Interaction of micro-encapsulating agents for immobilization of active agents in a matrix of Polyvinyl Alcohol hydrogel

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In recent decades, the controlled release of active ingredients using agents for micro-encapsulation has advanced enormously[1]. There is a constant search for natural or synthetic materials which can be used for this purpose. Hydrogels of polyvinyl alcohol (PVA) are widely used in this application as matrix because they are polymers with excellent mechanical properties, biocompatible biodegradable and low cost[2]. As an industrial practice, the active agent with or without encapsulation should be mixed and stabilized in the primary water solution (gel) prior crosslinking. However, hydrogels are usually chemically crosslinked structures. This reaction is usually carried out by means of radiation treatment (ionizing or UV) or by extremely toxic chemical agents as dialdehydes. These crosslinking processes can easily destroy the active agent and promote an unacceptable toxicity for the product.

A physically crosslinked matrix of PVA can be prepared by using thermal cycles to induce the crystallization of PVA molecules, which contributes to the direct immobilization of active ingredients sensitive to other processes of crosslinking[3,4]. However, because it is a hydrophilic polymer, is necessary using an encapsulating hydrophobic agent that allows the immobilization of hydrphobic active ingredients without preventing the release of these through the device.

This work aimed to investigate the interaction of five different encapsulating agents with a matrix of PVA and their cytotoxicity.

To develop the work we used PVA Celvol™ 325 Mw = 85,000, degree of hydrolysis 98.4%, starch from tapioca, carboxymethylcellulose (CMC), Aerosil™ R805 and R 972 and Kollidon™.

The PVA solution was prepared at 10%, in an autoclave, and crosslinked by thermal cycling at two different times, 2 and 12 hours and 1-7 cycles of freezing and thawing.

Studies of the physico-chemical properties were performed by testing gel fraction and swelling and biological characterization by the cytotoxicity test *in vitro*.

According to the results, the crosslinked PVA matrix in cycles of 2 hours and 12 hours showed improved mechanical properties at each cycle but they were considered satisfactory from the 6th and 2nd cycle respectively.

The encapsulating agents were starch, CMC, Aerosil™ R805 and R972 shown to be compatible with the PVA, by promoting insignificant changes in the physical crosslinking, keeping the same quantities of freezing and thawing cycles when compared with PVA.

Cytotoxicity tests were performed with PVA and PVA + starch, that shown not cytotoxic effect. The others ones are still test stage.

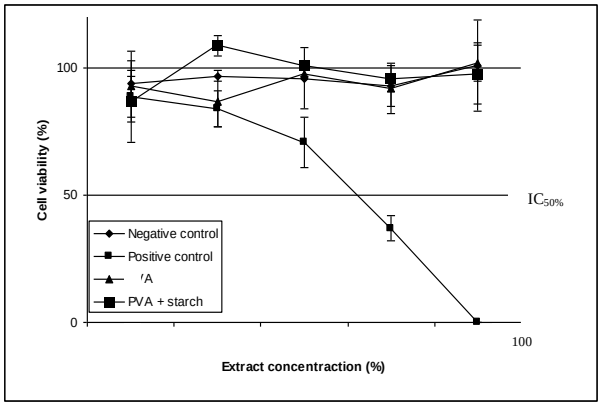

Figure 1. *Viability curves of PVA with and without starch in the cytotoxicity assay.*

In the cytotoxicity assay (Fig.1) PVA and PVA with starch showed the same behavior as negative control, no cytotoxic effect.

The results showed that hydrogels of PVA crosslinked be freeze and thawing cycles have adequated properties to be used as a matrix for controlled release systems and this hydrogel is non-cytotoxity, therefore it can be used safely as controlled release matrix by using encapsulating agents for immobilization of active agents.

References

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