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Hierarchical Zeolites as Potential Carriers of Curcumin

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Abstract : Based on the latest data, it is expected that the substances of therapeutic interest used will be as natural as possible. Therefore, active substances with the highest possible efficacy and low toxicity are sought. Among natural substances with therapeutic effects, those of plant origin stand out. Curcumin isolated from the Curcuma longa plant has proven to be particularly important from a medical point of view. Due to its ability to regulate many important transcription factors, cytokines, and protein kinases, curcumin has found use as an anti-inflammatory, antioxidant, antiproliferative, antiangiogenic, and anticancer agent. The unfavorable properties of curcumin, such as low solubility, poor bioavailability, and rapid degradation under neutral or alkaline pH conditions, limit its clinical application. These problems can be solved by combining curcumin with suitable carriers such as hierarchical zeolites. This is a new class of materials that exhibit several advantages. Hierarchical zeolites used as drug carriers enable delayed release of the active ingredient and promote drug transport to the desired tissues and organs. In addition, hierarchical zeolites play an important role in regulating micronutrient levels in the body and have been used successfully in cancer diagnosis and therapy. To apply curcumin to hierarchical zeolites synthesized from commercial FAU zeolite, solutions containing curcumin, carrier and acetone were prepared. The prepared mixtures were then stirred on a magnetic stirrer for 24 h at room temperature. The curcumin-filled hierarchical zeolites were drained into a glass funnel, where they were washed three times with acetone and distilled water, after which the obtained material was air-dried until completely dry. In addition, the effect of piperine addition to zeolite carrier containing a sufficient amount of curcumin was studied. The resulting products were weighed and the percentage of pure curcumin in the hierarchical zeolite was calculated. All the synthesized materials were characterized by several techniques: elemental analysis, transmission electron microscopy (TEM), Fourier transform infrared spectroscopy, Fourier transform infrared (FT-IR), N2 adsorption, and X-ray diffraction (XRD) and thermogravimetric analysis (TGA). The aim of the presented study was to improve the biological activity of curcumin by applying it to hierarchical zeolites based on FAU zeolite. The results showed that the loading efficiency of curcumin into hierarchical zeolites based on commercial FAU-type zeolite is enhanced by modifying the zeolite carrier itself. The hierarchical zeolites proved to be very good and efficient carriers of plant-derived active ingredients such as curcumin.

Keywords : carriers of active substances, curcumin, hierarchical zeolites, incorporation
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