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Green Synthesis, Characterization and Kinetics of Nano Agro Fertilizer Containing Nanostructured Hydroxyapatite

Swati Mishra and Dr.Anjali Soni
Department of Chemistry
Medi-caps University

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KEYWORDS
Nano-hydroxyapatite (n-HAP), Cucurbita pepo, phosphorus (P), Nano structured, Nano agro fertilizer.

Abstract-
Agriculture is the has been continuously increases with the rapid population growth. Due to high biodegradability and biocompatibility of phosphorus used in the field of insecticide, bio fertilizer, bio pesticide. However, much less progress has been made regarding their application in precision agriculture.

Phosphorus is the major plant nutrients of plants. phosphorus is the least accessible since most farmland are frequently phosphorus deficient. Hence, phosphorus use efficiency should be maximized to conserve to resource base and maintain agricultural productivity. The challenge to 66 meet the increasing phosphorus demand in a sustainable manner at a global scale require development of smart solution, modification and improvisation in the chemical properties of fertilizers. Approximately 30 to 65% of total phosphorus present in inorganic form which is not available for plant. According to geographic paper 2020 farmer face many problem related to phosphorus.

More soluble phosphorus such as single super phosphate, triple super phosphate polluted water bodies with leads to eutrophication. We use rock phosphorus as the raw material to manufacture fertilizer for this purpose we imports rock phosphorus from UK, China, morocco.

This study reported the green synthesis of n-HAP using aqueous seed extract of Cucurbita pepo by wet chemical method because Cucurbita pepo is a common plant in which all parts are editable and rich I Calcium and Phosphorus and phosphorus content and characterized by FTIR(Fourier Transform Infrared Spectroscopy) , SEM(Scanning electron microscopy) and XRD(X-ray diffraction analysis)and study the effect of n-HAP on plant growth.

Introduction

Agriculture is the security system of nearly 700 million people in the country and we need to build our food security on the foundation of home grown food. Nano agrochemical is a very popular technology now a days because it is the combination of Nano fertilizer and Nano technology. This Nano agrochemical is very effective as well as ecofriendly Nano-agrochemicals owing to their enormous benefits in agriculture and helped the farmer economically by increasing the yield of crops qualitatively and quantitatively, thereby substituting synthetic fertilizers and pesticides in order to maximize the output and conserve the input which leads to economic prosperity .There is a need for sustainable agriculture. Now because the population is increasing day by day.

Fertilizer is very important for plants growth Nano agro fertilizer provide the essential elements to the plants and it improve the quality of crops and it is ecofriendly. Nano material is the collection of atoms. The range of particles is 1 to 100nm. Nano technology focusing on special properties of materials emerging from Nano metric size has the potential revolutionized to in the food sector , biomedical and so many field nanotechnology applications in agriculture are gradually transforming the theoretical possibilities into the practical applications . Well organized delivery system for agrochemical like fertilizer, pesticides improved system combination for food processing increased revolution using nanotechnology in the agriculture sector [4].

Phosphorus is a major plant nutrient. Phosphorus is an ‘energy unit’ of plants. In plants during photosynthesis ATP generate and phosphorus is a vital component of ATP [20] . Only 0.6%.phosphorus isolated as phosphate and their potential for rock phosphate [31].

The main source of phosphorus is rock phosphate and agriculture is far the main user of mined Phosphorus globally , according for 80-90% of the word demand [30] The phosphorus content of soil is quite variable ,

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ranging from less than 0.04 P_2O_5in the sandy soils of the Atlantic and gulf coastal plains to more 0.3 % in soils of the northwestern state[24].Phosphorus affect the root development it increase the stalk and stem strength improve crop quality , increase the formation of flower and it also help in the production of seed but it affected by several factor like – pH of the soil , holding capacity etc. Approximately 30-65% of total phosphorus is in organic form which is not available for plant.

Problem Identification

Over the last century the requirement for food resources has been constantly increased day by day with the rapid population growth [14] The main source of phosphorus is rock phosphorus which is use as a fertilizer but due to of several factor such as-leaching, degradation, insolubility and decomposition the availability of these resources is poor for plants and leads to lower bodies cause eutrophication . A few resources of phosphorus rock mainly in UK, China, Morocco by some estimation those could run out in at little 50 to 100 years. Thus the price will likely rise making it harder for growers to afford fertilizer and for people to afford food.

Nano Hydroxyapatite

Nano hydroxyapatite is one of the innovative Nano particle , which ranked as one of the most favored candidates in agronomic application which can supply the phosphorus nutrients[23].n-HAP is very effective nanoparticle it is a well-known biometrical that has been explores for a variety of biomedical application of phosphorus to the plants. The unique quality of n-HAP is mobility HAP show lesser mobility to the surrounding agriculture possesses an extraordinary probability to enhance agrochemical yield and lesser risks of water eutrophication n-HAP deliver both calcium and phosphorus to plants.

Material and Method-

During experiment the following chemicals were used as received disodium phosphate (Na_2PO_4, madicaps), Calcium chloride ($CaCl_2$ madicaps) ,distilled water and Cucurbita pepo seeds collected from local market ,India. All glass ware was cleaned with water before being used. The seeds were first washed several time with water and then dried at room temperature. The washed Cucurbita seeds were stored at room temperature under dark and dry condition.

For the Cucurbita pepo extract preparation seeds socked overnight in distilled water and then cursed it with the help of mortar and pestle after that extract was filtered using whatman no.1 filter paper and stored at 4^0c in dark for further studies. The green synthesis on n-HAP conducted according to Tarafdar et al(28) with few modification . In extract solid disodium phosphate and calcium chloride is added and a low speed shaker will used to stir mixture until a color change will observed after some time mixture were centrifuged and then pellets were washed by distilled water and placed in oven for drying. Which they were scraped for further analysis.

Chemical equation-

$Na_2HPO4 + CaCl_2 \dashrightarrow Ca_{10}(PO_4)6(OH)_2 + NaCl$

Green Synthesis of Nano Hydroxyapatite-

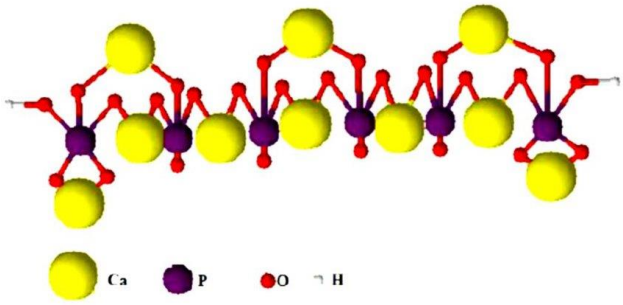

Figure 1 structure of n-HAPs

Characterization of Nano hydroxyapatite-

UV – Visible Spectroscopy –

Uv-Visible extinction spectra of plant extract and synthesized phosphorus and calcium nanoparticles were collected in a Cary spectrometer from 200-400 nm , using 1 cm quartz cuvette. The use of Uv-visible spectrum analysis to confirm n-HAP green synthesis was investigated which is shown in figure 2. This finding is quite similar to those of prior investigations (29). There were no other peaks in the spectrum , showing that the n-HAPs synthesized by this rapid and green approach were of significant purity.

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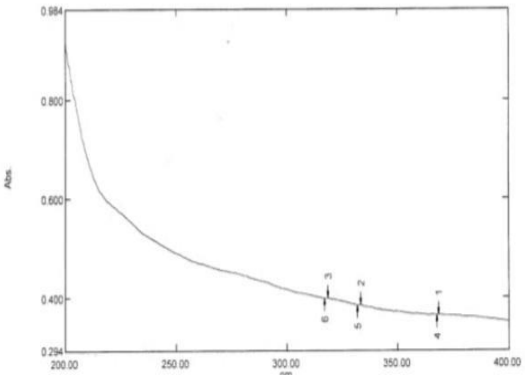

Figure -2 uv- visible absorption spectrum of n-HAP synthesized using aqueous extract of Cucurbita pepo seed

Fourier Transform Infrared Spectroscopy (FTIR)

FT-IR spectroscopic analysis was used to identify the functional group in Cucurbita pepo seeds extract that participate in the synthesis of n-HAPs The FT-IR for n-HAP were obtain 600 to 4000cm^{-1},similar result were obtained as published earlier (17,30,31) . The broad peak at 1019cm^{-1}represents phosphate group (asymmetric stretching) The broad peak 3259cm^{-1} represents the stretching vibration of O-H bonda(34).The absorption band at 1541 cm^{-1} are corresponding to the carbonyl group (ketone, carboxylic group). The bands located at 1623cm^{-1} represents alkene (-C=C-) group (30).The IR data confirmed the presence of phenolic compound in the plant extract. This results of investigation are in accordance with those of Hala M. Abdelmigid and Maissa M, Morsi et al., (17).

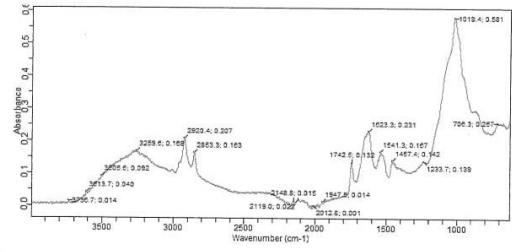

Figure 3 spectrum of nano hydroxypatite synthesized by Cucurbita pepo

X-Ray Diffraction Analysis

X-ray diffraction is a versatile, nondestructive analysis method for identification and quantitative determination of various crystalline form present in powder and solid samples.(34) . The XRD pattern of the green synthesized n-HAPs is compared with stander values of JCPDS (33). This confirmed the successful formation of Nano hydroxyapatite.

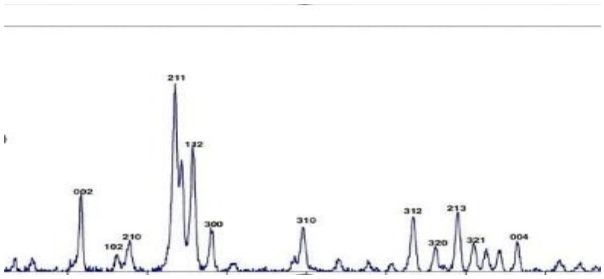

Figure 4 XRD pattern of Nano hydroxyapatite

Scanning electron Microscopy –

Scanning electron microscopy is very useful in the chemical compositions crystal orientations . The particle size distribution of Nano hydropatite was evaluated using software , which treated the NPs as spheres and accordingly calculated the size distribution. The agglomeration of the nanoparticles might be because Vander walls forces , existing among n-HAPs The spherical shaped particles with clumped distributions are visible from SEM analysis. The SEM image show the spherical shaped particles as confirmed by Ferraz et al., (2004) for reported results of n-HAPs (35)

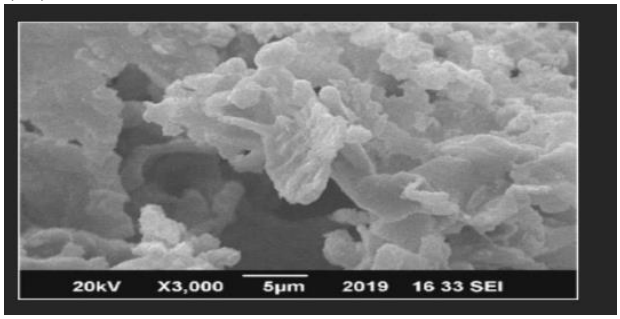

Figure 5 SEM pattern of Nano hydroxypatite

Kinetics study of n-HAPs on plant-

Kinetics studies are especially important in designing treatment system. In kinetics studies only morphology of plant is consider . In pot experiment first picture of pot show the effect of n-HAPs on plant morphology while the second pot show without n-HAPs . The result

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of pot experiment n-HAPs increase the length and number of branches.

Figure 6 Effect of n-HAPs on egg plant

. . . .

Figure 7 show the result without nHAPs

Conclusion –

n-HAPs were synthesized from Cucurbita pepo in a simple wet chemical synthesis. The developed synthesis method is simple , fast and environmentally friendly since there were no waste of chemical by product. The synthesized nanoparticles were characterized using multiple techniques. The synthesized Nano hydroxyapatite were characterized by uv-visible , FT-IR, XRD , SEM particularly to investigate the shape , size and functional group .n-HAPs have been tested for their potential application in the phosphorus nutrition of plants and this study show the results about their effects on plants. Our green ecofriendly approach was successful.

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Conflicts of interest

The authors declare no conflict of interest.

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