Degradation behaviour of starch/EVOH thermoplastic blends in a simulated physiological solution with enzymatic activity

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Introduction

Blends of native corn-starch (constituted from amylose and amylopectin) with ethylene vinyl alcohol (EVOH) are potential alternatives to the biodegradable polymers currently used in clinical applications[1]. These bioabsorbable polymers may be useful, for temporary hard and soft tissue replacements. The present work is an attempt to study the degradation behaviour of such type of biomaterials in a simulated physiological solution, including the evaluation of the respective degradation products. In fact, it is of major importance to assess if the released products are biocompatible and non toxic. Furthermore, it is also necessary to identify eventual reactions or interactions with human fluids or the surrounding tissues that may interfere with the healing process. In this communication, it is reported the effect of enzymes on the materials degradation behaviour.

Materials and Methods

The material selected was a blend of corn starch with poly(ethylene-vinyl alcohol) copolymer (60/40 mol/mol), SEVA-C. The SEVA-C samples were immersed for several pre-fixed ageing periods until 90 days in a sterile balanced salt solution(HBSS) with α-amylase from human saliva (50 unit./l). The evaluation of the materials leached to the solution were studied under strictly controlled conditions at 37ºC and pH = 7.4. The starch, polysaccharides and glucose amount were determined by colorimetric methods. The effect of the solution on the surface morphology and roughness of the SEVA-C specimens, as a function of immersion time, was followed by scanning electron microscopy (SEM) and atomic force microscopy (AFM).

Results

The results for starch and glucose amount are presented in Figures 1 and 2. They evidence a great increase in the respective degradation rates, comparison with previous studies performed with the same material immersed in an isotonic solution (NaCl 9g/l) without enzymatic activity. They also reveal that almost the total mass of starch released to the solution was converted into glucose, since the amount of glucose released increase since the beginning of the immersion period.

Keywords: biomaterials, *in vitro* degradation, enzyme(s),

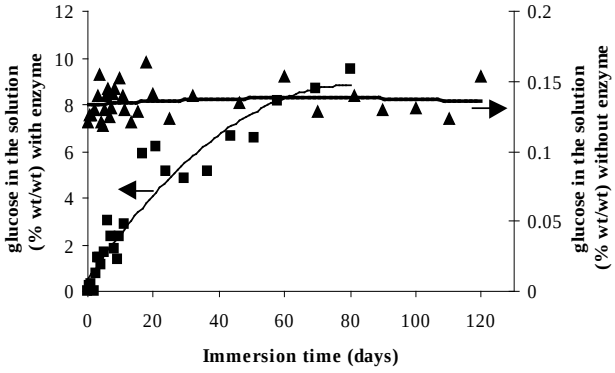

Figure 1 – Mass of glucose in the solution per initial specimen mass (in %), as function of the immersion time. The amount of solution is 50 ml and specimen mass 1.61 g.

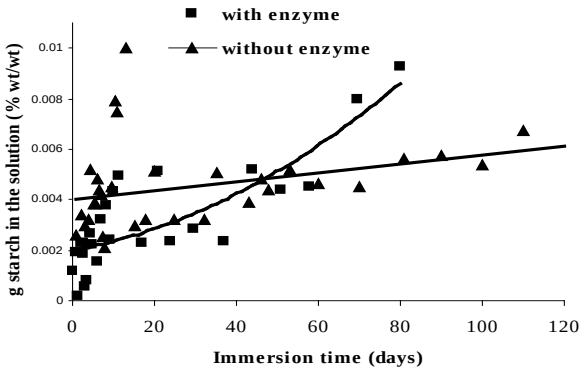

Figure 2 – Mass of starch in the solution per initial specimen mass (in %) as function of the immersion time. The amount of solution is 50 ml and specimen mass 1.61 g.

The mass of glucose in the degraded solution increased almost 2-fold, as compared with the same assays without enzymatic activity. The performed studies also showed that the degradation behaviour might be affected by porosity, among other factors.

Conclusions

The work confirmed the significant effect of α-amylase on the degradation rate of the SEVA-C blend and evidenced that almost all the starch released to the solution was converted into glucose.

References

1. Reis, R. L. et al .(1995) J. Mat. Sci.: Mater. In Medicine, **6,** 786.