A Novel Process For Production of Tartaric Acid From Tamarind For Inhibition of Growth of Urinary Stone Found In Human Kidney.

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Abstract

Tartaric acid is a white crystalline acid. It occurs naturally in many plants, particularly grapes, bananas and tamarinds. Tamarind is commonly combined with baking soda to function as a leavening agent in recipes, and is one of the main acids found in wine. It is added to other foods to give a sour taste, and is used as an antioxidant. Salts of tartaric acid are known as tartrates .It is a dihydroxyl derivative of succinic acid. Urinary stone is one of the oldest problems faced by humans. A number of people suffer from urinary stones. Phosphate crystals are frequently found in urinary stones. Many fruits contain high amount of tartaric acid. In the present study phosphate crystals are grown by single diffusion gel growth technique. The effect of tartaric acid is investigated on growth and dissolution of crystals in this article.

Keywords: tamarind, tartaric acid, urinary stone, UV spectrophotometer, phosphate crystals.

Introduction

A number of people suffer from urinary stone. In India 12 % of the population is expected to have urinary stone, out of which 50-60 % may end up with loss of kidneys or renal damage. Also, nearly 15 % of the population of northernIndia suffers from kidney stones.Feweroccurrences of urinary calculi are found in southern India which may be due to regular dietary intake of tamarind. As tamarind contains tartaric acid, in the present investigation, the effect of tartaric acid and tamarind is studied on one of the urinary type crystals, under in vitro conditions.

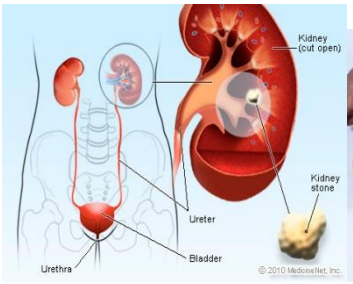

Fig 1: Urinary stone found in human kidney. Fig 2: Tamarinds

Experimental Description

Tamarinds are used for production of tartaric acid, thus taking the suitable volumes ratio of water:tamarinds are heated on a electric heater at about 3 hrs.The obtained product is cooled for 6-8 hours in the refrigerator, the resulting mixture contains Potassium Bi-tartrate, .The mother liquor is kept aside. The obtained potassium bi-tartarate is dissolved in sufficient amount of water. The known grams of calcium carbonate in potassium Bi-tartarate. It becomes calcium tartarate and neutral potassium tartarate this reaction releases C02. The known grams of calcium chloride are dissolved into the hot water and this solution is added to the above prepared solution. Here, a Double exchange reaction takes place. Add sulphuric acid to above and after some time calcium tartarate are decomposed to pure tartaric acid and at the bottom calcium sulfate settles.

For growth of Phosphate crystals, sodium metasillicate solution was mixed with suitable molar concentration solution of orthophosphoric acid and it was stirred. Thereafter, the mixture was transferred into test tubes, and allowed to set in a gel form. Then calcium chloride solution was poured on it, without disturbing set gel. Nucleation of crystals took place in a day or two, and complete growth of phosphate crystals was obtained within a month, due to reaction between the two reactants to the gel and continuous supply of reactants to the growth sites. Different types of crystal morphologies were observed. The test tubes were placed under the influence of sunlight for providing the heat and other conditions of natural environment.

Fig 3: Preparation of Tartaric acid solution Fig4: Prepared tartaric acid

Observations for determination of concentration of prepared tartaric acid

UV-visible spectrophotometer:- Scan was done in spectra mode & calibration curve was prepared in photometric mode using wavelength = 492 nm.

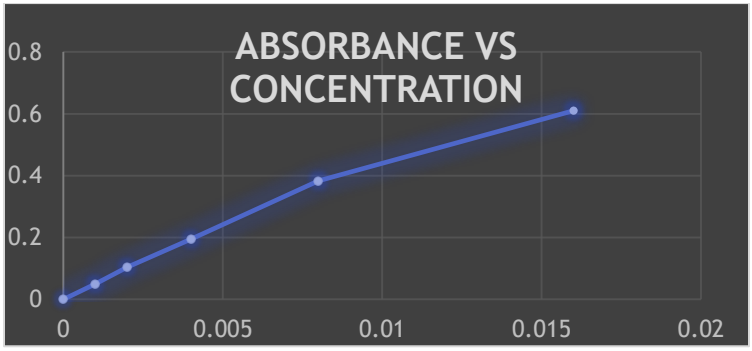

Fig5:Plotofabsorbancev/sconcentration for determination of prepared tartaric acid concentration.

Fig 6: Prepared urinary stone in vitro conditions **Fig 7: Final tartaric acid formulation**

Observations for inhibition of growth of urinary stone.

Molar concentrations of calcium chloride as well as ortho- phosphoric acid solutions were varied in equal amounts and the effects were studied on the number and size of crystals. As the molar concentration increases for both solutions, the number of crystals also increases. The results suggested that the crystals decomposed upon heating through stages such as dehydration of crystal, and finally turned into calcium pyrophosphate. The study also revealed the growth of the crystal in the form of a platelet having prominent crystallographic face . The structure of the crystal was confirmed through X-ray powder diffraction.

The growth of urinary calculi is a complex process involving various parameters. When the nucleation process occurs in pure solution it is known as homogeneous nucleation. Apart from this, the concept of aggregation is also important. Crystal nuclei cannot grow large enough to attach to and occlude on renal tubular lumens within 5 to 7 min and pass through tubules and enter the renal pelvis. Nevertheless, they can aggregate into large clumps within an order of a minute. It is, therefore, required to incorporate the growth and aggregation phenomenon to explain the occurrence of stones.

Many chemicals are found as important inhibitors of crystal aggregation. Magnesium and citrate inhibit crystal aggregation. It is interesting to note that the interference with crystal growth and aggregation is a possible therapeutic strategy for prevention of recurrent stone diseases. The interference of tartaric acid in the nucleation and growth of phosphate urinary type crystals, which may have possible therapeutic applications.

Tamarind is largely used in different Indian cuisines. The pulp of tamarind contains nearly about 10% tartaric acid, citric acid and malic acid and their salts, as well as about 8% potassium hydrogen tartrate. However, malic acid, reducing sugar and insoluble matter are comparatively lesser in amount. A critical survey of tamarind chemistry, technology and uses has been carried out by Shankaracharya.

It had been found that the lower incidence of urinary calculi in South India compared to that in North India is probably due to regular dietary intake of tamarind in the south, although there are some other dietary differences, including a lower animal protein intake in the south. It has been claimed that the daily intake of 10 g of tamarind pulp significantly increases the

inhibition of calcium oxalate crystallization, which is due to the high tartaric acid content of tamarind. It has been earlier established that between 14 and 20% of injected tartrate is excreted in the urine. This increases tartrate level in the urine.

Tartrates are expected to form metal ion complexes with calcium . The presence of tartrate in urine may decrease the amount of ionized calcium available for calcium oxalate precipitation. Tartrates bind with the cations needed for crystal formation and subsequent growth, and also function as a crystal growth inhibitor of calcium oxalate by chemical adsorption on the crystallization sites at a growing interface.

Conclusion

When comparing with previous process it deals with costly chemicals and non available instruments. So the modified processes developed by this research , two commercially important constituents of the tamarind pulp are potassium Bitartrate and tartaric acid obtained.

The inhibition of crystals increases as the concentration of tartaric acid increases; consequently, the number of grown crystals and their average size decreases. Tartaric acid inhibits the growth of crystals in vitro.

The dissolution time of grown crystals depends on the concentration of tartaric acid added in the supernatant solution; as the concentration of tartaric acid increases, dissolution occurs faster. This also confirms that the tartrate readily forms complexes with calcium and inhibits the growth of crystals.

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