LEVAN AND LEVAN/PULLULAN BLEND FILMS: AFM AND FTIR SPECTROSCOPY CHARACTERIZATION

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Introduction & objectives

Food packaging is an important discipline in the area of food technology and concerns a preservation and protection of all types of food; however, an increased use of synthetic packaging films has led to the serious ecological problem due to their lack of biodegradability [1]. Polysaccharides are known for their structural complexity and functional diversity and their films are known to be an effective barrier to the gas transference although these materials are generally very hydrophilic [2].

Microbial levan has been considered as a biopolymer in food industry due to its biocompatibility, renewability, high molecular weight, low viscous nature, antioxidant and prebiotic effects [3]. Pullulan was firstly considered a food additive in food packaging, and then began to be massively used as an edible coating. These coatings were successfully used to extend the shelf life of fresh fruits.[4]

The aim of this work was to obtain the levan and levan/pullulan blend films and compare them by Atomic force microscopy (AFM) and Fourier transform infrared spectroscopy (FTIR).

Materials & methods

The levan used in this work was produced by *the B. licheniformis* NS032 strain [5] and pullulan was commercial Hayashibara Inc. (Okayama, Japan). Two different film compositions were prepared: levan and levan/pullulan in the proportions 1:1. Films were firstly prepared by making the 15 % polysaccharide(s) suspension in distilled water and then adding the 25 % glycerol as emulsifier (m/m). They were stirred for 15 min, casted onto 50 mm diameter Teflon plates and evaporated at room temperature.

Morphology of the samples was studied by atomic force microscopy with AutoProbe CP-Research SPM (TM Microscopes-Bruker) using 90 μm large area scanner. AFM images were taken and later analyzed using the software Image Processing and Data Analysis Version 2.1.15 and SPMLab Analysis, DI SPMLab NT Ver. 6.0.2. FTIR spectra of levan and levan/pullulan blend films were recorded using a Thermo Nicolet 6700 Spectrophotometer in ATR mode.

References:
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Results & discussions

Figure 1 represents the AFM three-dimensional images of the 25 μm surface area of the studied films. They show a smoother surface of levan (1a) film compared to the levan/pullulan blend (1b) films.

Figure 2a shows FTIR spectra of levan film with characteristic peaks for levan type polysaccharides. The peaks at around 3300 cm−1, 2940 cm−1 and 1648 cm−1 came from the OH stretching vibrations, C-H stretching vibrations and bound water, respectively. Several sharp peaks dominated at around 1000 cm-1 due to the C-O-C stretching vibrations, and the presence of furanoid rings was confirmed by peaks at 928 cm−1 and 812 cm−1 [6,7]. Comparing to the NIST database, the peaks at 865 cm−1 and 674 cm−1 came from the glycerol.

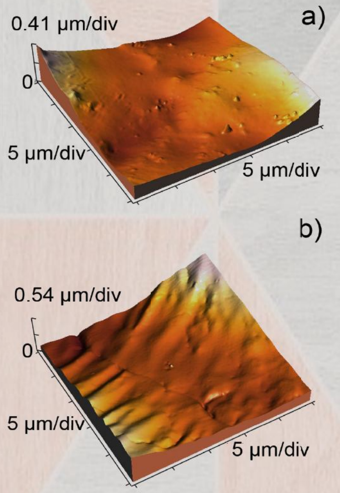

Figure 1. AFM three-dimensional images (surface 25 μm) of (a) levan and (b) levan/pululan blend films.

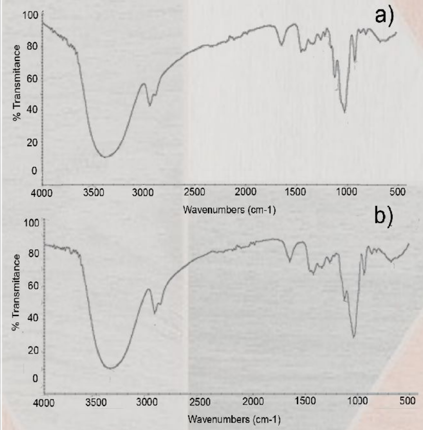

Figure 2. FTIR spectra of (a) levan and (b) levan/pullulan blend films.

FTIR spectrum of levan/pullulan blend film is shown in Figure 2b. The spectrum shows peaks that correlate with a previous spectrum of levan film, which is expected, since it is a mixture of two polysaccharides. A slightly more intense peak at 855 cm^{-1} is characteristic for the α-D-glycosidic linkages present in the pullulan [8].

Conclusions

FTIR spectra showed peaks, which corresponded to all components of the obtained films while AFM measurements demonstrated that levan film had a smoother surface and lower roughness comparing to the levan/pullulan blend films. Obtained films are composed of biodegradable components and therefore are potentially applicable in food industry.

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