## Simultaneous encapsulation of biological and chemical agents for plant protection/nutrition

M. Vinceković<sup>1\*</sup>, S. Topolovec-Pintarić<sup>2</sup>, E. Đermić<sup>2</sup>, S. Jurić<sup>1</sup>, N. Jalšenjak<sup>1</sup>, M. Bujan<sup>1</sup>, S. Fabek<sup>3</sup>,

I.Žutić<sup>3</sup>

Department of Chemistry<sup>1</sup>, Department of Plant Pathology<sup>2</sup>, Department of Vegetable Crops<sup>3</sup> University of Zagreb Faculty of Agriculture

## mvincekovic@agr.hr

Novel chitosan/alginate microcapsules simultaneously loaded with copper and Trichoderma viride have been prepared and characterized. FTIR spectroscopy was used in order to obtain information about encapsulated bioactive agents and biopolymers interactions. Copper concentration and microcapsule size were considered as variables with possible influence on essential microcapsule parameters (loading capacity and efficiency, swelling behavior and releasing of active agents). All measured parameters depended on both, the kind of encapsulated agents and microcapsule size. The increase in copper concentration promoted swelling, but there existed obvious differences with regard to loaded agents and microcapsule size. Higher swelling extent and greater amount of released copper of microcapsules loaded only with copper than those simultaneously loaded with copper and TV were attributed to the differences in chitosan layer thickness. The in vitro copper release profile was fitted to Korsmeyer-Peppas empirical model. Fickian diffusion was found to be ratecontrolling mechanism at smaller microcapsules, whereas release from larger microcapsules was controlled anomalous transport kinetics (combination of the diffusion mechanisms and Type II transport). While the copper release exhibited initial burst followed by a slower release, Trichoderma viride releasing profile increased exponentially after initial lag time. Much slower release at the early stage may be ascribed to the higher size of Trichoderma viride spores in comparison with copper ions. In the light of importance of Trichoderma viride as a biocontrol agent simultaneous encapsulation of copper and Trichoderma viride will give wider opportunity in the plant nutrition and protection.

Keywords: micrencapsulation, biopolymers, bioactive agents (copper, Trichoderma viride)