7. SUMMARY, CONCLUSION AND SCOPE FOR THE FUTURE

We provide here, in this Chapter, a summary of the present work, conclusion derived out of the present study and the scope for future work in the same area of research.

7.1. Summary and Conclusion

The in vitro investigations on the crystallizations of constituents of urinary calculi and other pathological calcification have received considerable attention in connection with the formation of metabolic and non-metabolic stones, bones and teeth. The formation of crystalline particles in tubular fluid as well as in urine comprises two major physicochemical aspects. The thermodynamic aspect includes supersaturation. The kinetic aspect comprises rates of crystal nucleation, growth, aggregation and phase transformation. Also, it has been found that it is very much possible to utilize the same physical principles in the study of biological crystals and those crystals that are grown in the laboratory. In addition, it has been found that it is possible that the antidiabetic drugs (or their metabolites) used by the diabetic patients may promote the stone formation.

As an attempt to understand the effect of three antidiabetic drugs (glyciphage, daonil and semiglynase) normally consumed in South India on the formation of three major constituents of urinary stones (whewellite, brushite and struvite), these urinary stone crystals were grown by the gel method without and with adding the three antidiabetic drugs separately with four to five concentrations in each case. The grown crystals were
characterized by various physical techniques. Observations were also made on the size, shape, transparency and approximate number of crystals obtained to derive conclusions regarding the promotery / inhibitory effect of the drug incorporated.

Attempt was also made to investigate the effect of juices of tomato, lime and cucumber (advised for the diabetic patients to take frequently) in balancing the effects caused by the antidiabetic drugs.

Photographs, total product mass determination and crystals formed indicate that all the three drugs considered in the present study have promotery effect (except semiglynase in the case of struvite) on the growth of all the three urinary stone crystals considered. All the three juices considered in the present study are found to be balancing (or inhibiting) the promotery effect of the drugs. X-ray diffraction, thermogravimetric and FT-IR spectral analyses show that the lattice structures of the urinary stone crystals are not distorted by the addition of drug and / or juice.

As far as the antidiabetic drug glyciphage is considered, it may be mentioned that it has a side effect of promoting the formation of the urinary stone crystals (considered in the present study) in the urinary tract (metformin is excreted unchanged in the urine and does not undergo hepatic metabolism nor biliary excretion). But, when the other two drugs are considered, no authentic statement can be made in this direction with the results obtained in the present study. However, results of the present study may probably help to carry out further study in treatment of urinary calculi.
7.2. Scope for Future

The present work, reported in this thesis, is only a part of the vast area which is of very much scope to go in further. Due to lack of time, the present work was limited to concentrate only on three urinary crystals and three drugs. Same type of work can be extended to the other components of urinary calculi. Similarly it can be extended to investigate the effects of some other widely used drugs, medicinal herbs, and soft drinks, which will be of very much use to the society. The quantitative elementary analysis of drug / herb using ICPAES or EDAX will be highly useful in the preparation of new drugs as well as to understand the role of each component in formation of urinary stone crystals. Going deep into the pharmacology of drugs and the body metabolism, more authentic conclusions can be made regarding the effect of drugs. More progress can be achieved in this field in collaboration with different disciplines like urology, nephrology, biochemistry, biophysics, pathology and mineralogy.

Since most stones do not contain a single crystal type, but rather a mixture of several different types with one or two that are predominant, attempts can be made to grow mixed stones also. Using known inhibitors trials can be made for the dissolution studies of already grown crystals so that it can be implemented for the cure of natural stones \textit{in vivo} instead of going for painful surgery and all.

Since brushite is a bone mineral, these studies can be extended in association with hydroxyapatite to understand the bone formation.