TITLE: ELECTRICAL BIOIMPEDANCE SCANNING (EBS) PROTOTYPE: STANDARDIZATION, PARAMETER ASSESSMENT AND BACTERIAL DETECTION IN COW MILK

AUTHORS: OLIVEIRA, W.C.; GELLER, A.M.; AYRES, L.C.; NEUENFELD, R.H.; CARVALHO, C.W.; PORTO, R.W.

INSTITUTION: UNIVERSIDADE ESTADUAL DO RIO GRANDE DO SUL, ENCANTADO. RS (RUA ALEGRETE, 821, SÃO JOSÉ, CEP 95960-000, ENCANTADO – RS, BRAZIL). INSTITUTO FEDERAL SUL-RIO-GRANDENSE, LAJEADO, RS (RUA JOÃO GOULART, 2150, OLARIAS, CEP 95910-016, LAJEADO – RS, BRAZIL).

ABSTRACT:
The EBS is a technique that is based on the selection of biological materials, being an application of chain excitation, being non-invasive, portable and easy to handle, good reproducibility, low costs and when automated has a high speed of data processing. Thus, EBS analyzes can be made an alternative to science and technology, such as in food analyzes. The objective was to develop and characterize a prototype of EBS and to determine the electrical conditions in milk to detect bacterial. In an ABS structure the multiplexed measuring channel was incorporated with the electrodes arranged in strip. The frequency of application of the electric current was varied between 10 Hz and 1 MHz. The impedance date was made through four electrodes: two for excitation with alternating current and two for the measurement of potential difference. Crude milk (autoclaved) and UHT-integral (I), semi-skimmed (SN) and skimmed (DN) - at different dilutions (12.5-100%) were with and without Staphylococcus aureus. The characters of a module decreasing from the impedance module reach a frequency of 10 kHz. At higher frequencies, the impedance modulus presents a more flat asymptotic behavior. The output of the response is a type of circuit test that represents a complex impedance of the milk sample. The impedance profile of the milk samples is maintained at a constant rate of change. There was a difference in impedance values between raw milk (110.2 Ω) and UHT (I=127.4 Ω; SN=123.8 Ω; DN=124.4 Ω); three types of UHT milk. The fat content did not influence the impedance variation. The aqueous influence on the impedance was only observed at concentrations below 50%, due to the minimum phase variation. The presence of S. aureus in the samples of UHT-integral milk was detected from the reduction in impedance values (pure=145.0 Ω; 10^1 CFU/mL=120.9 Ω; 10^7 CFU/mL=118.2 Ω). In the frequency 100 Hz it was possible to verify a greater influence of the concentration of bacterial cells on the electric current. The higher the cell density, the lower the impedance. There was a difference in impedance values between raw milk (157.9 Ω), crude autoclaved (120.0 Ω) and UHT-integral (145.0 Ω). However, the same was not observed at the 1 MHz frequency, where impedance values were similar. The prototype responded to the expected of a resistive and capacitive electric model, proving to be a promising tool in bacterial detection and food analysis.

Keywords: Impedance spectroscopy, electric conductivity, microbiology of food, microbiology of milk.