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Abstract

The Use of Fluorescent Optical Respirometry to Study the Antimicrobial Activity of Plant Products and Evaluation of the Pharmaceutical Preparations †

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Abstract: The determination of the number of microorganisms is crucial in the biotechnology, pharmacy, and food industries. Monitoring the quality of pharmaceuticals and food products requires rapid, sensitive, and selective methods to detect minute numbers of viable bacterial cells. Isolation of the natural compounds presented in foods with antibacterial properties requires the testing of many samples and detection of many bacteria in a short period of time. Counting bacteria on the agar plates, membrane filters, and using the "most probable number" are basic methods used to determine the number of live bacteria. These methods require a long incubation time, colonies may be formed by several related species of bacteria, and full identification takes up to seven days. The serial dilution method in broth is used in clinical microbiology and allows for the determination of the minimum inhibitory concentration. However, the length of the assay time and the impact of the physical properties of the sample affect the results. We used the fluorescence oxygen-sensitive sensor ruthenium-tris(4,7-diphenyl-1,10-phenanthroline) dichloride ($Ru(DPP)_3Cl_2$), the fluorescence of which depends on the amount of oxygen in the tested sample. This sensor was applied in the fluorescent optical respirometry (FOR) method. Molecular oxygen is a fluorescence quencher. Growing microorganisms consume oxygen, thus affecting fluorescence intensity in the sample. The FOR method was performed to evaluate the effect of chemical and environmental factors and plant extracts on aerobic bacteria. The FOR method allows the detection of bacteria in sterile and non-sterile pharmaceutical products. This method allows also for a rapid, unequivocal detection and counting of live bacterial cells.

Keywords: ruthenium-tris(4,7-diphenyl-1,10-phenanthroline) dichloride ($Ru(DPP)_3Cl_2$); oxygen sensor; fluorescence optical respirometry; broth microdilution method; plant extracts; pharmaceutical products; antibacterial properties

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