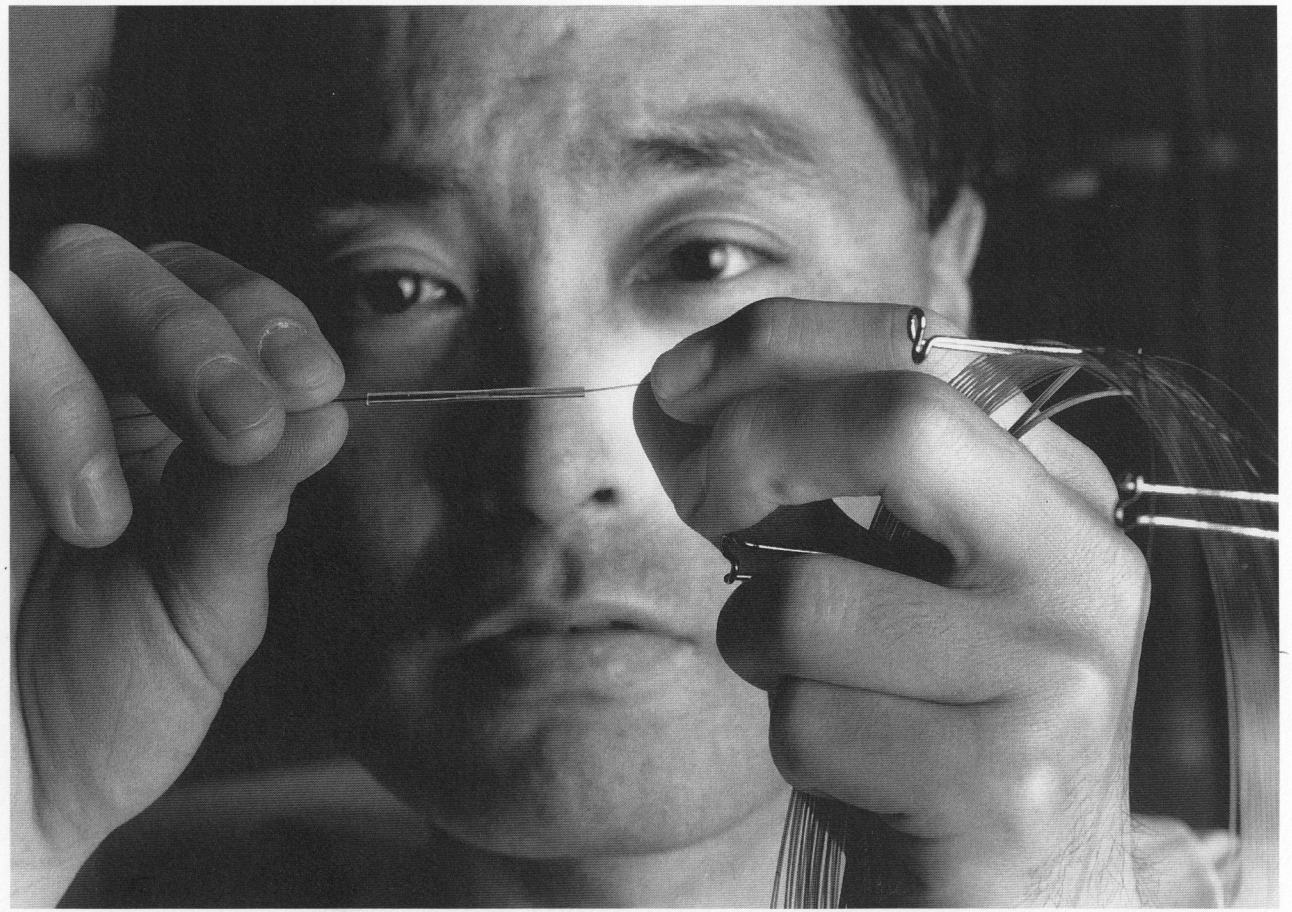
Flavors and Aromas

The taste and aroma of food is complex and often elusive. More than 40 years ago, a chemist in the Eastern lab, after many months of work, was able to identify 26 different flavor and aroma compounds in apple essence. All the chemicals added up to only 50 parts per million of the original apple juice. The analysis was a remarkable achievement, carried out as it was without the sophisticated analytical equipment available to researchers today.

In other fruits and vegetables, however, there are even more complex combinations of chemicals affecting taste and smell. An orange tastes like an orange, for example, mostly because of the aroma of the oil in the peel—a mind-boggling combination of more than 200 chemicals.

Much of the research on flavors and aromas has been carried out at the Western lab. In 1961, a chemist there demonstrated that flavor components in fruits can be incorporated into an



At WRRC, Chemist Gary Takeoka prepares a chromatographic column for tests capable of detecting flavor adulterants.

amorphous sugar mixture. These locked-in flavors were stable at room temperature and could be used to fortify flavors of candies, cookies, and cakes. This technique for capturing flavors/aromas has been used extensively by the food industry.

Meanwhile, other Western scientists began to study odor thresholds by taking each component of an aroma in turn and observing the point at which a particular concentration could first be detected by the human nose. This systematic approach enabled the chemists to determine which components in a complex mixture contribute most significantly to a characteristic aroma.

Some of the more important discoveries about flavors/ aromas at the WRRC include:

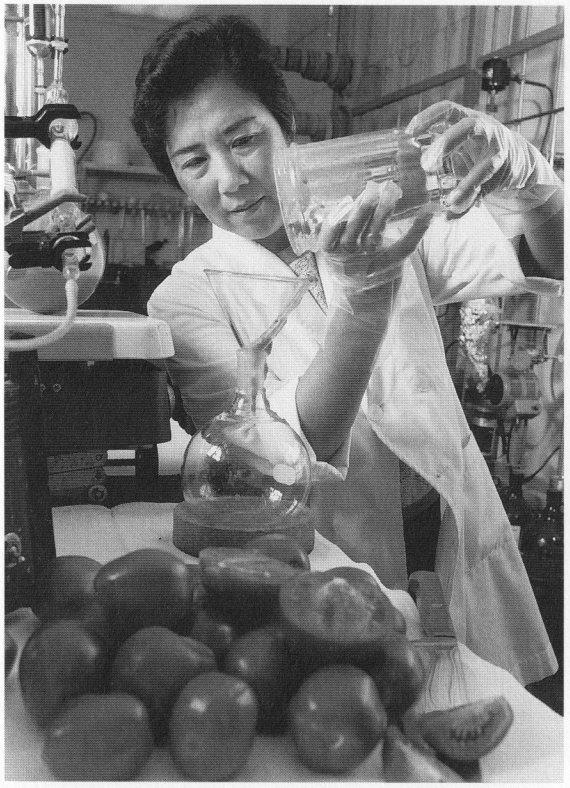
- Isolation and characterization of two of the most important flavoring constituents in an orange: alpha- and beta-sinensal. The chemicals were later synthesized, and the work led to a much better understanding of orange flavor.

- Identification and eventual synthesis of the major compound responsible for the aroma of the bell pepper. The chemical is used by processors today to restore the flavor of dehydrated peppers.

- Discovery of a hitherto unknown compound that gives one kind of aromatic rice its popcorn-like aroma. Aromatic rice is favored in most of the rice-eating countries of the world.

- Isolation of the flavor and aroma components that make a tomato picked fresh from the vine taste better than one purchased in the supermarket.

In part, these findings were made possible by an instrument indispensable to scientists today—the gas chromatograph (see chapter on "The Tools of Research," p. 35). Western lab researchers were the first to combine a capillary gas chromatograph with a fast-scan mass spectrometer to probe aromas. The method revolutionized the identification of constituents available only in minute quantities. Another useful technique, developed at WRRC in the 1970's, uses liquid carbon dioxide to extract aromas. Separation of aroma constituents is complete, and since the gas is nontoxic and flavorless, there is no damage to the chemicals extracted. Researchers also use computers to rank the most important natural aroma chemicals affecting the flavor of foods.



Physical science technician Louisa Ling of the Western lab prepares to test tomatoes to determine their flavor and aroma constituents at differing lengths of time after picking, storing, and cutting.

Important work on flavor has also been carried out in New Orleans. Southern researchers identified the flavoring components of celery as early as 1962. Researchers also used both the gas chromatograph and human taste panels to access the flavor potentials of new peanut varieties. Recently, they developed robotlike food tasters to trap and test flavor volatiles on the production line. The robots enable processors to reduce waste by identifying and replacing substandard ingredients during processing instead of waiting to test the end product.

At the Northern lab, researchers pioneered a technique known as dynamic headspace gas chromatography to learn more about

compounds that sometimes give off-flavors to soybean oil. As in the South, human sniffers supplement instruments in monitoring vegetable oils in Peoria. "We put a nose in the computer loop," explains one scientist.

The human nose also gets a lot of respect at the Western lab. The flavor of high-quality fresh pineapple is largely the work of nine aroma compounds. One of these natural chemicals is so potent—or noses so sensitive—that panelists could detect its aroma at concentrations of only 6 parts per trillion. That is equivalent to six grains of sugar in an Olympic-size swimming pool. And an aromatic chemical in tomato paste could be detected by panelists at one part per 100 billion—the equivalent of a pinch of salt in 1,000 tons of potato chips. That last study, by the way, identified which of the 44 aroma chemicals in high quality tomato paste give the product its fresh tomato aroma. As in most such studies, the researchers have a practical objective. They hope that tomato paste processors, for example, will use their findings to check flavor quality—and possibly enhance flavor—by modifying procedures in their processing plants.

Aroma and flavor findings also help food processors to detect synthetic food flavors that are priced and sold as all-natural products. A WRRC research chemist, working with a California manufacturer, has come up with a new detection technique that easily separates key flavor compounds of certain fruits into two distinctive forms—one natural and one a tip-off to synthetic flavorings.

"Consumers expect to get what they pay for when they buy natural flavorings," says the researcher. "But it's easy to get fooled. One major jelly manufacturer, for example, asked us to use our new technique to check out an imported apple essence that somebody was trying to sell him. We found that one of the main flavor compounds in the essence was a blend of two forms of the aroma chemical. One was a mirror image of the other. That tipped us off that the essence was a blend of natural and artificial ingredients."

The scientist adds that there may be nothing wrong with a synthetic flavor. "It might taste just as good," he said. "But you shouldn't have to pay the natural-flavor price."