



PHYSICAL CHEMISTRY 2018

*6<sup>th</sup> Workshop*

## SPECIFIC METHODS FOR FOOD SAFETY AND QUALITY

*September 27<sup>th</sup> 2018, Vinča Institute of Nuclear Sciences, Belgrade, Serbia*

**PROCEEDINGS**

**6<sup>th</sup> WORKSHOP: SPECIFIC METHODS FOR FOOD SAFETY AND  
QUALITY**

**September 27<sup>th</sup>, 2018, Belgrade, Serbia**

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and Applied Aspects of Physical Chemistry*

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and

**FACULTY OF PHYSICAL CHEMISTRY**  
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## CRUDE EXTRACTS OF CINNAMON AND OREGANO SPICES AS COMPONENTS OF PULLULAN BASED EDIBLE FILMS

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### ABSTRACT

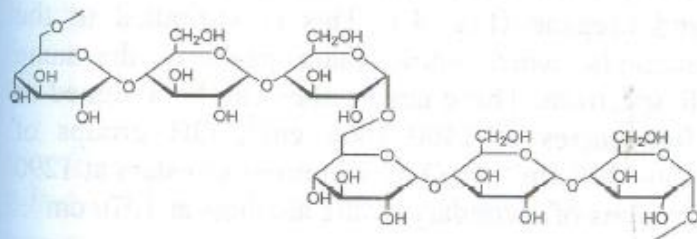
Pullulan based films were prepared with crude extracts of cinnamon and oregano spices. Obtained films were characterized by FTIR-ATR spectroscopy and their antioxidant and antimicrobial properties were evaluated. These biopolymer based films have potential use in food applications as food ingredients and active packaging material.

### INTRODUCTION

Development and utilization of bioactive natural edible films and coatings is environmentally friendly and a good alternative to synthetic polymer films. Some microbial polysaccharides, as natural food materials with favorable physicochemical characteristics in preparing films, have a great use [1]. One of them, pullulan, has a commercial use for over 20 years as a low-calorie food ingredient and coating for food applications, because it is flavorless, soluble in water, and has good oxygen barrier properties [2]. Pullulan is essentially a linear  $\alpha$ -D-glucan composed of maltotriose repeating units mutually linked by  $\alpha$ -(1,6)-glycosidic bonds (Fig. 1.).

Spices have numerous benefits in prevention of human health issues and also in the treatment of many diseases [3]. Effect of spice on food preservation and safety is also well-known [3]. Many biologically active compounds isolated from spices showed antioxidant properties and antimicrobial activity against some bacteria, yeasts and molds that affect the food quality and shelf life [3]. Therefore, the extracts of different spices were used to improve some properties of different biopolymer based films

in order to find promising natural biodegradable materials for use in food technology [4].



**Figure 1.** Structure of pullulan.

This paper reports the preparation of pullulan based films containing separately two crude extracts of spices, cinnamon (*Cinnamomum verum*) and oregano (*Origanum heracleoticum*) as an active natural additives, with a goal to obtain potentially applicable edible films as a new food supplements or edible coatings in packaging system with a dual purpose as an edible and antimicrobial components.

## EXPERIMENTAL

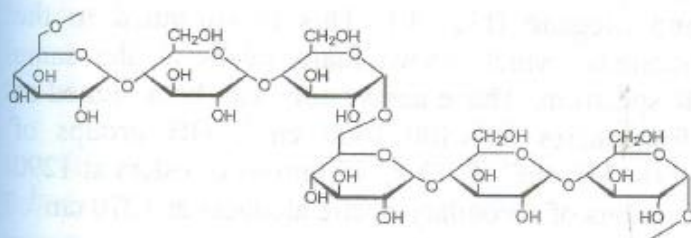
Pullulan used in this work was produced by the *A. pullulans*, strain CH-1 (ICHTM, Collection of Microorganisms) [5,6]. Spices *C. verum* and *O. heracleoticum* were purchased from the local market. All other reagents and solvents were purchased from commercial sources and used as supplied.

Pullulan powder (2.1 g) was dissolved into distilled water (30 mL) by continuous stirring. Film-forming solutions were prepared with and without addition of two different spices, cinnamon and oregano. Their crude extracts were prepared separately, by extraction of each spice (1.5 g) in following solvent system: water-ethanol-acetone (1:1:1) (30 mL) with stirring and heating (70°C, 90 min). After centrifugation (3000 rpm, 10 min), each supernatant separately was mixed with water solution of pullulan in a ratio of 1:1 (vol/vol), and poured (per 5 mL) into plastic Petri dishes. The solutions were dried at 50°C for 18 h, which resulted in thin films. Characterization of prepared films was performed using FTIR-ATR spectroscopy. Antioxidant and antimicrobial activity were also evaluated [7].

## RESULTS AND DISCUSSION

The FTIR-ATR spectra of the films containing crude extracts show some significant changes in the peak intensity in the range of 850–1600  $\text{cm}^{-1}$  compared to intact pullulan. Crude extracts of cinnamon and oregano have similar FTIR profiles due to their polyphenolic compounds, which are often found in glycosidic form [3]. FTIR spectrum of pullulan (Fig. 2.) shows the typical spectral pattern characteristic for neutral carbohydrates [8]. However, the intensity of the absorption peaks at 1600, 1412, 1280, and

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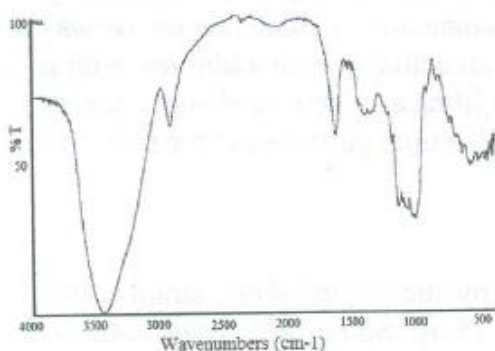
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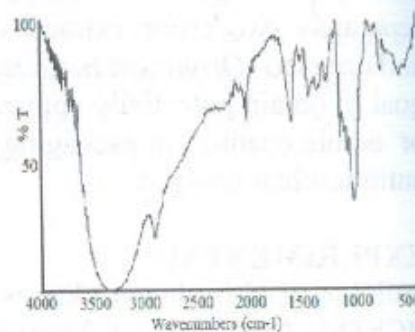
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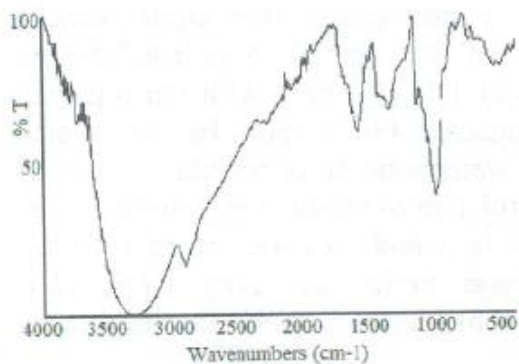
1020  $\text{cm}^{-1}$  in the spectrum of pullulan raises after adding the crude extracts of cinnamon (Fig. 3.) and oregano (Fig. 4.). This is attributed to the presence of extract compounds, which show sharp peaks at the same wavenumbers in the FTIR spectrum. These absorptions can be assigned as follows: aromatic ring frequencies at 1400–1600  $\text{cm}^{-1}$ , OH groups of phenolic compounds at 1400–1310  $\text{cm}^{-1}$ , C–O–C vibrations of esters at 1290  $\text{cm}^{-1}$ , C–OH stretching vibrations of secondary cyclic alcohols at 1070  $\text{cm}^{-1}$ .



**Figure 2.** FTIR spectrum of pullulan.



**Figure 3.** FTIR spectrum of pullulan-cinnamon film.



**Figure 4.** FTIR spectrum of pullulan oregano film.

Antioxidant capacity of prepared films was evaluated *in vitro* using DPPH free radical-scavenging mechanism. With regard to scavenging ability on DPPH radicals, the samples of film pullulan-cinnamon and pullulan-oregano showed scavenging ability as evidenced by their  $\text{EC}_{50}$  values, which were 0.24 and 0.29  $\text{mg/mL}$ , respectively. Films of native pullulan did not show any anti-oxidant activity.

Antibacterial activity of the formed films was determined by test against *Staphylococcus aureus* ATCC 25923. It was determined that both films had an inhibitory effect on bacterial growth, while film of pure pullulan did not show antimicrobial activity.

## CONCLUSION

Pullulan based films containing crude extracts of cinnamon and oregano spices were characterized by FTIR-ATR spectroscopic data. Prepared samples showed antioxidant and antimicrobial activities, which qualify these films as promising candidates with a dual purpose as edible and antimicrobial components for their application in food technology.

## Acknowledgement

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