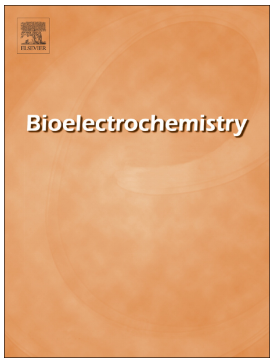

Dielectric properties of isolated adrenal chromaffin cells determined by microfluidic impedance spectroscopy

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Dielectric properties of isolated adrenal chromaffin cells determined by microfluidic impedance spectroscopy

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Abstract

Knowledge of the dielectric properties of biological cells plays an important role in numerical models aimed at understanding how high intensity ultrashort nanosecond electric pulses affect the plasma membrane and the membranes of intracellular organelles. To this end, using electrical impedance spectroscopy, the dielectric properties of isolated, neuroendocrine adrenal chromaffin cells were obtained. Measured impedance data of the cell suspension, acquired between 1 kHz and 20 MHz, were fit into a combination of constant phase element and Cole-Cole models from which the effect of electrode polarization was extracted. The dielectric spectrum of each cell suspension was fit into a Maxwell-Wagner mixture model and the Clausius-Mossotti factor was obtained. Lastly, to extract the cellular dielectric parameters, the cell dielectric data were fit into a granular cell model representative of a chromaffin cell, which was based on the inclusion of secretory granules in the cytoplasm. Chromaffin cell parameters determined from this study were the cell and secretory granule membrane specific capacitance (1.22 and 7.10 μF/cm^2, respectively), the cytoplasmic conductivity, which excludes and includes the effect of