



Fraunhofer Center for Molecular Biotechnology

The Fraunhofer Center for Molecular Biotechnology (CMB) conducts research and development in plant and microbial biotechnology using plant-based systems for rapid, inexpensive production of vaccines, therapeutics and diagnostics.

The Center's staff has expertise in plant virology, molecular biology, plant biology, biochemistry and immunology.



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The Vaccine Factory

A collaboration between two Fraunhofer research centers, CMB located in Newark, DE and CMI in Boston, MA has created a first-of-a-kind, plant-based vaccine factory. The technology can produce specific proteins within the leaves of rapidly growing plant biomass. The factory's robotically tended machines are able to plant seeds, nurture the growing plants, introduce a viral vector that directs the plant to produce a target protein and harvest the biomass once the target has accumulated in the plant tissue.

The factory was designed to be time, cost and space efficient. It has the capacity to grow tens of thousands of plants in one batch. The plants, called "host plants," are grown hydroponically in multi-plant trays which are placed under controlled light and temperature conditions to allow for optimal and consistent biomass growth, and are moved around the facility by robots. The process, from seeding to harvesting, takes about six weeks. Once plants have reached a certain stage of growth, recovering large doses of bulk drug substance for vaccines can be accomplished within two weeks. Using pre-programmed robots and processing equipment eliminates the need for human contact, preventing potential contamination of the process and economizing the operation.

Key advantages of the technology is that it is cheaper and faster. It is relatively inexpensive compared to producing proteins in microbial or animal cell bioreactors; it provides a safer source of proteins than native sources or animal cell systems, and, unlike transgenic plant or animal systems, relatively large amounts of target protein can be accumulated within a few days.

H1N1

CMB has refined its unique plant-based system to respond to emerging disease threats such as H1N1 (so called "Swine Flu") strain of influenza virus. The core technology is based on using 'launch vectors' to rapidly produce high levels of target proteins in non-genetically modified plants.

Bill & Melinda Gates Foundation funds 3 CMB programs:

Pandemic H5N1 Influenza Vaccine

Vaccines targeting potential pandemic H5N1 strains of influenza virus constitute a major program at CMB. Influenza is a highly contagious disease, and highly pathogenic strains originating from bird species can cause pandemics such as that experienced in 1918 that caused up to 50 million fatalities worldwide. Currently, vaccines are primarily produced in egg-based systems that have limited capacity to cope with demand in the face of a pandemic, and are themselves susceptible to some influenza virus strains. CMB is applying its plant-based production platform as an alternative means to produce protein subunit vaccine candidates based on the hemagglutinin (HA) surface protein of influenza virus.

Transmission Blocking Vaccine for Malaria

CMB, as part of a consortium, is also developing a transmission blocking vaccine (TBV) against malaria. TBVs act by blocking transmission of Plasmodium parasites through the mosquito vector. This consortium successfully identified promising vaccine candidates to take into more extensive preclinical studies culminating in a Phase 1 clinical trial, prompting the Foundation to extend funding for an additional four years.

Cattle Vaccine for Trypanosomiasis

CMB is developing a cattle vaccine targeting trypanosomiasis, a complex disease of man and domestic animals in sub-Saharan Africa caused by *Trypanosoma* parasites and transmitted by tsetse flies. The disease is known as Sleeping Sickness in humans and as Nagana in livestock, and it is a great constraint to development in rural areas. CMB's trypanosomiasis vaccine project is being conducted in collaboration with Makerere University in Uganda.

Vaccines and Therapeutics to Combat the Bioterror Agents Anthrax and Plague

CMB in conjunction with the United States Naval Medical Research Center is developing vaccines and monoclonal antibody therapeutics directed against the potential bioterror agents *Bacillus anthracis* and *Yersinia pestis*, the causative agents of anthrax and plague, respectively. This program focuses on establishing CMB's plant-based expression system as a platform for the production of a combined vaccine targeting anthrax and plague, and therapeutic monoclonal antibodies for treatment following exposure to these agents.



Dr. William Hartman, Exec. V.P. Fraunhofer USA, Dr. Vidadi Yusibov (foreground) and Delaware Senator Kaufman in the CMB pilot plant.



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