Tobacco plants yield the first vaccine for the dreaded 'cruise ship virus'

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Scientists have used a new vaccine production technology to develop a vaccine for norovirus, a dreaded cause of diarrhea and vomiting that may be the second most common viral infection in the United States after the flu. Sometimes called the "cruise ship virus," this microbe can spread like wildfire through passenger liners, schools, offices and military bases.

The new vaccine is unique in its origin — it was "manufactured" in a tobacco plant using an engineered plant virus. Researchers are enlisting plants in the battle against norovirus, swine flu, bird flu, and other leading infectious diseases. This plant biotechnology opens the door to more efficient, inexpensive ways to bring vaccines quickly to the public, especially critical in times when viruses mutate into unpredictable new strains, said Charles Arntzen, Ph.D., who reported on the topic today at the 238th National Meeting of the American Chemical Society (ACS).

"The recent outbreak of H1N1 influenza virus has once again reminded us of the ability of disease-causing agents to mutate into new and dangerous forms," Arntzen points out. "It will be at least six months until a vaccine for this new strain will be available, and it will take even longer to create large stock piles of vaccine. For a case like the H1N1 influenza virus, you want to be able to move very rapidly and introduce a commercial vaccine in the shortest possible time. We think we have a major advantage in using engineered plant viruses to scale-up vaccine manufacture within weeks instead of months."

Noroviruses are always mutating, making it a moving target for vaccine developers. Arntzen says this has presented an obstacle for big pharmaceutical companies who might have considered developing a vaccine. Production costs can skyrocket when a single disease may frequently require new vaccines that must be developed and tested for safety and effectiveness. As a result, vaccines do not exist for many diseases that sicken enormous numbers of people each year. Arntzen notes that plant biotechnology could create a cheaper, quicker vaccine manufacturing technique uniquely suited to combat mutating viruses like norovirus and the flu.

Norovirus temporarily disables its victims, giving them severe diarrhea or nausea for up to three days. While not as life-threatening as the flu, Arntzen says it is equally important.

"It essentially closes down wings of hospitals, schools, day care centers and homes for the elderly. In the case of the military, it can shut down an entire ship and delay military operations while there is a cleanup in process. Because the disease spreads so rapidly, the major economic consequences are caused by the disruption of normal daily life and commerce," says Arntzen.

Norovirus will continue to evolve new strains, so Arntzen's team designed a vaccine manufacturing process quick enough to keep up with it and other shape-shifting viruses.

"With plant-based vaccines, we can generate the first gram quantities of the drug and do clinical tests within eight to 10 weeks… We could easily scale that up for commercial use in a two to four month period," explains Arntzen.

Plant-based vaccine production also offers cost advantages. Building greenhouses is more cost effective than the sterilized facilities,

expensive manufacturing technology and stainless steel tanks required for the insect or mammalian cell cultures used in most traditional vaccines.

"The other cost advantages relate to vaccine purification and formulation. Purification from plant extracts is simpler because there are no infectious agents to clean up. There are no viruses in plants which can infect humans, so you don't have to worry about viral removal," notes Arntzen.

The team re-engineered plant viruses to produce high levels of specially designed "virus-like" nanoparticles in tobacco plants. At about 25 nanometers in diameter, the particles are about the same size as the norovirus, but they consist only of the outer surface protein — the portion of the virus recognized by the human immune system. The particles contain none of the infectious material of the original virus, but they stimulate a robust immune response to fight off an actual infection.

To battle each new strain of the norovirus and to keep full resistance to older strains, Arntzen says the vaccine could be administered as a booster every 12 to 18 months. After successful experiments in mice, his team is developing a nasal delivery system for the virus-like particles. Arntzen expects to start clinical trials in late 2009 or early 2010.

Several companies, most notably pharmaceutical heavyweight Bayer, are investing in new facilities to create plant-based vaccines for cancer, as well as other pharmaceutical proteins. He suggests the first plant-based vaccines should be publically available within four to five years.

"Mammalian and insect-based vaccines are tried and true — some have barely changed in nearly 60 years," says Arntzen. But that doesn't necessarily mean they are the best in terms of manufacturing costs or flexibility. It simply means that the industry is not accustomed to using

plant biotechnology.

"Among other factors, the uncertainty on how such products would be viewed in the FDA approval process has created uncertainty in big pharma companies, and uncertainty is often a 'kiss of death' in product development that can involve hundreds of millions of development cost." But, he adds, "the current pipeline of new products now working their way to FDA approval is sure to change these opinions in coming years."

Source: American Chemical Society (news : web)