Kidney stone disease is a common urinary stone disorder in humans and often causes serve pain, which may lead to emergent hospitalization, shock wave lithotripsy and surgery. Calcium oxalate is a major component if it is kidney stone. It forms upon the supersaturation of the urine with calcium and other salts especially oxalate. The size of the stone can increase and obstruct in the urinary system. Although the most effective treatment of kidney stone is extracorporeal shock wave lithotripsy, the side effects of this method are grave and can lead to recurrence of kidney stones. Therefore alternative treatments are of high interest means by using herbal medicines.

The use of herbal medicines is now wide spread for the treatment of various diseases and disorders. In this regards, this research work focuses on the most common and prevailing disorder, kidney stone and its treatment using herbal extracts from a traditionally used herbal plants Tribulus terrestris (Fruits), Crataeva nurvala (Stem bark), Tamarindus indica (Leaves), Costus igneus (Stem), Grewia tiliaefolia (Stem bark). Through our ongoing research in this area we found that this plant Costus igneus contain antiurolithiatic activity related compounds to solve the complicated problems of kidney stone was isolated, purified and characterized as discussed in chapters of this thesis.

A large number of people are suffering from problem due to kidney stones. To investigate the composition and type of 38 kidney stones samples were surgically removed from patients in our population by FTIR spectroscopy. Through our research programme found that, Out of 38 kidney stones samples, 28.9% were pure calcium oxalate stones, 21% were calcium oxalate dihydrate in combination with calcium phosphate and magnesium ammonium phosphate stones,18.5% were calcium oxalate + uric acid, 15.7% were calcium oxalate + aspartate, 10.5% were magnesium ammonium phosphate and 5.4% were pure uric acid. Pure calcium oxalate stones
followed by calcium phosphate and magnesium ammonium phosphate stones are commonly found in patients of Tiruchirapalli and its adjoining areas.

Hence, the three most common urinary stones CHPD, COM and Struvite crystals have been selected for in-vitro study to assess the inhibition effect of the above stated five medicinal plants viz. *Tribulus terrestris*, *Tamarindus indica*, *Crataeva nurvala*, *Costus igneus* and *Grewia tiliaefolia* by single diffusion gel growth technique. With an increase in the concentration of aqueous extract of five medicinal plants, the weight of the formed CHPD, COM and Struvite crystal growth were reduced. The formation of hydroxyapatite was observed in Brushite crystals and the morphology of the COM crystals changed from hexagonal (COM) to bipyramidal (COD) form due to inhibitory action by the aqueous extracts of stems of *Costus igneus* under in-vitro conditions. FTIR techniques confirmed its functional groups of CHPD, COM and Struvite crystals. The stems of *Costus igneus* extracts can promote the formation of hydroxyapatite crystals and COD crystals treat urinary stone by inhibiting the formation of CHPD and COM crystals, a major component of calcium urinary stone than compared to other four medicinal plants.

Hence, the effects of aqueous extract of leaves, stem and rhizome of *Costus igneus* are used as additives to inhibit the nucleation and growth of calcium urinary stones (CHPD and COM) crystals by single diffusion gel growth technique have been selected for in vitro study for further confirmation. With an increase in the concentration of aqueous extract of *Costus igneus*, the weight of the formed crystals were gradually reduced from 2.03 g to 0.06 g (leaves), 0.05 g (rhizome), 0.03 g (stem) for the CHPD crystals and 2.15 g to 0.07 g (leaves), 0.06 g (rhizome), 0.03 g (stem) for the COM crystals, respectively. The formation of hydroxyapatite was observed in Brushite crystals and the morphology of the COM crystals changed from hexagonal (COM) to bipyramidal (COD) form. The leaves of *Costus igneus* can reduce the nucleation rate of CHPD and COM crystals. FTIR and Powder XRD techniques confirmed its functional groups and crystalline phases of CHPD and COM crystals. SEM studies confirmed the morphology of the crystals changed and also the
average size of the crystals were reduced from 1616.7 x 810.7 μm (control) to 1025.2 x 834.4 μm (stem), respectively. The stems and rhizomes of Costus igneus extracts can promote the formation of COD crystals and treat urinary stone by inhibiting the formation of COM crystals, a major component of calcium oxalate urinary stone. The stem of Costus igneus showed maximum inhibition and also morphology of the crystals changed from COM to COD than compared to leaf and rhizomes extract.

So, the effects of aqueous extract of the stem of Costus igneus used as additives to inhibit the nucleation and growth of COM crystals by both gel and liquid growth methods have been selected for in vitro study for further confirmation. The COM crystal growth was reduced, and the morphology of the crystals changed from a hexagonal (COM) to a bipyramidal (COD) form due to the inhibitory action of the aqueous extracts of stem of Costus igneus under in vitro conditions. FTIR and Powder XRD techniques confirmed the functional groups and crystalline phases of the COM and COD crystals. SEM studies confirmed the morphology of the changed crystals. It also confirmed that the average size of the crystals was reduced from 1874.1 x 857.8 μm to 1075.5 x 990.5 μm and from 0.524 μm to 0.291 μm for the gel and liquid methods, respectively. This aqueous Costus igneus stem extracts promote the formation of COD crystals and may possibly treat urinary stones by inhibiting the formation of COM crystals, which are a major component of calcium oxalate urinary stones.

Therefore, the stem of Costus igneus has been selected for further isolation, purification and characterization of antiurolithiatic activity related compounds Lupeol and Stigmasterol by HPTLC, HPLC, IR, ¹H NMR and ¹³C NMR, prep-TLC and Column chromatography technique separately. TLC aluminum plates precoated with silica-gel 60F₂₅₄ (20cm x 10cm) were used with a mobile phase of n-Hexane: Ethyl acetate (80:20 v/v) for Lupeol, Toluene: Acetone: Acetic acid (8.9: 0.9: 0.2 v/v/v) for Stigmasterol and densitometric determination of these compounds was carried out at 366 nm in reflectance/ absorbance mode. The linear regression data for the calibration plots showed a good linear relationship with \( r=0.99794 \) and \( r=0.99291 \) for Lupeol.
and Stigmasterol, respectively. The average recovery of Lupeol and Stigmasterol was 100.16 % and 99.94 %, respectively. From IR, $^1$H NMR and $^{13}$C NMR spectral data, isolated compound was identified as Lupeol and Stigmasterol. The purity of the isolated compounds Lupeol and Sigmasterol were confirmed by HPLC technique.

Further, the assessment of inhibition effect of aqueous and ethanolic extracts of stem of Costus igneus and isolated antiurolithiatic compounds Lupeol and Stigmasterol using urolithiasis induced albino rats have been selected for in vivo study for further confirmation. The aqueous and ethanolic stem extracts of Costus igneus having the isolated compounds Lupeol and Stigmasterol were found significantly reduced the elevated level of calcium oxalate ions in treated albino wistar rats. The histopathological findings also conform the effect of the Costus igneus on animals treated with extract principally having Lupeol and Stigmasterol compounds. Costus igneus stems extract could inhibit the stone (CaOx crystals) formation induced by ethylene glycol in albino wistar rats.

Struvite stones are caused due to the urinary tract infection causing pathogens (Escherichia coli, Enterococcus aerogenes, Pseudomonas aeruginosa, Staphylococcus aureus and Proteus vulgaris) in the urinary tract system. So, further study focuses on to examine the antibacterial activity of Costus igneus stems extract and isolated constituents towards urinary tract infection causing pathogens using disc diffusion method. The pentacyclic triterpenoid compound Lupeol and steroidal compound Stigmasterol isolated from the stem of Costus igneus had good antibacterial activity against five selected urinary tract infection causing organisms as compared with crude ethanolic Costus igneus extracts. Lupeol from Costus igneus represent a significant activity against selected urinary tract infection pathogens as compared with Stigmasterol compound.

This research provides a multidisciplinary approach in characterizing and controlling urinary stones; CHPD and COM crystals grown in vitro and in vivo to help, formulate prevention or dissolution strategies in controlling calcium urinary stone growth. This research has also found new alternative herbal plant Costus igneus
for the treatment of calcium oxalate urinary stone. Therefore, the purpose of this research is to investigate the beneficial effects of *Costus igneus* at a different dose and single compound for the prevention and control of kidney stone formation and growth.

This work lead to follow further research on detailed isolation of other active phytoconstituents (terpenoids, flavonoids, alkaloids, steroids, phenols) possessing the therapeutic activity and clinical studies for the evaluation of safety and efficacy of the plant based drugs needs to be carried out.