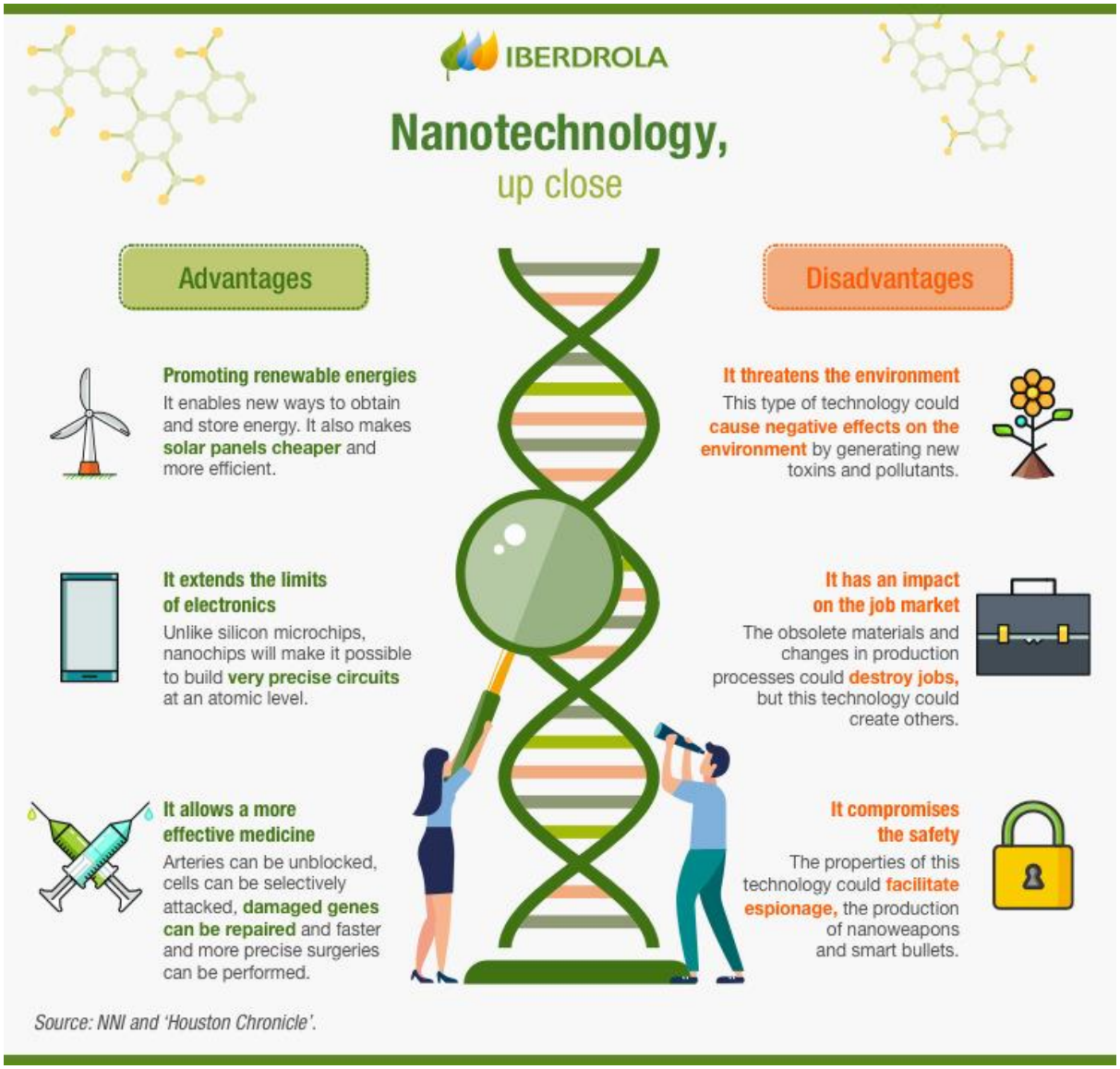

Fig 6 – Advantage and disadvantage of nanotechnology [8]

SYNTHESIS OF NANOPARTICLES

The bottom up or top down method are the two approaches in which nanoparticles are synthesized

1-Bottom up method- The synthesis processs building a material from atom to cluster to nanoparticles is described as bottom or constructive method.

For nanoparticles production most commonly used bottom up methods are

1- Sol-gel
2- Spinning
3- Chemical vapour deposition
4- Pyrolysis
5- Biosynthesis

2- Top down method- The method used for reducing bulk material to nanometric scale particles is defined as top down or destructive method.

Widely used top down methods are –

1- Mechanical milling
2- Nanolithography
3- Laser ablation
4- Sputtering
5- Thermal decomposition

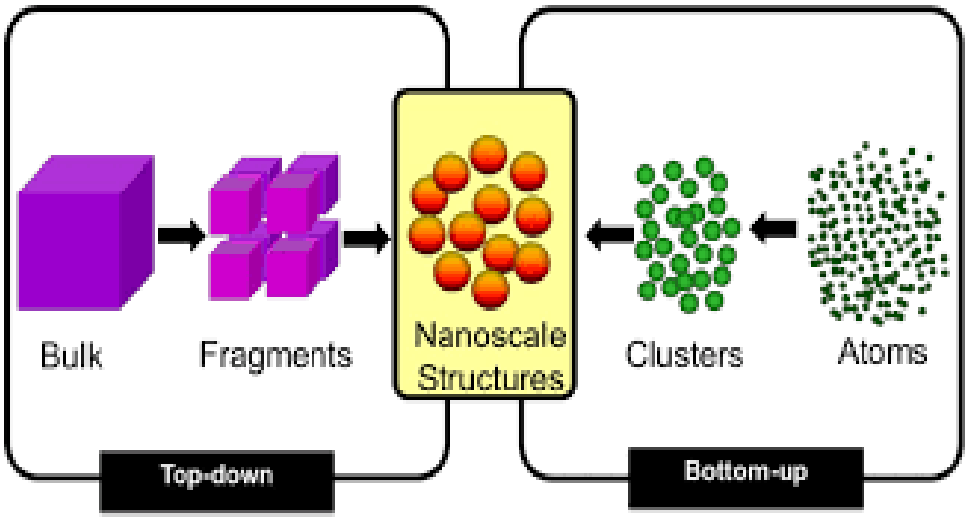

Fig7- Pictorial representation of top down and bottom up approach [9]

LIPID NANOPARTICLE

A strong lipid nanoparticle is regularly round with a normal breadth somewhere in the range of 10 and 1000 nanometer . Strong lipid nanoparticles have a strong lipid center lattice that can solubilize lipophilic atoms. The lipid center is settled by surfactants (emulsifiers). The emulsifier utilized relies upon organization courses and is more restricted for parenteral organizations.

The term lipid is utilized here from a more extensive perspective and incorporates fatty substances (for example tristearin), diglycerides (for example glycerol bahenate), monoglycerides (for example glycerol monostearate), unsaturated fats (for example stearic corrosive), steroids (for example cholesterol), and waxes (for example cetyl palmitate). All classes of emulsifiers (concerning charge and atomic weight) have been utilized to settle the

lipid scattering. It has been discovered that the mix of emulsifiers may forestall molecule agglomeration all the more productively.

Advantages of solid-lipid nanoparticles

SLNs have the mix of the upsides of other colloidal frameworks, for example, nanoemulsions, polymeric nanoparticles and liposomes. The significant points of interest of Solid lipid nanoparticle can be summed up as follows

• These nanoparticles have no biotoxicity as the lipids utilized are biodegradable and biocompatible substances.

• Without using natural solvents these nanopaticles can be delivered

• These nanoparticles have high strength and high stability

• The controlled medication discharge and furthermore targeting can be accomplished with SLNs

•The security of dynamic substances can be expanded by consolidation in SLNs

• These nanoparticles can be prepared in enormous scope

• These nanoparticles can also be sterlized.

CHAPTER -2

LITERATURE REVIEW

2.1-Nanoparticles and its synthesis-

Nanoparticles structure the premise of Nanoscience and nanotechnology which are considered as the most developing orders among different fields of science. Different strategies for blend of nanoparticles incorporate ordinary strategies like aqueous strategy, sol-gel method , laser-removal, electrochemical procedures, and warm techniques. Anyway biogenic amalgamation of iron nanoparticles is favorable over regular strategies because of its eco-accommodating, basic, financially savvy and non-harmful properties. Iron nanoparticles have wide scope of utilization from ecological remediation to polarization of dregs and they are likewise known to have hostile to oxidant and against bacterial action. Concentrates of different plants like green tea, Amaranthus dubius, and Eichhornia Crassipes, Cynometra Ramiflora, and Eucalyptus tereticornis, Melaleuca Nesophila Rosemarinus Officinalis are accounted for combination of iron nanoparticles. Diverse ecological remediation uses of iron nanoparticles incorporate corruption of colors, evacuation of nitrate, hexavalent chromium, arsenate, arsenite, synthetic oxygen interest and absolute phosphates. This survey centers around different plant extricates used for blend of iron nanoparticles and their expected applications. Various classes of phytochemicals liable for change of antecedent iron to nano-sized iron material, different portrayal strategies for iron

nanomaterials created utilizing plant concentrates and ideal conditions for toxin expulsion are additionally talked about.

2.2 Chemical method-THE POLYOL METHOD

Nanoparticles are sythesized chemically by this method .Polyol here is a non aqeous liquid which plays function of reducing agent as well as solvent .Large scale nanoparticles are beimg produced by this method and it helps in controlling the shape , texture and size of nanoparticles and it minimizes the surface oxidation as well as agglomeration.

This method plays a great role in the synthesis of oxides with condition that synthesis is performed with accyrate particle growth measures and slightly increased temperature . Many oxides are being synthesized such as y203,cotio3, pbo, sno2 etc

Ethylene glycol is mostly used as a solvent in in glycol method because it has high reducing capability ,high boiling point and high dielectric constant .Core shell nanoparticles and bimettalic alloys are also synthesized by plyol method

2.3-MICROEMULSIONS

Emulsion is basically when two liquids mix with each other and there is a constant line of separation between them .Polymers solution is capable of producing emulsion

on the basis of size of droplets and there is mini emulsion , micro emulsion and macro emulsion.

Inorganic nanoparticles are being synthesized by microemulsions .Water oil is being created when the water and oil is mixed and to create water oil energy input is required .Water oil connections replace the water oil contacts amd combinations of these phases require energy input Surfactant molecules are used to align the interface between oil and water by reducing interfacial tension

Nanoparticles prepration in oil and water generally consist of two microemulsion mixing contain reducing agent and a metal salt .Later on brownian motion leads to the formation of metal ions .

Growth stage of nanoparticles happens around point of nucleation

Size of nanoparticles and morphology are based on the size and shape of nanoparticles.

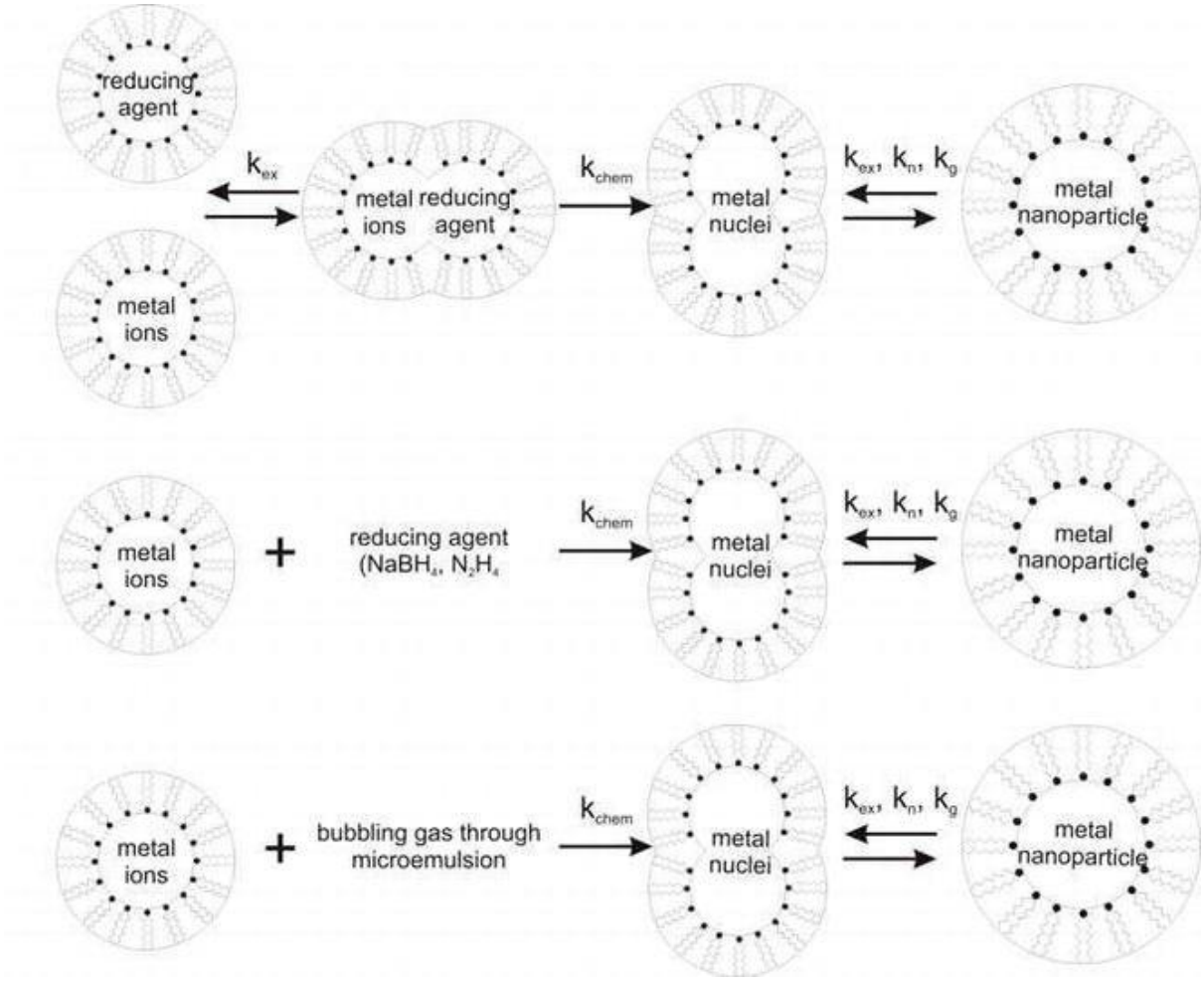

FIG – Microemulsion technique used for prepration of nanoparticle [10]

2.6-PHYSICAL METHODS (PLASMA)

Another method for production of nanoparticle is plasma method ,Radio frequency, heating coil help in the generation of plasma . Initially a metal is closed from all sides in a pestle which is further enclosed by an evacuated chamber .RF coils with high voltage encloses the evacuated chamber and the metal is heated.The metal should be heated above its evaporation point .

Helium is the gas used in this method which lead to the production of plasma having high tempearture . On the helium gas atom the vapor of the metal will nucleate and diffuse to a collector rod that is cold in nature and then the

nanoparticles is collected. After collection the nanoparticles are then passivated and this occurs with the help of oxygen gas

2.7-CHEMICAL VAPOR DEPOSITION

It is a method that is mediated by chemical reaction that is chemical vapor deposition method .It is mailnly used for depositing thin films made of different kind of matereal that is mainly used for thr manufacturing of semiconductors .

Volatile precursor are taken that can be one or more and then substrate comes in contact with precursor which will decompose on that and the formation of desired deposit take place

Now a substance is kept at high temperature in cvd reactor will come in contact with vaporised precursor and adsorption will occur onto high temperature substance

The adsorbed molecules will react with other molecules or they can either decompose that lead to formation of crystals

Main three steps of cvd method are –

1-With the help of boundary layers the reactants are transported over the growth surface

2-The chemical reaction occur over the growth surface.

3-The extra products produced by the gas phase reaction is removed from surface

In substrate – Heterogeneous nucleation occurs

In gas phase – homogeneous nucleation occurs

Ultrafine particles less thn 1 nm in size can be synthesized with cvd method with the help of chemical reaction occuring in gaseous phase

Controlled reaction can be performed in order to produce nanoparticles of different size ranging from 10-100 nm .

2.9-Green synthesis of iron nanoparticles-

With the advancement in nanotechnology and nanoscience,development of many novel nanoparticles had taken place whivch had ultimately increased the risk of health and the environmental diseases.so the focus is shifted towards developing an environmental safe proceduresfor synthesis of metallic nanoparticles.

The main purpose of opting these procedures is to minimize the negative effects of other procedure that are harmful along with other harmful chemicals and derivative compounds. So recently green nanotechnology is opted as a suitable approach for synthesi of nanoparticles from different biomaterials . Biological substances such as a,fungi,bacteria , algae and plants have been used for production of metalic nanoparticles in a way that is more energy efficient,non toxic, environmental friendly(ecofriendly) and is cost effective.This paper provides us an overview of different reports related to green synthesized zerovalent metallic ions, fe203,fe3o4 nanoparticles and their application in different fields mainly in controlling environment pollutions. The paper mainly highlights the various biological agents such ass amino acids ,bacteria, fungi , plant extracts for synthesis of iron nanoparticles and also discussed about their reaction pathways briefly.

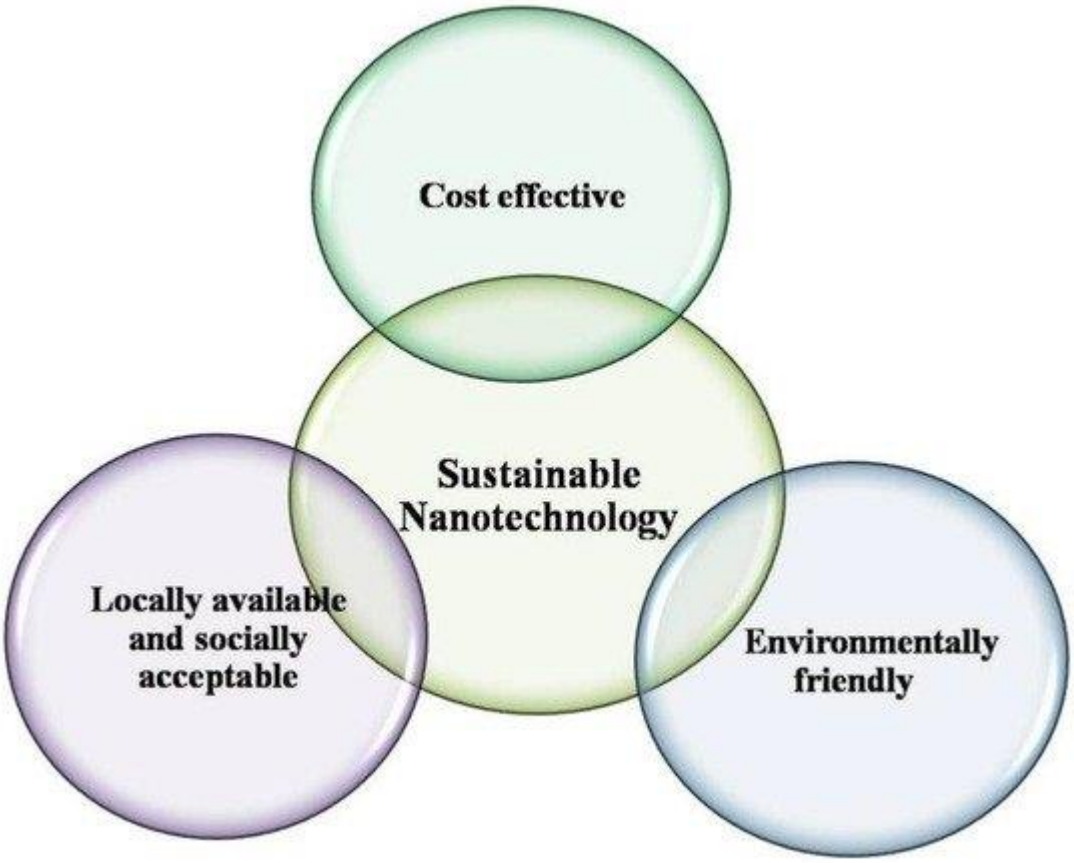

Fig8- Sustainable green nanotechnology [11]

2.10-Plant mediated synthesis of iron nano particles-

There are many methods for synthesis of nanoparticles including –

Hydrothermal method

Sol gel method

Electroche,ical techniques ,Thermal method

Green synthesis using plant biowaste

However the synthesis of nanoparticle by using green plants or biomaterial is quite advantageous over other conventional methods. Biological synthesis is ecofriendly ,non toxic and cost effective Nanoparticles structure the premise of Nanoscience and nanotechnology which are considered as the most developing orders among different fields of science. Anyway biogenic synthesis of iron nanoparticles is favorable over regular strategies because of its eco-accommodating, basic, financially cheap and non-harmful properties. Iron nanoparticles have wide scope of utilization from ecological remediation to polarization of drugs and they are likewise known to have hostile to oxidant and against bacterial action. Concentrates of different plants like green tea, Amaranthus dubius, and Eichhornia Crassipes, Cynometra Ramiflora, and Eucalyptus tereticornis, Melaleuca Nesophila Rosemarinus Officinalis are accounted for combination of iron nanoparticles. Diverse ecological remediation uses of iron nanoparticles incorporate corruption of colors, evacuation of nitrate, hexavalent chromium, arsenate, arsenite, synthetic oxygen interest and absolute phosphates. This survey centers around different plant extricates used for blend of iron nanoparticles and their expected applications. Various classes of phytochemicals liable for change of antecedent iron to nano-sized iron material, different portrayal strategies for iron nanomaterials created utilizing plant concentrates and ideal conditions for toxin expulsion are additionally talked about.

2.11-Chemical and plant mediated synthesis of iron nanoparticles-

Various techniques are being developed due to advancement in nanotechnology and these techniques are being utilized for the production of nanoparticles and use of their application in various fields broadly life sciences. By large no of methods and processes properties and application of iron nanomaterials are studied and where these nanomaterials can be used.Many techniques are there for the production of nanoparticles but for the production of iron nanomaterial the best fit process or approach is green synthesis of iron nanoparticles . Hence this paper helps in studying of the production of iron nanoparticles from green tea leaves and carrom seeds by green technology and further the characterization was done by UV Visible Spectroscopy , dynamic light scattering for the comparative analysis of green technology and chemical reduction methods which are used for the synthesis of iron nanoparticles. Observed size of prepared iron nanoparticles from carom seeds and green tea by green innovation and substance decrease technique were seen in the scope of 50-90 nm, 50-200nm and 70-90 nm separately. UV Visible Spectroscopy was additionally affirmed the amalgamation of iron nanoparticles from carom seeds and green tea by utilizing green innovation have a similar top as the pinnacle noticed for combination of iron nanoparticles by utilizing synthetic decrease strategies at 500nm frequency. This was lead to affirm the amalgamation of iron-nanoparticles on the grounds that the excitation of surface plasmon vibrations of iron nanoparticles happen at 500nm. It was affirmed that the concentrates of plants were effective of creating iron nanoparticlesand best option in contrast to other compound combination advancements. In any case, synthetic decrease technique is fast and simpler for the blend of nanoparticles, however the combination of iron nanoparticles by

utilizing green innovation is discovered to be tantamount better eco-accommodating and practical decision because of evasion of harmful synthetic compounds. Subsequently, the green innovation determined iron nanoparticles of characteristic sources can be utilized for additional considered for protected and non-harmful applications in fields of biosensor innovation, biomedical methodologies, drug industry, clinical restorative measures utilized for the therapy of different illnesses.

CHAPTER 3 -

MATERIALS AND METHOD

Beforehand, fine particles are viewed as which are measured in the middle of 100 and 2,500 nanometers and ultrafine particles are absolutely called nanoparticles which were seen in the scope of 1-100 nanometers in size

1. Another strategy was additionally revealed for getting ready quantum dots (QDs) magnetic nanoparticles (MNPs) in light of layer-by-layer (LbL) self-gathering methods have created and utilized for malignant growth cells imaging

2. With the utilization of new physical and substance techniques for the combination of nanoparticles were currently become the worries for expanded ecological pollution because of its high harmfulness and low biodegradation lineages

3. Iron's reactivity was seen to be significant in plainly visible applications particularly in rusting and predominant concerned application at the Nano scale. Thus, this critical reactivity has made the iron nanoparticles more hard to read and badly arranged for functional applications once in a while in the perspective for their profile debasement or bio-decrease. In

any case, iron anyway has an extraordinary arrangement to bring to the table at the Nano scale including its powerful attractive and synergist properties

4. The engineered or synthetic strategies to get ready nanoparticles were lead to create perilous results that could influence the climate straightforwardly just as by implication to humankind too5. Thymol and polyphenols were additionally discovered to be normally happened in seeds of Trachyspermum ammi (carom seeds) and leaves of Camellia sinensis (green leaves) separately which go about as common cell reinforcements and have against cancer-causing properties. It is likewise revealed that its compound immobilization based nanoparticles onto eco-accommodating biocompatible, non-harmful, non-hypersensitive and non-destructive ox-like serum egg whites (BSA) support by utilizing green innovation made it all the more modernly practical to broadened catalyst application. It was discovered to be more savvy technique to build the capacity dependability and warm soundness of bound fixings and further their huge biodegradation. This sort of catalyst based nanoparticles readiness and their portrayal by green nanotechnology was likewise done into synthetically altered emulsified egg albumin. Accordingly, the necessity of green science was come into logical features that incorporates ecological cordial strategies which need low prerequisite of high pressing factor, energy, temperature or poisonous synthetic substances as contrasted with compound strategies. These green innovation techniques are discovered to be accounted for practical and can be effortlessly increased to be utilized for enormous scope creation of metallo-nanoparticles. The concentrates of plants and flavors might be fit for delivering Iron nano molecule. Under the UV-Visible frequency nanoparticles were showed calm acceptable surface plasmon reverberation conduct with wonderful shading changed when Ferric chloride was blended in with diminishing specialist. What's more, further, their charcterization was finished by XRD, SEM, TEM and FTRI. As indicated by the analysts, it was likewise seen that the polyol parts present in the plant separate based metal nanoparticles which help for the

metal bio-decrease for example ferric chloride corruption and water-solvent heterocyclic parts that balance out the incorporated nanoparticles. Biosynthesis of metal nano-particles can be effectively set up from different pieces of plant like, leaves, seeds, buds, natural product and so forth including metal bio decrease during their preparation12-14. Subsequently, in our investigation, we were combined iron nanoparticles by green innovation structure initiated Trachyspermum ammi (carom seeds) and Camellia sinensis (green tea leaves) and by utilizing compound decrease strategies. Further, we were oppressed those pre-arranged iron nanoparticles to the portrayal to affirm the development of iron nanoparticles. Their portrayal was finished by Dynamic Light Scattering and UV Visible Spectroscopy to do the near investigation of green innovation and substance decrease techniques utilized for the blend of iron nanoparticles

Procedure (to be done in future)-

1- Trachyspermum ammi seeds and camellia sinensis leaves are the two selected natural sources which are to be taken by 25 grams each for the green synthesis of iron nanoparticles

2- Fecl3 solution as precursor and selected plant extract will be used to act as reducing agents in the green synthesis

3-Iron nanoparticles can be synthesized by using 0.265 grams ammonium ironII) sulfate [(NH4)2.Fe(SO4)2.6H2O], 0.059 grams ammonium iron (III) sulfate [NH4.Fe(SO4)2.6H2O] and 15.998 grams of sodium hydroxide [NaOH]16 in the form of chemical synthesis

Green Synthesis of Iron Nanoparticles by using Slightly Modified Green Method

Preparation of plant extract –

1-Thoroughly washed and then dried samples of carrom seeds and green tea leaves should be assured to be devoid of all the moisture in hot air oven

2- 25 grams of this sample should be weighed and finely crushed into a fine homogeneous paste using pestle and mortar with slowly adding double distilled water

3- This paste of the sample will be further incubated for 30-40 minutes at 60 -70 degree celsius in an oven and then later centrifuged at 5000 rpm for about 20 -25 minutes

4- After collecting the supernatant off of the pellet it will have to be filtered through whitman filtered paper and the filterate is to be collected. Lastly the supernatant will be collected again after the centrifugation of the filterate at 5000 rpm for 20 -25 minutes and the pellet should be discarded

5-Further the resultant supernatant shall be used for synthesis of iron nano particles

Preparation of FeCl3 solution-

Fecl3 solution could be prepared by dissolving 0.03244 grams of fecl3 in 200 ml of double distilled water and will be used for the synthesis of iron nanoparticles as a precursor

Addition of FeCl3 solution to the Plant Extract-

Prepared FeCl3 solution has to be poured drop wise onto the plant extracts e.g. Trachyspermum ammi (carom seeds) and bush (green tea leaves) in equal quantitative relation (1:1) with constant stirring at fifty - 60°C for 40-60 minutes victimization magnetic stirrer. Then, the ready reactionsolution is to be used for incubation at temperature for 10-15 minutes and once the incubation was done , it is then subjected to stirring at temperature for hour victimization sonicator

Chemical Synthesis of Iron Nanoparticles by Modified Chemical Reduction Method

1- Mixture solution of 0.265 gm of ammonium iron (II) sulfate and 0.059 gm of ammonium iron (III) sulfate is to be prepared by addition of 200 ml of double distilled water**.**

2- A mixture solution of ammonium iron (III)sulfate and ammonium iron (II) sulfate will be prepared by slowly and gradiently adding 0.4 m solution of naoh and the ph is to be adjusted at 7.0.

3- Finally the reaction mixture solution will be stirred by a magnetic stirrer for 40-60 minutes and later with a sonicator for 60 minutes at room temperature

CHARACTERIZATION-

The green technology is used to synthesize ion nanoparticles from carrom seeds and green tea leaves extract and will be subjected to ph analysis ,uv visible spectroscopy and dynamic light scattering for the characterization by chemical technology .The synthesis of ironanoparticle are to be confirmed by confirming the completion of reduction reaction done by ph

analysis.The formation of ironnanaoparticles in the form of obtained peak 500 nm was indicated by the uv visible spectroscopy done at 200 nm ,300nm,400 nm ,500 nm ,600nm, 700 nm and 800 nm .The size range of synthsized nanoparticles are to be determined by dynamic light scattering.

CHAPTER 4

RESULTS

Sr no		Ph variation	
1	Trachyspermum ammi (carom seeds) by using modified green technology method	Before reduction has occurred 6.0	After reduction has occurred 4.0
2	Camellia sinensis (green tea leaves) by modified green technology method	5.0	2.0
3	By modified chemical reduction method	Regulated to 7	4

Table 1-Change in pH before and after the occurred reduction during the synthesis of iron nanoparticles by using modified green technology [from Trachyspermum ammi (carom seeds) and Camellia sinensis (green tea leaves)] and chemical technology (by modified chemical reduction method and the results are positive for sr no 1,2,3.

UV Spectroscopy

For observing exact variation in absorbance at 200 nm, 300 nm, 400 nm, 500 nm, 600 nm, 700 nm and 800 nm at regular intervals in the samples of synthesized iron nanoparticles uv visible spectroscopy was performed

The obtained results of UV – Vis absorption spectra analysis were confirmed the bioreduction of Fe3+ ions in the prepared iron nanoparticles of the Trachyspermum ammi seeds (carom seeds) extract followed by Camellia sinensis leaves (green tea leaves) extract followed by modified chemical reduction methods. It indicates that the formation of iron nanoparticles were confirmed by the obtained peak at 500 nm because of the excitation of surface plasmon vibrations of iron nanoparticles. This is further confirmed by its comparison with the previously reported anaylsis

DYNAMIC LIGHT SCATTERING -

Sr no	Name of the	diameter	Intensity	Width	

	sample				
1	Carrom seeds	65.6 nm	100%	34.02nm	
2	Green tea	72.2 nm	98.4%	81.85nm	
3	Chemical reduction	88.9 nm	100%	14.36 nm	

TABLE 2- DLS data observation of prepared iron nanoparticles from Trachyspermum ammi seeds (carom seeds) extract and Camellia sinensis leaves (green tea leaves) extract by modified green synthesis and by modified chemical reduction methods

CHAPTER 5-

DISCUSSION

The plant extract were prooved efficient enough for the production of iron nanoparticles having a good observed size in comparison with other method .Ph analysis and uv visivle spectroscopy and DLS were performed to observe characterization .Before and after the reduction reaction a decrease in ph of both the plant extracts and chemical reduction sample confirming the iron nanoparticles synthesization was observed .A good sized iron nanoparticles after synthesis showed a good surface plasmon resonance behaviour by its presence as depicted in uv visible absorption spectra data.This study has shown in both chemical reduction method as well as plant extract sample prepared by green technology .

Hence the effeciency of synthesization of iron nanoparticle is confirmed to better by plant extracts as prepared by other chemical methods .Also they have prooved to be cheaper source

and desired functional group of our interest and biological ingredients can be attached and used for eg widening of the application of any therapeutic drug in various industries.

FUTURE PERSPECTIVE

1- To synthesize iron nanoparticles in greater amount by using less no of biomaterials.
2- To reduce the toxicity of the nano materials so that they are less damaging to the environment such as promting techniques like green synthesis.
3- Finding more applications where the iron nanoparticles can be utilized
4- To synthesize iron nanoparticles in the lab by myself.

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