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РОЗРОБКА НАНОКОМПОЗИТНОГО АМПЕРОМЕТРИЧНОГО БІОСЕНСОРА ДЛЯ КОНТРОЛЯ ЯКОСТІ ВИНА НА ОСНОВІ ВИЗНАЧЕННЯ ЛАКТАТУ.

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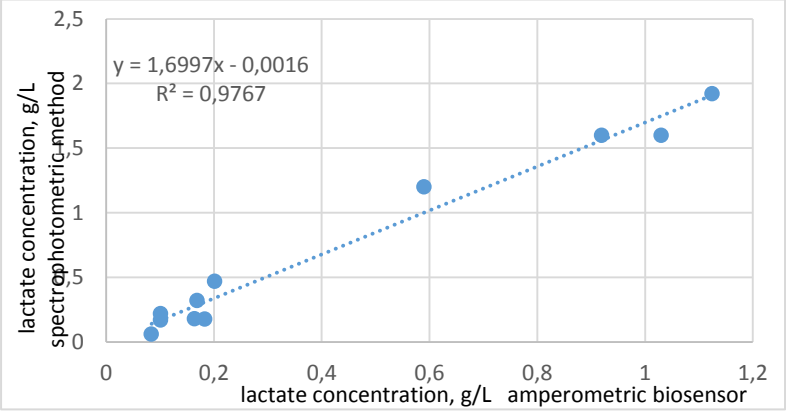
DEVELOPMENT OF NANOCOMPOSITE AMPEROMETRIC BIOSENSOR FOR THE CONTROL OF WINE QUALITY BASED ON LACTATE DETERMINATION.

Lactate is the key metabolite of the anaerobic glycolytic pathway. Lactate concentration in blood is an excellent indirect marker of anaerobic glucose breakdown, and so, cellular fatigue. An elevated blood lactate concentration can indicate multiple organ failure or septic shock and can be used as a sensitive indicator of survival during surgical operations or intensive care therapy. Development of reliable methods of lactate determination is of great importance in clinical analysis because the concentration of lactate in blood is a fundamental parameter for the prevention and diagnosis of a number of pathological disorders such as hypoxia, some acute heart diseases and drug toxicity and also the level of lactate indicates liver and renal failure or diabetes mellitus. Determination of lactate is also essential in clinical analysis for the diagnosis of lactate acidosis as a result of metabolic, respiratory, or haemodynamic disturbance. In sport medicine the level of lactate reveals the maximum performance of an athlete in intensive and endurance-based activities.

Nanomaterials are suitable for acting as “electronic wires’’ to shorten the electron transfer distance, enhance the electron transfer between redox centers of the enzyme and the electrode surface and simultaneously retain the biological activity of the redox enzymes. Different materials in nanometric scale have been used for the construction of sensors and biosensors including metal and carbon nanoparticles (e.g. nanotubes, graphene, nanowires).



Graf. 1. Lactate concentration measured in wine samples by developed biosensor and by spectrophotometric method

Some of them have shown great advantages over conventional materials for H_2O_2 detection such as ZnO nanorod arrays, MnO_2-modified vertically aligned multiwalled carbon nanotubes, nitrogen-doped carbon nanotubes orplatinum nanoparticles.

The aim of the work was to develop an amperometric sensor based on lactate oxidase, carbon electrodes were modified with Pt-Pd nanoparticles and Nafion, for the lactate analysis in wine. The carbon screen printed planar electrodes 1mm in diameter (“BVT Technologies”, Czech Republic) were used.

The optimized biosensor has shown the following characteristics: the linear range for lactate determination - 0,05ч1,5 мМ, sensitivity of of 6 $nA \cdot M^{-1}$ cm^{-2} and detection limit of 0,1 μM. The response of developed biosensor is resistant to influence of potential interferents. The correlation coefficient of data obtained using the biosensor and spectrophotometric method is 0,976 Graf. 1. The value of biosensor response on the 28^{th} day of storage at the temperature of 4єС was 35% of initial value. The developed sensor can be used in wine production for the selective detection of lactate in raw material during fermentation and control of the final quality of wine, as well as in food industry.