

The Fruits of Genetic Modification

If you have ever looked at the ingredients on your meat tenderizer or your soft contact lens cleaner you've probably noticed the presence of papain. This is a "proteolytic enzyme" which is just a complicated way of saying that it is a molecule that breaks down proteins. The meat that we eat, which is basically an animal's muscle tissue, is made of protein and can be tenderized by breaking it down into its component amino acids. Similarly, the residue on contact lenses is made of proteins, and can be removed with papain. At one time papain showed promise for the treatment of low back pain caused by swollen disks. The idea was to inject some papain into the disk to reduce the swelling caused by the accumulation of proteins. Unfortunately the results were not as good as had been hoped for. But there is interest in another potential medical application. Some preliminary studies suggest that papain therapy may reduce the adverse effects associated with chemotherapy and radiation, and perhaps may even control tumor growth.

Where does papain come from? It can be extracted from the papaya fruit. And therein lies a problem. Most of the papaya used in North America comes from Hawaii or the Caribbean. Starting in the 1940s, scientists noted that papaya trees, like humans, were susceptible to certain viral infections. The concern was "papaya ring spot virus" which reduced yields and damaged the quality of the fruit. The virus does not spread through the air, but is easily spread by insects. Indeed, by the 1990s, most Hawaiian plantations were affected. Papaya production declined from 58 million pounds in 1993 to 36 million pounds by 1997.

Then a novel approach was tried. Papayas were genetically engineered to resist the virus. Humans can be vaccinated against viruses, so why not plants? Researchers at Cornell University discovered that if DNA from the virus were inserted into the genes of the papaya plant, the plant would not be attacked by the virus. Why not? To understand this we have to take look at the way viruses reproduce. A virus actually is a very primitive organism and consists of nothing more than a bit of genetic material surrounded by a protein coat. It is incapable of reproduction. In order to multiply, a virus has to infect a cell and trick the cell's machinery into producing the components which can then be assembled into another virus. The virus does this by incorporating its genes into a cell's genes.

In the process worked out at Cornell, copies of viral genes were inserted into the papaya's DNA in the laboratory. These genes produce proteins that are needed by viruses but have no function in the absence of a virus. When a virus infects the plant, it inserts its genes into the plant's DNA in an attempt to commandeer the plant's genetic machinery to produce the components it needs to make new viruses. But the plant now senses an abnormal situation because all of a sudden it has an extra copy of a gene. So it reacts by turning off the gene. But it cannot distinguish between the gene inserted by the virus and the gene previously engineered into it and both are turned off. This process is known as "cosuppression." Any seeds produced by the plant share this trait and are therefore resistant to the ring spot virus.

By 1999, the effects if this genetic intervention were becoming evident. Hawaiian papaya production was up by 6 million pounds when compared with 1997. Is there any risk to this process? Of course long term environmental concerns cannot be ruled out, but health problems are most unlikely. After all, people have been consuming papaya infected with the virus for many years. And consuming the genetically modified papaya is no different from

consuming fruit that has been infected with the virus. There is some worry though from organic farmers who fear that cross-pollination of their crop will result in loss of organic status. But this is an economic, not a health problem. Indeed, the restoration of the Hawaiian papaya crop to health has been one of the most fruitful applications of genetic modification.