

*Well, well, well...*

## **Ozone is Produced by Antibodies During Bacterial Killing**

The Scripps Research Institute La Jolla, California November 14, 2002:

The Scripps Research Institute (TSRI) is reporting that antibodies can destroy bacteria, playing a hitherto unknown role in immune protection. Furthermore, when antibodies do this, they appear to produce the reactive gas ozone.

The ozone may be part of a previously unrecognized killing mechanism that would enhance the defensive role of antibodies by allowing them to participate directly in the killing. Previously, antibodies were believed only to signal an immune response. Also called immunoglobulins, antibodies are secreted proteins produced by immune cells that are designed to recognize a wide range of foreign pathogens. After a bacterium, virus, or other pathogen enters the bloodstream, antibodies target antigens [proteins, fat molecules, and other pieces of the pathogen] that are specific to that foreign invader. These antibodies then alert the immune system to the presence of the invaders and attract lethal 'effector' immune cells to the site of infection.

For the last hundred years, immunologists have firmly held that the role of antibodies was solely to recognize pathogens and signal the immune system to make an immune response. The conventional wisdom was that the dirty work of killing the pathogens was to be left to other parts of the immune system. Now, Scripps has demonstrated that antibodies also have the ability to kill bacteria. This suggests that rather than simply recognizing foreign antigens and then activating other parts of the immune system to the site of infection, the antibodies may further enhance the immune response by directly killing some of the bacteria themselves. Antibodies appear to make ozone, which they detected through its chemical signature, which no other known molecule has. Never before has ozone been detected in biology.

It has been known that all antibodies have the ability to produce hydrogen peroxide, but they need to first have available a molecule known as 'singlet' oxygen—another highly reactive oxygen species—to use as a substrate. Singlet oxygen is an energetically charged form of oxygen that forms spontaneously during normal metabolic processes. Phagocytes like neutrophils produce singlet oxygen and are the most likely source of the substrate for antibody production of hydrogen peroxide. Antibodies attract neutrophils to the site of an infection. Once there, the neutrophils will engulf and destroy bacteria and other pathogens by blasting them with singlet oxygen and other oxidative molecules. The antibodies combine singlet oxygen with water to produce hydrogen peroxide, producing ozone as a side product.

Another interesting finding is that the antibodies carry the reaction through an unusual intermediate chemical species of dihydrogen trioxide, a reduced form of ozone. Dihydrogen trioxide has also never before been observed in biological systems.

The research article, "Evidence for Antibody-Catalyzed Ozone Formation in Bacterial Killing" is authored by Paul Wentworth, Jr., Richard A. Lerner, et. al. and appears in the November 18, 2002 "Science Express," the advanced publication edition of the journal *Science*. The article will appear in *Science*.