Chlorhexidine Loading into Commercial Bentonite Samples and Drug Release Evaluation.

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Abstract

This work presents a simple method to study chlorhexidine diacetate incorporation into commercial bentonite. X-ray powder diffraction (XRPD), infrared absoption spectroscopy (FTIR), and thermal analysis (TG and DSC) helped to characterize the structure and properties of unloaded and loaded samples. UV-Vis spectroscopy aided monitoring of chlorhexidine loading and release. All these techniques revealed that chlorhexidine molecules accommodated in the basal spacing of the clay. In this condition, maximum chlorhexidine release occurred in aqueous medium (pH near 7) in less than 24 h. The influence of conditions such as pH and temperature on drug release will be assessed in the future.

Introduction

New drug generations use various types of active species with therapeutic value; e.g., antimicrobials and growth factors, as well as supplements, like vitamin C. The most advanced medicaments include systems that can perform controlled delivery of the active substances at the target site. It is also desirable that new drugs be able to release the active phase at specific sites in a sustainable fashion. In the present study, we have incorporated chlorhexidine (CHX) into commercial bentonite, named Bent, to obtain the Bent-CHX hybrid via the adsorption methodology (kinetic and equilibrium studies). We discuss drug incorporation into and release from bentonite; we also detail the characterization of loaded and unloaded bentonite.

Results and Discussion

To evaluate the degree of CHX incorporation, two parameters were fixed: contact time and CHX concentration. First, in a typical bath adsorption experiment, 0.5 g of bentonite was placed in glass flasks and submitted to magnetic stirring for 1 to 2880 min; the CHX concentration was 50 mg/L. The amount of incorporated CHX was estimated by UV-Vis spectroscopy. The system reached equilibrium in about 90 min; there were no changes in the final concentration before this time. In another experiment, highly concentrated CHX solution (200.000 mg/L) was added to 1.0 g of bentonite. The capacity of the clay to incorporate CHX was analyzed before conduction of release experiments.

A large amount of CHX was incorporated into bentonite (87.5 mg/g). Characterization of this sample by XRPD revealed that the original clay displayed the typical reflection pattern of clays belonging to the smectite group; the basal spacing (13.64 Å) was compatible with montmorillonite. After the incorporation experiments, the basal spacing increased to 21.91 Å. The difference of 8.27 Å in the basal spacing of the unloaded and loaded bentonite was compatible with the arrangement of a CHX monolayer into the bentonite basal spacing. The remaining bentonite reflections did not change, which showed that CHX incorporation did not affect other clay plans. The release experiment (Figure 1) was conducted in distilled water (pH = 7, T = 25 ºC) and monitored by UV-Vis spectroscopy. CHX started being released from the clay after approximately 8 h of contact with water. Equilibrium was reached after 48 h. In the evaluated condition, maximum CHX release was 27.5%. New experiments varying conditions such as temperature, contact time, clay mass, and pH will be conducted to verify the best condition for CHX release from the clay matrix.

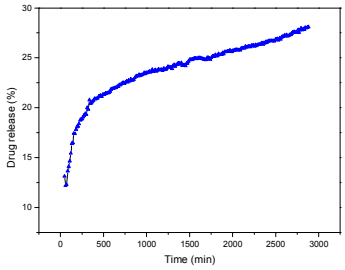

Figure 1: CHX release from commercial bentonite in function of contact time (without stirring).

Conclusion

A high amount of CHX was incorporated into commercial. XRPD revealed the bentonite basal spacing changed after CHX incorporation into the clay, which indicated the presence of CHX in the basal spacing of the solid. Drug release experiments revealed that 27.5 % CHX was released within 48 h.

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