Release of Bovine Serum Albumin (BSA) from alginate-Ca^{2+}/PNIPAAm hydrogels.

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Statement of Purpose:

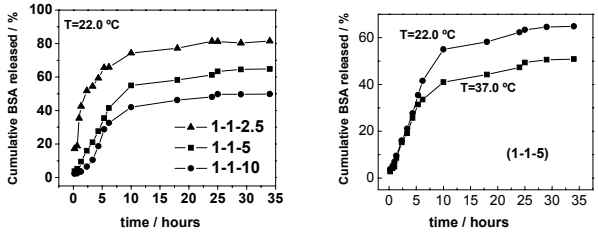
Aqueous PNIPAAm presents LCST (Lower Critical Solution Temperature) and PNIPAAm-based hydrogels contracts significantly just by warming above 32-35º C [1]. Due to this, hydrogel of PNIPAAm and its co-polymers have been applied in pharmaceutical field as device for controlled delivery of drugs [2]. The loaded drug, uniformly distributed in the matrix, may leave the hydrogel during the contraction. One serious requirement to be applied as biomaterial is that the hydrogel would be biocompatible. So, as the PNIPAAm is non-toxic, but its hydrogels are mechanically poor, others natural or synthetic polymers have been combined to overcome this constraint. Alginate is a polysaccharide extracted from the algae *Phaeophyceae* and presents excellent biocompatibility, hydrophilicity porosity and biodegradability. These properties allow the alginate to be one of more and wide applied biopolymer in biomedical field, mainly as releasing of drugs [3]. Combining alginate and PNIPAAm, thermo-sensitive hydrogels with good mechanical properties can be obtained [4]. In our lab several hydrogels of alginate-PNIPAAm have been synthesized [4]. The aim of this contribution is to investigate the releasing of Bovine Serum Albumin (BSA) from alginate-Ca^{2+}/PNIPAAm IPN hydrogels.

Methods:

Requested amounts of alginate-Na^{+} (SA), NIPAAm, MBAAm (as cross-linker), TEMED (as accelerator) were dissolved in water and N_2 was bubbled for 15 min. After, 1 mL of deoxygenated aqueous sodium persulfate (20 mg L^{-1}, as initiator) was added. The solution was quickly inserted between two square glass-plaques of 0.12 m in size separated with a rubber gasket spacer of 1.5 mm thickness. This system was kept at room temperature for 24 h. Next, the top plaque was carefully removed and the plaque supporting the hydrogel was immersed into a $CaCl_2$ aqueous solution (1 wt-% in conc.) for 48 h. After the hydrogel was soaked in distilled water for one week being the supernatant renewed every day. After the hydrogels were dried at low pressure. The hydrogels were loaded with BSA. For this, the dried hydrogels were soaked in a 0.19 % (m/v) BSA in buffer tris(hidroxymethyl)amino metane (Tris-Cl, 0.1M, pH = 7.4) aqueous solution for two days at 22º C. After, the hydrogels were removed and the amount of BSA loaded in each sample was calculated from the difference on initial and final BSA conc. in the supernatant. The conc. was determined from UV-Vis measurements. The different formulations were labeled as (A–C–P), where A, C, and P indicate the concentrations, in wt:v-%, of SA, $CaCl_2$, and NIPAAm, respectively.

Results/Discussion

The profiles of BSA delivered from different PNIPAAm/alginate-Ca^{+2} hydrogels at 22º C are shown in Figure 1.A. It can be noticed that as lower the NIPAAm content in the feed solution in which the hydrogel was synthesized higher is the initial rate of BSA delivery (given by the slope) as well as the final amount of BSA delivered. For a fixed amount of PNIPAAm (Figure 1.B) the initial rate of BSA delivery is not influenced by the temperature (22 or 37 ºC) but the intermediate rate as well as the final amount of BSA released at 37º C decreased when compared to 22º C. This shows that the contraction of matrix, that depends on the PNIPAAm content, influences the release of BSA but the hydrophobic-hydrophilic character, that is changed by the temperature, is also important in the BSA releasing from the alginate-Ca^{2+}/PNIPAA IPN hydrogels.



A **B**

Figure 1 – Profiles of BSA delivered: (A) from different PNIPAAm/alginate-Ca^{+2} hydrogels at 22º C; (B) for a fixed amount of PNIPAAm in the hydrogel at 22º C and 37º C.

Conclusions

The delivery profile of BSA from alginate-Ca^{2+}/PNIPAAm IPN hydrogels depends on the PNIPAAm content in the hydrogel and also of the hydrophobicity, that can be tailored by the temperature changes.

References

[1] Schild HG, Progr, Polym. Sci., 1992; 17:163-249.

[2] Hoffman AS, Afrassiabi A, Dong LC, J. Contr. Release, 1986; 4: 213-222.

[3] Draget KI, Skjåk-Braek G, Smidsrød O, *Int. J. Biol. Macromol.,* 1997;21:47-55.

[4] de Moura M, Guilherme R, Campese GM, Radovanovic E, Rubira AF, Muniz EC, *Eur. Polym. J.*, 2005;41:2845-2852.

Acknowledgements: CPNq (Proc. 479539/2004-9), CAPES and Fund. Araucária, Paraná (Proc. 5739, Conv. 114/04).