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Antiurolithic properties of the leaf extracts of *Kalanchoe pinnata* (Akkapana)

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Kidney stone disease is a significant health issue in the world. More than 60% of kidney stones compose of $CaC_2O_4.H_2O$ and $CaC_2O_4.2H_2O$. In this study, the effect of aqueous Akkapana extract on the crystallization and the dissolution of calcium oxalate crystals were investigated in supersaturated and artificial urinary circumstances in order to understand the effect of Akkapana extract on calcium oxalate kidney stone. Aqueous solutions of 8 mM $CaCl_2$ and 125 mM $Na_2C_2O_4$ were mixed to prepare the supersaturated solutions. Akkapana extract was obtained by grinding leaf with deionized water. Different volumes of the Akapana extract were separately added to the prepared supersaturated solutions and artificial urinary solutions. The pH of the solution was adjusted to 7.3 and the crystal deposition process was monitored by UV-vis absorption and conductivity measurements. The crystals formed were characterized by FT-IR, XRD, TGA and redox titrations. A kidney stone collected from a patient was also treated with akkapana extracts. According to the analysis, Akkapana has an inhibition effect in the supersaturation solution and in artificial urinary circumstances showing 8% and 4% decrease in crystal deposition, respectively with 80 mL of Akkapana compared to positive control experiments. The proteins present in the extract may be reducing the crystal aggregation thus improving inhibition effect by attaching to the crystal surface and acting as a barrier for further attachment. The dissolution effect of Akkapana is far more superior to the inhibition effect. Akkapana treated sample showed 31% dissolution of calcium oxalate crystals, whereas the control experiment under the same conditions, showed approximately 18% dissolution. The kidney stone of the patient showed ~18% dissolution with four 300 mL washings of Akkapana extract. This could be due to strong binding of Ca^{2+} ions with the organic acids and amino acids present in Akkapana, and forming water soluble complxes.

Keywords: Calcium oxalate, Akkapana, inhibition and dissolution effect

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