Abstract No: 874 ***Natural Sciences***

β-CYCLODEXTRIN ASSISTED INTERCALATION OF CURCUMIN INTO H^{+-} AND $Al^{3+-\ EXCHANGED}$ MONTMORILLONITE CLAYS

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Curcumin present in turmeric (*Curcuma longa* L.), has a wide range of beneficial pharmacological effects including antioxidant, antibacterial, hypocholesterolemic, anticoagulant, anti-inflammatory, hepatoprotective and anticancer. However, curcumin has low water solubility and degrades rapidly at physiological pH, resulting in low systemic bioavailability and poor pharmacokinetics, and hence reduced *in vivo* efficacy. Various encapsulation-based formulations have been investigated in order to improve the delivery of curcumin in its native hydrophobic form. We investigated the feasibility of a novel drug delivery system based on β-cyclodextrin-assisted intercalation of curcumin into H^+- and Al^{3+}-exchanged montmorillonite (MMT) clays; MMT clays are layered aluminosilicates with expandable interlayer nanospaces and β-cyclodextrin (CD) is a semi-natural cyclic oligosaccharide with extremely low toxicity and enhance drug delivery through biological membranes.

H^+- and Al^{3+}-exchanged MMT clays were prepared by standard procedures. Curcumin (Cur), isolated from turmeric by solvent extraction and chromatography, was mixed with CD and H^+-MMT/Al^{3+}-MMT sequentially and simultaneously in aqueous acetone to obtain various clay composites of curcumin, which were characterised by PXRD and FTIR. The interlayer distance (d_{001}), deduced from PXRD data, of the clay composites was consistent with the intercalation of curcumin into the nanospaces of MMT. The amount of curcumin trapped in each clay composite was determined by UV-Visible spectroscopic analysis of curcumin (λ_{max} 419 nm) remaining in the supernatant. The clay composites had varying amounts of curcumin. With H^{+-}MMT, the highest amount (55%) of curcumin was trapped when all three components – Cur, CD and the clay – were mixed together. However, no curcumin was intercalated into H^{+-}MMT in the absence of CD. In contrast, with Al^{3+}-MMT, the highest amount (59%) of curcumin was trapped in the absence of CD, and the amount was only 29% when all three ingredients were mixed together. The H^+-MMT and Al^{3+}-MMT clays, when treated with CD initially, trapped 17% and 24% of curcumin, respectively. The amount of the CD-Cur inclusion complex intercalated into either of the two cation-exchanged clays was low (2-3%). The releasing of curcumin from the clay composites was examined at pH 2.2 and 37 ºC, simulating gastric pH and temperature. The composites obtained from CD-treated clays and those obtained by simultaneous mixing of the three ingredients displayed slow release of curcumin. The composites that trapped curcumin (2-3%) poorly, also released curcumin in amounts detectable by UV-visible spectroscopy. The cation-exchanged montmorillonite clays can intercalate curcumin with the mediation of β-cyclodextrin.

Financial assistance given by University of Peradeniya and Postgraduate Institute of Science is acknowledged.