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Frequency- dependent cell responses to an electromagnetic stimulus[1] TOLOO TAGHIAN, ABDUL SHEIKH, DARIA NARMONEVA, ANDREI KOGAN, University of Cincinnati — External electric field (EF) acting on cells in the ionic environment can trigger a variety of mechanical and chemical cell responses that regulate cell functions, such as adhesion, migration and cell signaling; thus manipulation of EF can be used in therapeutic applications. To optimize this process, realistic studies of EF interaction with cells are essential. We have developed a combined theoretical-experimental approach to study cell response to the external EF in the native configuration. The cell is modeled as a membrane-enclosed hemisphere which is cultured on a substrate and is surrounded by electrolyte. Maxwell's equations are solved numerically (ANSYS-HFSS) to obtain 3D EF distribution inside and near the cell subjected to an external EF. Theoretical results indicate that the cell response is frequency dependent, where at low frequency EF is excluded from the cell interior while EF penetration into the cell increases for higher frequencies. In both regimes the spatial distribution and strength of induced EF in membrane varies with frequency. Experimental results are consistent with theoretical predictions and show frequency-dependent cell response, including both membrane-initiated and intracellular pathway activation and growth factor release.

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