

Yeast in an Egg Shell

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Nature's eggshells have inspired Chinese researchers: A team led by Ruikang Tang at Zhejiang University have successfully equipped living yeast cells with an artificial mineral coating. As reported in the journal *Angewandte Chemie*, the hard inorganic shells protect the cells, allowing them to survive longer storage times. By incorporating iron oxide particles into the shells the researchers were also able to make them magnetic.

Our breakfast egg is an anomaly of nature; a single cell protected by a thin mineral layer. With the exception of some tiny amoebas and diatoms, individual cells do not normally have a hard shell. The Chinese researchers have now developed a strategy to equip cells of baker's yeast, *Saccharomyces cerevisiae*, with an artificial shell of calcium phosphate.

First, a synthetic polymer, such as a polyacrylate, is attached to the cell walls of the yeast cells. The negatively charged carboxylate groups (COO^-) of the polymer stick out into the surrounding calcium phosphate containing solution.

Positively charged calcium ions from the medium bind to the carboxylate groups and attract the negatively charged phosphate ions to form nuclei for the growth of calcium phosphates. In the course of the mineralization process, the yeast cells are completely encapsulated by an inorganic layer.

Yet the cells remain viable. They enter into a resting state, in which they even survive a lack of the nutrients normally used for yeast storage. With

their shells, the yeast cells last much longer; whereas a maximum of 20 % of yeast cells are normally viable after a month, 85 % of the cells with shells last that long. In addition, the shell protects the cells from unfavorable external conditions, even the attack of enzymes that break up cell walls. When the shell is dismantled by lightly acidic conditions or ultrasound, the yeast cells resume their normal cell cycle.

Genetically modified yeasts are also used to produce important pharmaceutical agents, such as interferon and insulin, as well as vaccines. In molecular biology research, easily cultivated yeasts are often used for basic investigations of cellular processes and for the diagnosis of human diseases.

The protection and improved shelf life provided by the shell could increase their potential in this field. In addition, the shell can act as a scaffold for chemical and biological property modifications. The team was thus able to produce magnetic yeast cells by the inclusion of iron oxide nanoparticles in the shell.

Citation: Ruikang Tang, Zhejiang University, Yeast Cells with an Artificial Mineral Shell: Protection and Modification of Living Cells by Biomimetic Mineralization, *Angewandte Chemie International Edition*, doi: 10.1002/anie.200704718

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