Amyris Biotechnologies
Contact: Kinkead Reiling
510-450-0761 x715
reiling@amyrisbiotech.com
www.amyrisbiotech.com

FOR IMMEDIATE RELEASE

UNIVERSITY OF CALIFORNIA, BERKELEY, AND AMYRIS BIOTECHNOLOGIES COLLABORATE TO DEMONSTRATE MICROBIAL PRODUCTION OF ARTEMISININ

Key Step in Engineering Inexpensive Antimalarial Drug Reported in *Nature*

Emeryville, CA – April 12, 2006 – Research conducted at the University of California, Berkeley, in collaboration with Amyris Biotechnologies, Inc., has demonstrated the production of artemisinic acid in microbes, according to a report in the journal *Nature*. This work represents a key technical milestone for a three-part collaboration between UC Berkeley, Amyris and the Institute for One World Health (iOWH). This project is funded by a $43 million grant from the Bill and Melinda Gates Foundation to iOWH to develop a low-cost production process for artemisinin, a powerful antimalarial compound. The team is now one critical step closer to its goal of bringing an affordable, microbial source of artemisinin to the developing world.

By engineering microbes to make a chemical precursor of the drug artemisinin, the researchers are aiming to greatly reduce the cost of producing the drug. Today's report describes how the research team was able to successfully engineer the microbial production of artemisinic acid, which is only three chemical alterations away from artemisinin. The research was conducted by scientists from UC Berkeley and the Lawrence Berkeley National Laboratory (LBNL) led by Jay D. Keasling, Ph.D., UC Berkeley professor of chemical engineering and bioengineering, with support from Emeryville-based Amyris Biotechnologies.

"This achievement is a major milestone in the collaboration's efforts to leverage recent breakthroughs in synthetic biology to produce complex molecules at an extremely low cost," said Jack Newman, Ph.D., vice president of research and co-founder of Amyris. "We are confident that the UC Berkeley—Amyris team will be able to build on the work reported today to finish the development of an artemisinin production process. By isolating genes from their natural sources and inserting them into industrial microbes, Amyris will build on this proof-of-concept project to produce a wide range of high-value compounds in a stable, scaleable, and cost-efficient manner."

Currently available artemisinin-based drugs are made from extracts of the wormwood plant, *Artemisia annua*, and are synthetic derivatives of artemisinin. Artemisinin derivatives, in combination with other drugs, have proven nearly 100 percent effective against malaria, and thus represent a major hope for the 300 to 500 million people, primarily in Africa and Asia, who become infected with malaria each year. Malaria results in 1 to 3 million deaths annually, most of them children.

In late 2004, a unique three-way partnership was formed to address the supply and cost constraints that currently limit the use of artemisinin. The three partners include iOWH, the first nonprofit pharmaceutical company in the United States; the University of California, Berkeley, a pioneer in synthetic biology; and Amyris Biotechnologies, a biotechnology company using microbial chemical factories to bring high-value compounds to market. In the collaboration, UC Berkeley is conducting basic research; Amyris is developing the process for industrial fermentation and commercialization; and iOWH will implement a global regulatory and access strategy for the drug. To ensure affordability, UC Berkeley has issued a royalty-free license to both iOWH and Amyris to develop its technology to treat malaria.

In the work reported in *Nature*, the UC Berkeley team discovered the genes required for production of artemisinic acid and functionally expressed them in a modified yeast strain designed to produce the artemisinin precurser. The team used sophisticated bioinformatics techniques and a synthetic biology screen to discover the genes responsible for this remarkable production. UC Berkeley graduate student Eric Paradise led a team that developed a screening host based on a highly modified yeast strain derived from *Saccharomyces cerevisiae.* The Joint Genome Institute also aided the collaboration by sequencing a library taken from *Artesmia Annua*. Putting the top candidates from the gene discovery effort together with the screening host, the team was able to identify the artemisinic acid biosynthetic gene in their first screening effort. In support of UC Berkeley's efforts, Amyris provided chemical standards and chemical characterization and purification of products. Amyris is now charged with transitioning this discovery to an industrial setting and then scaling up the process in 2007.

"The research milestone reported today not only helps to advance the project's goal of providing a less expensive version of artemisinin, it also brings Amyris closer to its corporate objective of bringing other important natural compounds, many of which are currently inaccessible, into the clinic and world markets," stated Kinkead Reiling, Ph.D., president and co-founder of Amyris Biotechnologies.

About Amyris Biotechnologies
Amyris Biotechnologies, Inc. uses synthetic biology to produce complex chemicals important to the pharmaceutical and fine chemical industries. Amyris employs a variety of biosynthetic pathways engineered into microbes to provide commercial access to a range of high-value molecules, including promising new drugs that have not been developed because of supply limitations. For more information, please visit www.amyrisbiotech.com.

More information on the collaboration between the Institute for OneWorld Health, UC Berkeley and Amyris Biotechnologies can be found at www.artemisininproject.org.

# # #