DeLuca and Helinski discover a way to turn bacteria into manufacturers of the enzyme that triggers light emission in fireflies

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GLOWING DISCOVERY AT UCSD

Throughout the years, scientists who study bioluminescence in fireflies have had to rely on boy scout troops in Tennessee, students in Baltimore and other groups to collect the millions of insects required for their research. That will no longer be necessary, thanks to researchers at the University of California, San Diego.

Biochemist Marlene DeLuca and biologist Don Helinski have discovered a way to turn bacteria into inexpensive and efficient manufacturers of the all-important enzyme that triggers light emission in fireflies.

The availability of the enzyme, called luciferase, promises to speed up basic research in gene expression, give the medical community a quick and sensitive tool for diagnosing disease, offer communities a handy and fast means of testing drinking water for harmful bacteria--and more.

"This is a case in which biochemists and molecular biologists have come together using the powerful techniques of bioengineering to produce theoretically limitless amounts of an enzyme with numerous applications," Helinski said.

An article by DeLuca and Helinski on the success of their experiments appears in the current issue of Proceedings, a semi-monthly publication of the National Academy of Sciences. UCSD graduate students Jeffrey R. de Wet and Keith V. Wood, who were responsible for conducting the experiments, are co-authors.

To clone luciferase, the research team made a copy of the genetic message of the luciferase gene of a firefly. The cloned DNA is capable of producing active firefly luciferase in bacteria.

The glow of fireflies is created when luciferase combines with a compound present in all living cells called adenosine triphosphate (ATP), oxygen and an organic molecule called luciferin. Luciferase plays the role of catalyst, converting the chemical energy into light with a very high degree of efficiency.

The luciferase can be used to determine the amount of living cells in a sample. In the case of bacterial cells, bioluminescence makes it possible to measure bacterial content in urine to detect an infection. "You can measure it in wine or milk to determine whether pasteurization has been effective, you can measure it in polluted waters," DeLuca said.

As a diagnostic tool, luciferase can be used to determine the extent and nature of certain diseases, particularly metabolic diseases such as liver, kidney and heart disorders.

"In diagnostics, luciferase can, in principle, be used in every place that radioactivity tests are now being used. So, instead of measuring radioactivity, with all its associated risks and health hazards and disposal problems, you can measure light, which is virtually harmless and clean. Also, in theory, the shelf life of the enzyme procedure is considerably longer than that of radioactive immunoassays," DeLuca explained.

"An application of equal importance in the long run is the use of the luciferase gene as a 'reporter gene' to study how various other genes are regulated. For example, the luciferase gene could be spliced or fused to a particular gene so when the cells light up, we would know the genes are being expressed," she said.

"This becomes very important in the analysis of developmental processes and can help us follow the effects of hereditary diseases," Helinski said.

He is also excited about the potential of the enzyme procedure as a tool in protein engineering in plants. Increased understanding of how plant genes are turned on and off can put researchers in the position to manipulate genes in plants to improve their properties.

"For example, if we want to improve the protein content of a seed plant like soybeans--it's an extremely important source for protein--we would want to manipulate the seeds, which are the source of the protein. So, we have to have a very active promoter (of gene expression) directing a gene which makes a nutritionally high-quality protein and making that gene produce that protein in the seed, no place else but in the seed.

"There are other ways of doing it, but this promises to be a much more sensitive, less laborious and faster way of doing it," he said.

Scientists are also beginning to study the luciferase gene in animals. Another scientist at UCSD, professor of biology Suresh Subramani, has used a virus to introduce the gene into monkey cells to study how genes are expressed in animal cells.

The University of California recently filed for a patent on the firefly luciferase clone and its numerous applications.

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(December 4, 1985) For more information contact: Susan Pollock, 452-3120