МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ’Я УКРАЇНИ
БУКОВИНСЬКИЙ ДЕРЖАВНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ

М А Т Е Р І А Л И

106-ї підсумкової науково-практичної конференції
з міжнародною участю
професорсько-викладацького колективу
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Матеріали підсумкової 106-ї науково-практичної конференції з міжнародною участю професорсько-викладацького колективу Буковинського державного медичного університету (м. Чернівці, 03, 05, 10 лютого 2025 р.) – Чернівці: Медуніверситет, 2025. – 450 с. іл.

У збірнику представлені матеріали 106-ї науково-практичної конференції з міжнародною участю професорсько-викладацького колективу Буковинського державного медичного університету (м. Чернівці, 03, 05, 10 лютого 2025 р.) зі стилістикою та орфографією у авторській редакції. Публікації присвячені актуальним проблемам фундаментальної, теоретичної та клінічної медицини.

Загальна редакція: професор Геруш І.В., професорка Годованець О.І., професор Безрук В.В.

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2) Detection of C-reactive protein (CRP) based on fluorescence changes by CdSe/ZnS QDs, where QDs surfaces were modified with monoclonal antibodies. The fluorescence intensity has increased with the increasing of antigens concentration.

3) A novel QD-based method is developed to detect the presence of the DNA, damage to DNA, and mutation. The results obtained from the optical analyses indicated that the interactions of the CdTe/ZnSe core/shell quantum dots (QD) with different nucleobases were different, which reflected in different fluorescent emission maxima and intensities. The QDs were successfully applied to detect any change in the sequence (mutation) of DNA. The QDs also showed their ability to detect DNAs directly from the extracts of human cancer (PC3) and normal (PNT1A) cells, which indicates the possibilities to use this easy assay technique to confirm the presence of living organisms in extreme environments.

4) Wang et al. presented a platform to investigate the interaction among QDs, resveratrol, and HSA. The QDs fluorescence was quenched significantly by resveratrol, and then the QDs fluorescence was gradually restored by the addition of HSA. Therefore, a facile reversible fluorescent "turn-off-on" sensor can be developed for HSA detection. The successful application of the proposed method for HSA determination demonstrated that this method is accurate, rapid and sensitive enough for determining HSA at low ppb levels, and can be extended to the detection of many other proteins.

Conclusions. Quantum dots-based sensors have significant prospects in the detection of proteins by change in fluorescence intensity.

Gutsul O.V.

DETECTION OF BACTERIA BY ELECTRICAL IMPEDANCE SPECTROSCOPY

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Introduction. The detection of bacteria is crucial in various fields, including healthcare, food safety and environmental monitoring. Rapid and accurate identification of bacterial pathogens, such as *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*) is essential for public health and safety. Traditional bacterial detection methods often involve time-consuming sample preparation steps and complex analyses. Over the past decade, advancements in bacterial monitoring have led to the development of innovative, label-free methods that allow real-time bacterial detection. Electrical impedance spectroscopy (EIS) has emerged as a valuable technique for studying biological samples in suspension, as it characterizes the properties of these samples by measuring changes in electrical impedance. EIS leverages the electrical properties of bacterial cells to detect and characterize them based on impedance changes.

The aim of the study. In this research, we propose a method for the direct detection of *E. coli* and *S. aureus* on interdigitated electrode (IDE) sensors using immobilization-free impedance spectroscopy.

Materials and methods. Gram-negative *E. coli* and gram-positive *S. aureus* were reconstituted using Mueller-Hinton broth (MHB) and incubated overnight at 37°C (150 rpm). After culturing, the bacterial suspensions were centrifuged (13000 rpm for 10 minutes) to isolate the cells, which were subsequently washed twice with deionized water (DH_2O) and diluted to desired concentrations (10^3, 10^6, and 10^9 CFU/ml) using sterile deionized water (σ = 0.1 μS/cm). EIS measurements with Au/Pt IDE sensors were conducted using an IM 3536 LCR meter (Hioki) in the frequency range of 4 Hz to 8 MHz. Samples were placed in a Faraday cage, and the electrodes were clamped and connected to the LCR meter. Experimental Nyquist plots ($-Z_{im}$ versus Z_{rel}) were constructed to analyze electron transport processes at the Pt-IDE sensor interface for *E. coli* and *S.aureus* cells.

Results of the research. EIS (4 Hz–8 MHz, 1 V amplitude) and Pt-IDE sensors were used to detect and monitor varying concentrations (10^3, 10^6, 10^9 CFU/ml) of live and dead *E. coli* and *S. aureus* cells prepared in DH_2O. Measurements were conducted at 24 ± 1ºC with a sample volume of 1 ml. Analysis of impedance spectra based on Nyquist and Bode plots revealed significant changes in resistance with increasing bacterial concentration for both species and characteristic changes within the 10–100 kHz frequency range. Time-dependent impedance differences were also observed. The semicircular shape of Nyquist plots at high frequencies indicated faradic electron transfer at the electrodes, while the low-frequency spectrum reflected diffusion processes of bacterial waste products to the electrode surface. The presence of live *E. coli* cells led to a decrease in impedance compared to dead cells, with $R_{s+}R_{ct}$values decreasing by approximately 50%.

Conclusions. The proposed method of selective detection of bacterial cells can be used to identify two types of bacteria *E. coli* and *S. aureus*, to qualitatively characterize the differences between dead and live cells and to estimate their concentration in samples with an unknown number of bacteria per unit volume.

Ivanchuk M.A.

MATHEMATICAL METHODS IN MEDICAL PREDICTION

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Introduction. Medical forecasting involves predicting the probability or course of a disease and its potential outcomes by understanding the patterns of pathological processes. This study explores various mathematical methods that can help build accurate prognostic models in medicine.

The aim of the study. The primary aim is to explore the use of mathematical methods in medical prediction.

Material and methods. The study involved analyzing research on mathematical methods for medical forecasting.

Results. Several mathematical methods are used in medical forecasting, each with unique strengths. Cluster analysis is an unsupervised learning method. Unlike supervised models, cluster analysis does not require predefined groupings. Instead, data is grouped into clusters based on inherent patterns (e.g., patients with or without a specific disease). Researchers can then analyze the characteristics of each cluster to understand why certain patients were grouped together and make conclusions based on these patterns.

Support vector machines are supervised models that classify data by identifying an optimal hyperplane to separate two data classes. Using known patient data, an SVM model is trained to classify new cases, making it suitable for tasks such as disease prediction.

A naive Bayesian classifier is a probabilistic classifier that uses Bayes' theorem to determine the probability that an observation belongs to one of the classes.That is, if, based on the values of the variables, it is possible to unambiguously determine to which class the observation belongs, the Bayesian classifier will report the probability of belonging to this class.

A Markov process is a stochastic process describing a sequence of possible events in which the probability of each event depends only on the state attained in the previous event.In medicine, Markov processes can be used to build epidemiological models and predict disease prevalence.

Conclusions. The above list of mathematical methods that can be used in medical forecasting is far from complete. The selection of the method for a specific task depends on the available medical data and the goal of the researcher.

Kulchynskyi V. V.

ADVANCED MATERIALS FOR FLEXIBLE WEARABLE SENSORS OF BODY AREA NETWORKS: PHYSICAL LIMITATIONS AND PROSPECTS

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Introduction. Personalized medicine and telemedicine involve the use of Body Area Networks (BANs) for real-time monitoring physiological parameters. The functionality of BANs is effective in case of using flexible wearable sensors. Designing of new advanced materials is the way to enhance the performance of these sensors.