# Genetically Engineered Foods
# Tomatoes

#7 in a series

A Series from Cornell Cooperative Extension's Genetically Engineered Organisms Public Issues Education (GEO-PIE) Project

GENETICALLY ENGINEERED (GE) VARIETIES OF TOMATOES WERE MARKETED IN THE UNITED STATES FOR SEVERAL YEARS— NOTABLY CALGENE'S "FLAVRSAVR" TOMATO. CURRENTLY, THERE ARE NO GE TOMATOES ON THE MARKET.

## Frequently Asked Questions

### Am I eating genetically engineered tomatoes?

The short answer is no. Several genetically engineered tomato varieties have been developed in the United States and approved for commercialization, some of which were available in limited markets for a few years in the mid-1990s. For a variety of reasons these GE tomatoes are no longer marketed, and currently no GE tomatoes are present in U.S. markets either as whole tomatoes or in processed tomato foods.

### What genetically engineered traits were added to tomatoes?

At present, tomatoes are the only food that has been marketed with GE delayed-ripening traits. Delaying the ripening process in tomatoes is of interest to producers because it allows more time for shipment of tomatoes from the farmer's fields to the grocer's shelf, and increases the shelf life of the tomatoes for consumers. Although ripening makes tomatoes edible and flavorful, it also begins the gradual decline towards softening and rot, causing losses for producers and consumers. Tomatoes that are genetically engineered to have delayed ripening can be left longer on the plant to mature, will have longer shelf-life in shipping, and may last longer for consumers.

Some tomatoes have been genetically engineered to alter one particular aspect of tomato ripening: softening. The process of fruit softening is caused in part by the breakdown of pectins--compounds which give support to the walls of tomato cells. Tomatoes have been engineered to have reduced levels of a pectin breakdown enzyme called polygalacturonase. This not only increases shelf life, it makes the tomato products thicker (higher pectin to water ratio), which is of interest to tomato processors. This is the technique used in the well-known "FlavrSavr" tomato (see below).

Tomato plants naturally produce the compound ethylene to trigger the ripening of tomatoes on the plant. Several genetic engineering strategies involve the reduction or prevention of ethylene production to slow or stop the ripening process. To date, however, no genetically engineered tomatoes using this strategy have been marketed.

### What is the history and prevalence of GE tomatoes?

The first genetically engineered food to test the U.S regulatory system was Calgene's ill-fated FlavrSavr tomato, which utilized the pectin-based strategy of delayed softening (described above). In late 1991, Calgene had a variety of FlavrSavr tomato ready for marketing and requested the opinion of the U.S. Food and Drug Administration (FDA). In May 1992, the FDA approved the safety of the new variety, and Calgene announced that the FlavrSavr would be available in test markets after the 1993 growing season.

In early 1993, public concerns about food safety prompted Calgene to request a ruling from the FDA regarding the safety of antibiotic resistance genes in GE foods. Although Calgene had tomatoes ready for shipment, by the end of the year the FDA still had not issued a new ruling, and the 1993 harvest was never marketed.

Calgene was not alone in the race for the first GE tomato. Campbell Soup Co., which had collaborated with Calgene to develop the technology, had also been supporting the UK's Zeneca Seeds to develop another delayed-ripening tomato using the same technology. Threatening mutual lawsuits, Campbell, Calgene, and Zeneca worked out a compromise in February of 1994: Calgene would be given the world-wide rights to sell the fresh-market types of the new tomato, while Zeneca would focus exclusively on processing tomato applications. Although the tomatoes had to be grown in California, in the UK Zeneca contracted the Safeway and Sainsbury grocery chains to sell the world's first (and only) GE tomato paste. The product was clearly labeled as "made with genetically modified organisms," was considerably less expensive than tins of conventional brands (delayed-ripening made processing cheaper), and was very popular for several years (an estimated 60 percent share of canned tomato market in 1999). These products were pulled from shelves in the UK several year later, following the increasing unpopularity of GE foods in the UK.

Introduction of the FlavrSavr into U.S. markets was more problematic for Calgene. Like Zeneca, Calgene received FDA approval for its tomatoes in mid-1994. That summer the FlavrSavr tomatoes, under Calgene's "MacGregors" brand,

arrived in markets in the Chicago area. The tomatoes were clearly labeled as "genetically modified" and were accompanied by information pamphlets. Despite growing protests by activist groups (notably Jeremy Rifkin), the tomatoes were well received and Calgene had difficulty keeping up with demand.

But by early 1995, Calgene was showing signs of trouble: Calgene had contracted farmers directly to grow the FlavrSavr, and attempted to control the distribution and marketing system itself. Technical problems made it difficult to ship the delicate GE tomatoes without damage, the tomatoes hadn't grown well in Florida production fields, and Calgene was hit hard by high development costs and several years of low tomato prices. A patent-infringement lawsuit brought against Calgene by Monsanto may have been a final blow: Calgene agreed to sell a 49.9 percent share to Monsanto in July 1995, and by October that fraction was upped to 54.6 percent. Calgene sustained its dwindling supply of the FlavrSavr throughout 1996 (including some markets in Canada). By the beginning of 1997, however, it became apparent that production problems might be insurmountable, and Monsanto announced that it would buy the remaining shares of the cash-strapped Calgene. By March 1997, there were no more FlavrSavr tomatoes left to be found, less than three years after their introduction.

Also, in the mid-1990s, three additional companies attempted to develop GE delayed-ripening tomatoes, using the ethylene-reduction approach (described above). DNA Plant Technologies (DNAP), Monsanto, and Agritope gained regulatory approval to market such varieties, but to date none of these have been marketed. Yet research continues: Monsanto, Calgene, Agritope, Aventis, DNA Plant Technologies, Seminis, and others are currently attempting to develop new varieties of GE tomatoes using the delayed-ripening approach.

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