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ELECTROCHEMICAL DETECTION OF ANTIBIOTICS IN RAW MILK ON LIQUID-METAL INTERFACE

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Results of research work about detection of antibiotics in raw milk with help of electrochemistry and machine learning methods are presented. It was shown that developed electrochemical method allow determinate antibacterial drugs due to redox peaks on I-V curves. Machine learning algorithm can classify samples into several groups. Addition of aptamers contribute good sensitivity and signal amplification.

Antibiotics – the drugs which applied for prevention, treatment of diseases, and for growth stimulant. Overusing of these substances can lead to the side effects: negative influence on organ's functions, antibiotics may accumulate genes of antibiotics' resistance and so on. Thereby, a problem of antibiotics' residual concentrations in animal products is actual. The control of these substances can be provided by several analyses: microbiological inhibition, chromatography/mass-spectrometry, and enzyme-linked immunosorbent assay (ELISA). Microbiological inhibition and enzyme-linked immunosorbent assay are distinguished by their low cost, chromatographic and spectrometry method, otherwise, are expensive, but they all have one thing in common - long analysis time.

Here proposed a universal method of antibiotics detection on a liquid electrode with application of machine learning, which can determine the type of antibacterial drug and its quantitative content. Four groups of samples were created: pure milk, antibiotic in milk, aptamer in milk, and antibiotic + aptamer complex in milk.

Detection of antibiotics was carried out on eutectic gallium indium liquid electrodes in a gel system. The gel system consists of buffered saline (NaCl, KCL, Na2HPO4, KH2PO4), agar-agar microbiological, and raw milk. Also, aptamer was added – it is a substance, which specifically connected with antibiotics and allow increase sensitivity of electrodes and peak size. A gel sample put on the electrodes and connect them; the measurements are taken using cyclic voltammetry. Collected current values loaded into one database, which was built in the Microsoft Excel. The database was processed by a special program for machine learning – Weka. Algorithms classify almost all samples into right groups. The results have shown that the proposed method is work. Peaks on voltammograms are clearly visible. Addition of the aptamer in the gel system increase sensitivity of electrodes, and redox peaks become more pronounce. Random Forest algorithm have shown the best percentage of learning.

In the future we are planning to develop an electronic tongue system for complex analyses of raw milk. Moreover, it is planned to improve architecture of applied algorithms for increasing a percentage of learning.

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