CHITOSAN FILMS WITH INCORPORATED CHITOSAN AND ROSMARINIC ACID COMPLEXES

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There has been a growing interest in recent years to develop biodegradable, edible packaging films from biopolymers to improve food safety and shelf life. Chitosan (CH) is a biodegradable, non-toxic, biocompatible, inexpensive natural polymer that has a good film-forming ability but weak antioxidant ant antimicrobial properties. Incorporation of antioxidant and/or antimicrobial agents into CH films is a good way to improve physical and biological properties of CH films [1]. Phenolic compounds can be selected as additives for CH films because of their abundancy in the plant kingdom, antioxidant, antimicrobial, anti-inflammatory properties [2].

The aim of present study was to incorporate insoluble rosmarinic acid (RA) and CH complexes having different RA to CH molar ratio (further referred as CR) into CH films, and to investigate their mechanical and chemical properties.

CR powders with the molar ratio of RA to CH equal to 0.22. 0.39, 0.6 and 0.88 were obtained by using multistep adsorption process [3]. 1 % CH solution was prepared in 1 % acetic acid, and 20 % (v/w) of glycerol was added as a plasticizer. Then 5 % (w/w) of CR powders was added into CH solution, after homogenization mixture was poured into Petri dishes, and kept at 25 ^{o}C for 48 h. Finally, films were collected form Petri dishes and stored for further analysis.

Mechanical properties of CH and CH/CR films were evaluated according to ASTM D882 by using Universal testing machine BDO-FBO.5TH (Zwick GmbH, Germany), and are shown in Table. As it could be seen from the presented data, the values of tensile strength, elongation at break and the Young's module depended on the molar ratio of CR added into the film forming solution. CH films with CR having RA to CH molar ratio of 0.22 had the highest value of tensile strength and the Young's module.

Solubility and moisture sorption of films was also evaluated, and obtained data is presented in Table. Both CH and CH/CR films were soluble in water. Moisture sorption of films also depended on the CR molar ratio, and rapidly decreased with the increased amount of RA in complex added to CH films. This could be explained by increased hydrophobicity of CR powders with higher amount of adsorbed RA [3].

Table. Mechanical properties, water solubility, moisture sorption of CH and CH/CR films

Film	Tensile strength (MPa)	Elongation at break (%)	Young's modulus (MPa)	Water solubility* (%)	Moisture sorption** (%)
CH	45.6 ± 5.3	19.0 ± 5.8	1327 ± 127	97.4 ± 0.2	44.7 ± 0.4
CH/CR(0.22)	54.4 ± 2.1	13.1 ± 3.2	2037 ± 96	97.7 ± 0.2	40.1 ± 1.5
CH/CR(0.39)	47.2 ± 4.9	23.7 ± 2.4	1585 ± 79	97.4 ± 0.2	32.5 ± 2.1
CH/CR(0.6)	44.9 ± 2.8	15.2 ± 2.1	1609 ± 273	97.3 ± 0.2	29.7 ± 1.0
CH/CR(0.88)	45.3 ± 3.9	15.4 ± 5.9	1724 ± 181	96.9 ± 0.2	27.7 ± 0.5

* After 24 h
** After 24 h in desiccator with RH = 95 %.

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[1] G. Kerch, Chitosan films and coatings prevent losses of fresh fruit nutritional quality: A review, Trends in Food Science & Technology 46, 159-166 (2015).
[2] F. Shahidi, P. Ambigaipalan, Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review, Journal of Functional Foods 18, 820-897 (2015).
[3] D. Liudvinaviciute, K. Almonaityte, R. Rutkaite, J. Bendoraitiene, R. Klimaviciute, Adsorption of rosmarinic acid from aqueous solution on chitosan powder, International Journal of Biological Macromolecules 118, 1013–1020 (2018).