Dressed to Kill: From Virus to Vaccine

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(PhysOrg.com) -- In a pioneering effort, researchers at the National Institute of Standards and Technology and the University of Queensland in Australia have successfully demonstrated that they can count, size and gauge the quality of virus-like particle-based (VLP) vaccines much more quickly and accurately than previously possible. Their findings could reduce the time it takes to produce a vaccine from months to weeks, allowing a much more agile and effective response to potential outbreaks.

Viruses are small, simple bodies consisting of DNA or RNA wrapped in a protein shell studded with short strands of protein. Viruses use these short strands of protein like a skeleton key to unlock and invade healthy cells, replace their DNA, hijack the cells' replication machinery and turn them into virus-producing factories. As with smallpox and influenza, the

only way to combat the virus is through vaccination, in which dead or weakened viruses are injected into the body. Unable to cause any real harm, the dead or weakened viruses allow the body to develop antigens that can fight off the infection in the future.

“The problem with this approach is that it takes a long time to develop vaccines because viruses have to be grown in chicken eggs or cell culture, which can take months,” said Leonard Pease, a NIST researcher working on the project. “In the case of new diseases, such as bird flu, which spread very rapidly, thousands or even millions of people could become infected and die in the time it takes to produce an effective vaccine.”

In order to speed the creation and delivery of these life-saving treatments, scientists at NIST and the University of Queensland in Australia are working to develop a new class of vaccines with virus-like particles (VLP). First used in the cervical cancer vaccine, VLP-based vaccines consist of an artificial protein shell that has been coated with proteins specific to whatever disease the vaccine is intended to control. Although the VLP is dressed up to look like the real thing to the body’s immune system, it contains no DNA or RNA and is incapable of causing infection. Because VLPs do not have to be grown, vaccines based on these particles can be deployed much faster than traditional vaccines.

Whether or not a VLP-based vaccine will be effective depends on whether the VLPs are well-formed and properly coated. Electrospray differential mobility analysis (ES-DMA) is a particle sizing technique able to count millions of particles an hour with subnanometer resolution. NIST researcher Leonard Pease and his team were able to determine that well-formed VLPs that have been coated with bird flu proteins are 2 nanometers larger than those without, a critical step towards the creation of future bird flu vaccines. The team verified their results using a number of other highly accurate, but much slower, particle sizing

methods. This experiment marked the first time that ES-DMA has been used to characterize VLPs, though researchers at NIST have also shown the technique to be useful for other biological applications (See "NIST Trumps the Clumps: Making Biologic Drugs Safer".)

NIST scientists plan to adapt the technique as a means of creating virus filter testing solutions in collaboration with virus filter manufacturers to ensure vaccines given to the public meet Food and Drug Administration safety standards.

Reference: L.F. Pease III, D.I. Lipin, D-H. Tsai, M.R. Zachariah, L.H.L. Lua, M.J. Tarlov and A.P.J. Middelberg. Quantitative characterization of virus-like particles by asymmetrical flow field flow Fractionation, electrospray differential mobility analysis, and transmission electron microscopy (dx.doi.org/10.1002/bit.22085). *Biotechnology and Bioengineering*. Published Online: Aug. 18, 2008.

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