

Cells Get Sprayed

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Genetically engineered products have become indispensable. For example, genetically modified bacteria produce human insulin. In future, gene therapy should make it possible to introduce genes into the cells of a diseased organism so that they can address deficiencies to compensate for malfunctions in the body.

In order for this to work, foreign (or synthetic) DNA must be introduced into host cells, which is not exactly a trivial task. Japanese researchers have now developed a method which could represent a true alternative to conventional processes. As described in the journal *Angewandte Chemie*, the cells are “bombarded” with water droplets produced and accelerated by electrospray.

There are several methods to transfer DNA into a host cell. In the simplest case the foreign DNA forces its way into the cell through a cell membrane that has been made porous, through treatment with electrical current or UV lasers, for example. Viruses and liposomes can be used as genetic transporters and the genetic material can be injected or shot into the cell with a “particle gun”. These methods all have the disadvantage of either severely damaging delicate cells or of being markedly expensive and complicated.

A team at the Saitama University led by Takafumi Sakai, in cooperation with Kazuto Ikemoto (Mitsubishi Gas Chemical Company), has now developed a methodology that could provide an alternative: They “bombard” the cells with tiny electrically charged water droplets. The droplets tear tiny holes in the cell membranes, through which external

DNA molecules can enter. After about one minute, the holes have closed back up and even delicate cells survive the procedure undamaged.

This method is based on a technique called electrospray, which has long been used with success, particularly in mass spectrometry. In this process, the tip of an extremely fine steel capillary is put under a high voltage. A highly charged drop of water exits the capillary and is atomized into many micro- or nanoscopic droplets. These charged microdroplets are strongly accelerated in an electrical field—toward the plate holding the cell culture.

The advantage of this new method: It is suitable for a large variety of cell types—mammalian cell cultures and bacteria, as well as living tissue, as was demonstrated with bird embryos. No cytotoxic reagents that could damage the cells are needed; only pure water or a cell-tolerated saline solution are used. An entire plate of cell cultures can be “sprayed” bit by bit, or a specific point on some tissue can be targeted. The equipment needed is simple, inexpensive, and portable.

Citation: Takafumi Sakai, DNA Introduction into Living Cells by Water Droplet Impact with an Electrospray Process, *Angewandte Chemie International Edition*, doi: 10.1002/anie.200704429

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