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DETORIATION OF CALCIUM OXALATE CRYSTALS USING BOILED EXTRACT OF MUSA PARADISIACA

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ABSTRACT

Herbal medicines derived from plant extract, are increasingly being recognized in treating various diseases. Calcium Oxalate leads to the formation of stones in human kidneys which cause a risk factor on human health. This stone formation is considered as the most common problem of urinary tract. The motivation of this project is to deteriorate the growth of Calcium Oxalate crystals using the Boiled extract of Musa Paradisiaca.

Key words*:* Musa Paradisiaca, Calcium Oxalate, crystals, human kidney stones

1.1 INTRODUCTION

Crystal growth is one of the most important fields of material science, which involves controlled phase transformation. A crystal is defined as being atoms, molecules, or ions arranged in an orderly repeating pattern, a crystal lattice, extending in all three spatial dimensions. The process of crystal formation via mechanisms of crystal growth is called crystallization. Crystallization occurs in two major steps, nucleation and crystal growth. Nucleation is the appearance of a crystalline phase from either a super cooled liquid or a supersaturated solvent. The second step is known as crystal growth, which is the increase in the size of particles and leads to a crystal state.

Nucleation is broadly classified into two types, primary and secondary nucleation. The primary nucleation is further divided into homogeneous and heterogeneous nucleation. If the nuclei are generated in the vicinity of crystals present in supersaturated system, then this phenomenon is often referred to as secondary nucleation. Following this nucleation process the growth of crystal takes place.

Kidney stones, or renal calculi, are solid masses made of crystals. Kidney stones usually originate in our kidneys. However, they can develop anywhere along the urinary tract. A kidney stone (renal calculi) is a common disorder worldwide with an obvious increase in incidence over

the past 20 years. It is found that 1 in 11 people have the problem of kidney stone disease. The four most common types of kidney stones contain: Calcium, Struvite, Uric acid and Cystine. The aim of the present work is to report the efficiency of using the Boiled extract of Musa Paradisiaca stem extract as a deterioration agent for Calcium Oxalate crystal.

Kidney stone is solid concretions (crystal aggregations) formed in the kidneys from dissolved urinary minerals. Bladder stones can form or pass into the urinary bladder. Usually, kidney stones form when the urine becomes concentrated to a great extent. This results in minerals, along with other substances, to form into crystals, which occur in the inner surface of the kidneys. In time, these crystals have the tendency to combine and to form a hard, small mass, or a kidney stone.

The diagnosis of a kidney stone can be fixed by radiological studies or Ultrasound examination, urine tests and blood tests are also normally performed. Using the sound waves, the stones can be crushed into smaller pieces so that they can be passed through urinal passage along with urine without causing pain or discomfort. This treatment is called Extracorporeal Shock Wave lithotripsy. The last remedy for kidney stones is open stone surgery. All these latest technological things may bring side effects. By using Musa Paradisiaca stem extract the one can get rid of kidney stone without any side effects.

1.2 MUSA PARADISIACA

Musa Paradisiaca is one of the important plants, widely distributed all over the tropical region. Most of the people in southern part of India use Musa Paradisiaca as medication for different diseases. The utilisation of Musa Paradisiaca will cause inhibition of growth Calcium Oxalate which is reported here. The treatment and removal of renal calculi is often dependent upon the composition and hardness of the stone, as well as stone size and placement in the urinary tract. Though the main components of renal stones tend to be Calcium Oxalate, Calcium phosphate (hydroxylapatite), magnesium ammonium phosphate and uric acid were found (Otnes, 1983; Dietrich et al., 1990) Pushpangadan et al., 1989; Ghani, 2003 said that Pseudo stem extract of Musa Paradisiaca is used for the removal of kidney stone, and also antidote for snake-bite in the Elsevier article. Singh et al., published about Assessment Of Glycemic Potential Of Musa Paradisiaca Stem Juice in the year 2007 and reported about the Hypoglycemic activity. The main investigation is to know the efficiency of Musa and its role in dissolving Calcium Oxalate crystals. Several factors which increase the risk of developing kidney stones include insufficient fluid intake, dehydration,

reduced urine flow/volume, high calcium, oxalate rich diet or low citrate in urine and several medical conditions (Kumar et al., 1991). Renal lithiasis is a multifactorial disease and is strongly related to dietary lifestyle habits and practices. Obesity and weight gain increases the risk of kidney stone formation (Taylor et al., 2005; Lieske, 2014). Increased rate of hypertension and diabetes which are linked to nephrolithiasis, also contribute to an increase in stone formation. Dietary factors in general which increase the risk of stone formation include low fluid intake, a high dietary intake of animal protein, sodium, refined sugars, fructose, high fructose corn syrup, oxalate, grapefruit juice, apple juice, and cola drinks (Borghi et al., 2006). Prasad KV et al (1993), investigated the antilithiatic activity of fresh juice of Musa Paradisiaca stem by implanting zinc discs in the urinary bladder of albino rats to induce urothiasis. The Musa stem juice was found to be effective in reducing the stone formation. It also dissolves the pre-formed stones.

1.3 SLOW EVAPORATION METHOD

In the present work crystal growth is carried out by slow evaporation method. This method is one of the growths from solution process. The slow evaporation method is similar to slow cooling method in terms of the apparatus concerned. In this method, the saturated solution is kept at a particular temperature and provision is made for evaporation. If the solvent is non-toxic like water, it is permissible to evaporate into the open atmosphere. The typical growth conditions involve a temperature stabilization of about 0.05°C and rate of evaporation of a few mm3/hour. The evaporation technique has an advantage that the crystals grow at a fixed temperature. This method can effectively be used for materials having very low- temperature coefficient of solubility. The crystals tend to be pure than the crystals produced by other technique, and good yield of crystals will obtain.

1.4 LOW TEMPERATURE SOLUTION GROWTH

Growth of crystals from aqueous solution is one of the ancient methods of crystal growth. The method of crystal growth from low temperature aqueous solutions is extremely popular in the production of many technologically important crystals. It is the most widely used method for the growth crystals, when the starting materials are unstable at high temperatures and also which undergo phase transformations below melting point. The growth of crystals by low temperature solution growth involves weeks, months and sometimes years. In the present work the calcium oxalate crystal is grown by slow evaporation method in which the pure form of crystal is to be obtained.

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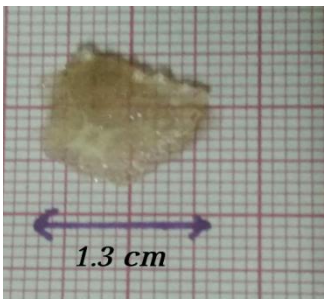
1.5 SCOPE OF THE PRESENT INVESTIGATION

The motivation of this project is to deteriorate the growth of Calcium Oxalate crystal using the stem extracts of Musa Paradisiaca. Nowadays, new approach is needed to overcome this problem. The extract from Musa Paradisiaca, has the ability to dissolve the crystals of Calcium Oxalate and to test against the formation of Calcium Oxalate crystals.

2.1 PREPARATION OF CALCIUM OXALATE CRYSTAL

The apparatus Petri-dish, beaker, spatula etc., were washed using Soap oil, Distilled water and Acetone. The stem of Musa Paradisiaca is taken and blended using a blender. Then it is filtered using Whatman filter paper to separate the extract from fibre. This freshly prepared boiled extracts of Musa Paradisiaca is used in the deterioration process.



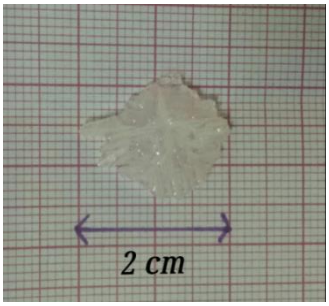


Fig. 1 Preparation of Calcium Oxalate Crystal

Fig. 2 Calcium Oxalate crystal before (2cm) and after (1.3, 0.7cms) using Musa Paradisiaca extract

The supersaturated CaC_2O_4 sub phases will be prepared by mixing appropriate quantity of Calcium chloride ($CaCl_2$), sodium chloride (NaCl) and sodium Oxalate ($Na_2C_2O_4$) solutions. The sodium hydroxide (NaOH) was used to maintain neutral pH7. The formation of crystals was obtained in 28 days. The structural and morphological analysis of the prepared Calcium Oxalate crystals is done by XRD, FTIR and UV analysis.

The harvested Calcium Oxalate crystal was 2cm in length. It is seen that Musa Paradisiaca extract treated crystal was found to be 1.3cm and on further treating the size is about 0.7 cm. Visible reduction in crystal growth is seen when Musa Paradisiaca extract is used. Therefore the extract said to be deteriorating the growth of the Calcium Oxalate crystal.

RESULTS AND DISCUSSION

XRD ANALYSIS

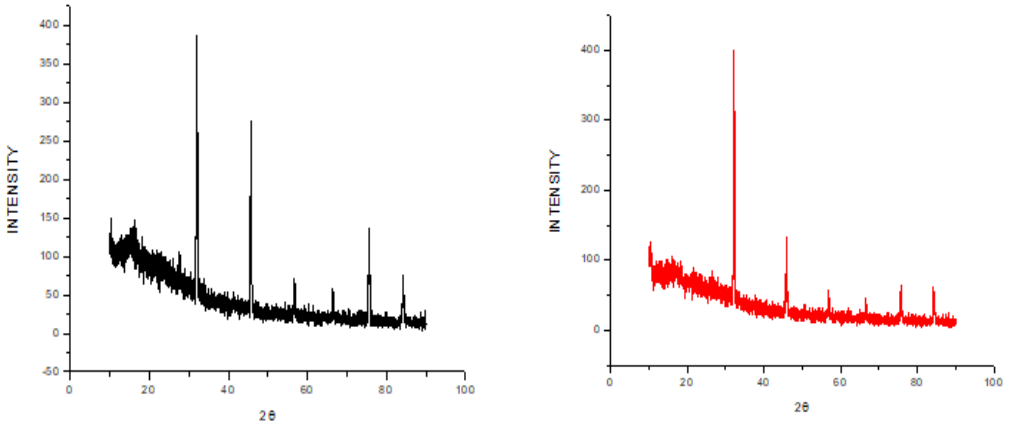


Figure 3 Calcium Oxalate crystals before and after using Musa Paradisiaca extract

The strong diffraction peaks demonstrates the crystalline nature. Figure 3 shows the XRD pattern of Calcium Oxalate crystal. On comparing the intensities of XRD patterns, we noted that the intensity of diffraction peaks changes and there is a shift in the 2Θ values. Average crystalline intensity peak of Calcium Oxalate was found in the range of 30-50 (degree). The XRD analysis reveals the formation of tetragonal structure of Calcium Oxalate crystal. The figure shows the XRD pattern for the Musa Paradisiaca treated Calcium Oxalate crystal. The intensity peak gets reduced compared to normal Calcium Oxalate crystal.

UV-VISIBLE ANALYSIS

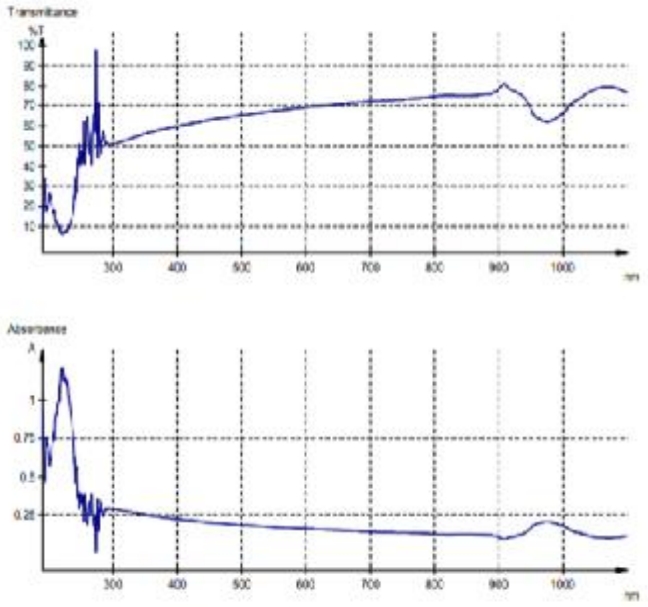


Figure 4 Calcium Oxalate without Musa Paradisiaca extract

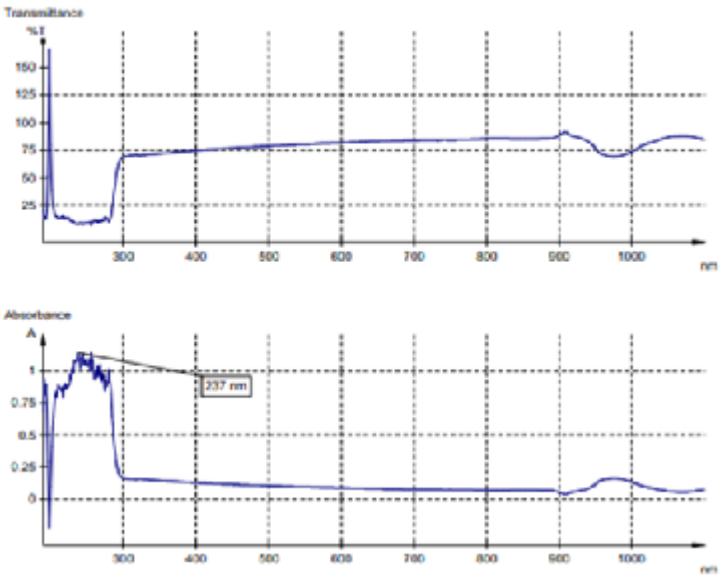


Figure 5 Calcium Oxalate with Musa Paradisiaca extract

Figure 4 and 5 shows the UV-Visible absorption spectrum of Calcium Oxalate crystal. The absorption patterns were analyzed and the absorption peak for UV studies obtained for Musa treated crystal shows 237nm.

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FTIR ANALYSIS

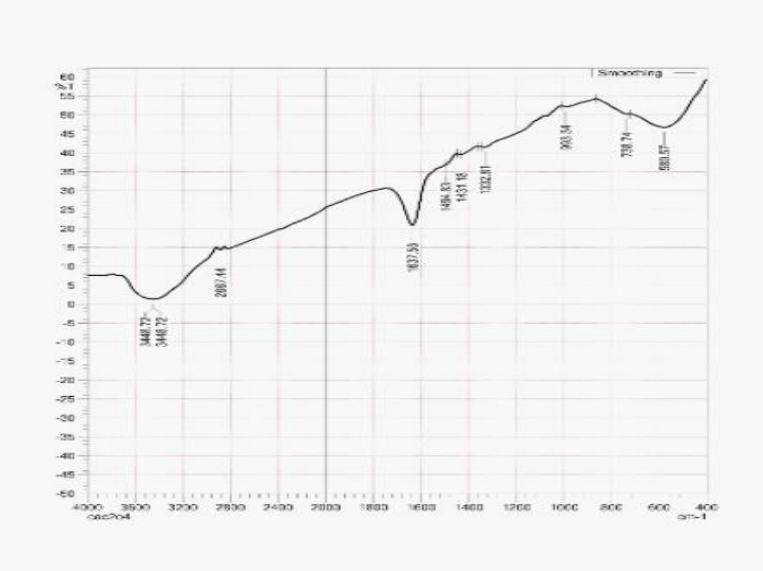

Figure 6 FTIR spectrum of Calcium Oxalate crystal without Musa Paradisiaca extract

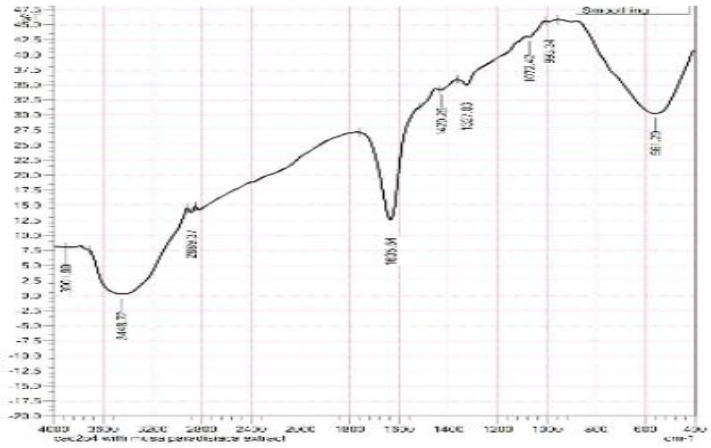

Figure 7 FTIR spectrum of Calcium Oxalate crystal with Musa Paradisiaca extract

Figure 6 shows the FTIR spectra of Calcium Oxalate crystal. The absorption peak was observed at 3442.72 cm^{-1} is attributed to O-H group and it is clear that there is decrease in the intensity and small shift in the peak. The peak shift to the range of 583.57 cm^{-1}.

Figure 7 shows the FTIR spectra of Musa treated Calcium Oxalate crystal. The absorption peak observed at 3448.77 cm^{-1} is attributed to O-H group. The peak shift to the range of 561.20cm^{-1}. This shows that shift value decrease to Musa Paradisiaca treated Calcium Oxalate crystal.

CONCLUSION:

The Calcium Oxalate crystals were successfully produced by slow evaporation method. The synthesized crystals were analyzed and characterized. It is also noted that Boiled extract of Musa Paradisiaca extract was mainly responsible for the deterioration of Calcium Oxalate Crystals. The structural and optical analyses were done by XRD and UV-Visible spectroscopy. The XRD analysis reveals the formation of tetragonal structure of Calcium Oxalate crystal. The absorption patterns were analyzed by UV-Visible spectroscopy. The absorption peak for UV studies was obtained at 237 nm. The functional groups and compounds responsible for the growth of crystal were studied by Fourier transform infrared spectroscopy (FTIR). The deteriorating nature of Boiled extract of Musa Paradisiaca against the Calcium Oxalate crystals was studied using the synthesis and optical characterization by slow evaporation method. The deterioration of crystal can be visually absorbed by the size and shape of the crystal grown. The UV result confirms the deterioration as the cut off wavelength of crystal grown with extract is lesser than that of crystal grown under normal conditions. Hence it is concluded from the present work that Boiled extract of Musa Paradisiaca acts as a good deteriorating agent in the growth of Calcium Oxalate crystal.

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