Recent developments involving the influenza virus include:

- In January, Food and Drug Administration (FDA) officials approved Flublok, the first influenza vaccine, consisting of recombinant hemagglutinin proteins, which are made in a baculovirus expression vector system without the live virus and without using chicken eggs; the vaccine was developed by Protein Sciences Corp. in Meriden, Conn.

- Several scientists, including Yoshihiro Kawaoka of the University of Wisconsin, Madison, Ron Fouchier of Erasmus Medical Center in Rotterdam, the Netherlands, and their collaborators, who were abiding by a voluntary moratorium on research involving avian H5N1 flu viruses, announced in January that they plan to resume that research. For details, see the February 1, 2013 Science (doi: 10.1126/science.1235140) or the January 31, 2013 Nature (doi: 10.1038/nature11858).

- Differences in antibody responses with age suggest that flu vaccines may work differently in the elderly, although it is too early to say if these differences make vaccines more or less effective, according to Stephen Quake at Stanford University in Stanford, Ca., and his collaborators. Details appear in the February 6, 2013 Science Translational Medicine (doi: 10.1126/scitranslmed.3004794).

RESEARCH ADVANCES

Nanoscale Technology Separates Microbes by Size Mainly, Plus Charge

Barry E. DiGregorio

Rapid electrokinetic patterning (REP), which combines lasers and electric fields, now can be used to separate microorganisms from one another on a nanoscale basis and, thus, could provide lab-on-chip systems for screening mixtures of microorganisms, according to mechanical engineer Steven T. Wereley from Purdue University in West Lafayette, Ind., and his collaborators there and at Oak Ridge National Laboratory in Oak Ridge, Tenn. Details appear in the December 2012 Lab on a Chip (12:4955–4959; doi: 10.1039/c2lc40662d).

“We invented and developed the REP technique using polystyrene latex beads suspended in dielectric fluids,” Wereley says. “We knew that even with a small difference in electrical properties between the fluid and suspended species, as is the case between a physiological growth medium and bacteria, we would be able to manipulate the species.”

Indeed, REP can be used to separate microorganisms—in this case, various species of fungi and bacteria—mainly on the basis of differences in their sizes, Wereley continues. The microorganisms tested included *Staphylococcus aureus* and *Shewanella oneidensis* MR-1 bacteria as well as the yeast *Saccharomyces cerevisiae*.

The device uses an infrared laser to heat fluid in a microchannel containing the microorganisms, to which an electric field is applied. The heat from the laser causes the fluids to circulate in vortexes, then separates the suspended microorganisms, mainly based on differences in size. However, because each microorganism also responds to a different electrical frequency, reflecting differences in proteins and cell membranes, same-sized microorganisms can be separated on the basis of those charge differences.

“Since there are only three parameters to adjust, it would be unrealistic to expect that we could differentiate different strains of the same organism or even organisms that are close in size and/or electrical properties,” Wereley says. “However, we could certainly use REP as a screening test to determine whether a more in-depth analysis is warranted.” A chip used to analyze mixes of microorganisms would not need to be much larger than the particles that are being measured, he adds. “A rule of thumb would be 10 times the size of the organism in each direction. For a bacterium, the volume of fluid needed would be 50 x 50 x 50 microns. It could be smaller for viruses or proteins. That said, it’s always the box that the device goes in that determines sensor size.”

“Existing manipulation techniques involving bioparticles are neither easy to implement nor rapid to perform, and their precision is relatively low,” says chemist Troy D. Wood of the State University of New York, Buffalo. “The [Purdue scientists] show that this approach can be used to sort bacteria based on their size, which suggests REP may be useful for off-chip bioassays.” Adds Robert Lodder of the University of Kentucky in Lexington, “REP is a logical next step in evolution of the ‘optical tweezers,’ [which] use a highly focused laser beam to provide an attractive or repulsive force. REP allows multiple cells to be handled simultaneously, [and] can be quicker for sorting cells than a simple optical tweezers . . . allowing for greater selectivity in the process of sorting and manipulating cells.”

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