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Health Determinations of Yeast Suspensions for Brewery Industry using Cell Velocity Spectrum

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Living yeast cells in the brewery industry are active cells. They have different responses to AC electric field if they possess different dielectric properties. Electrical parameters which are used to determine health of yeast cells are the conductivities of the cytoplasm (σ_c), the cell membrane (σ_m), dielectric constant of the membrane (ε_m) and the cytoplasm (ε_c), respectively. These parameters affect cell translational speeds of positive dielectrophoresis. We measured yeast velocities during their moving towards the electrode tips, under various AC field frequencies. Lower critical frequency (LF), where yeast cells were repelled (i.e. negative force) from the tip after being attracted, was recorded against the conductivity of cell suspension medium (σ_s). It was observed that as the σ_s was increased the LF was shifted towards a higher frequency value. Yeast velocity spectra were reduced significantly under greater σ_s value. When the increased σ_s reached a critical value the attractive force became negligible, implying equivalence to the cytoplasmic conductivity. Our experiments showed that yeast cells of 1.15×10^5 cell.ml^{-1} displayed the initial positive dielectrophoresis at LF of 60-80 kHz, when using σ_s of 6 μS.m^{-1}. The velocity spectrum of yeast suspensions were affected by σ_s of which the cells were suspending during the experimentation. An abrupt change in the velocity pattern explained dielectric properties of cell membrane and cytoplasm of yeast cells which reflect their health. By curve-fitting method, we achieved to determine health of yeast suspensions through the cytoplasmic and the membrane conductivity values.

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