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Stress and Strain in a Yeast Cell under High Hydrostatic Pressure

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The mechanical effects of the compression of a yeast cell (*Saccharomyces cerevisiae*) under high hydrostatic pressure up to 500 MPa as used in food science are modelled and simulated with the finite-element-method. The cell model consists of a cell wall, cytoplasm a lipid filled vacuole and the nucleus. Material parameters have been taken from literature or have been derived from thermodynamic relationships. Mechanical damage due to transient pressure application can be excluded by dimensional analysis, unless pressure oscillation frequencies of 700 MHz are applied. The deformation of the cell deviates strongly from isotropic volume reduction. Organelle membranes exhibit an effective strain up to 80% at a load of 400 MPa, being critical upon disruption. In the cell wall, the stress state is heterogeneous. Von-Mises stress reaches the critical value upon failure of the cell wall of 70 ± 4 MPa at a pressure load between 415 MPa and 460 MPa.

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