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A collaboration between C&EN and  
Andy Brunning, author of the popular  
graphics blog *Compound Interest*

## FAKING FLAVORS WITH CHEMISTRY

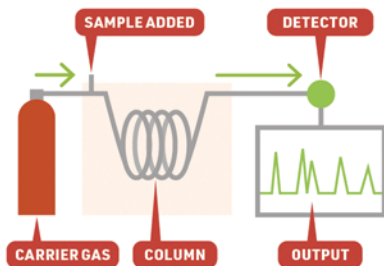
For over a century, chemists have made flavor molecules to evoke particular tastes. How do they know which compounds create a particular flavor, and how do they make these molecules?

### DETERMINING FLAVORS

Most flavors are a mix of numerous compounds rather than just one or two.

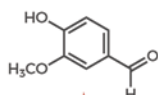


Gas chromatography is commonly used to analyze flavor mixtures. A vaporized sample is added to a carrier gas and travels through a column. Individual compounds separate from the mixture because the time a compound takes to travel through the column varies depending on factors like boiling point.



Coupling the gas chromatograph to a mass spectrometer gives scientists more information to identify compounds. Adding a sniff port lets chemists smell individual flavor components as they come off the column.

### EARLY ARTIFICIAL FLAVORS



VANILLIN

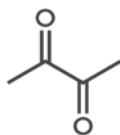


In the 1870s, vanillin, the key flavor compound in vanilla, was one of the first flavor compounds to be synthesized in a lab. The synthesis made the once rare and expensive vanilla flavor cheaper.



METHYL ANTHRANILATE

Artificial grape flavorings have used methyl anthranilate since the early 1900s. Later, scientists discovered the molecule in actual grapes.



DIACETYL



Diacetyl, which was first produced artificially in the 1920s, adds a buttery flavor to foods including butter substitutes and popcorn.

### MAKING FLAVORS

Chemists usually extract artificial flavor molecules from plants or make them in the lab. But recently they've turned to biotechnological methods, meaning food companies can market the resulting flavors as natural.

### BIOSYNTHESIS

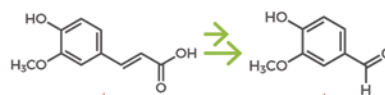


GLUCOSE

VANILLIN

Biosynthesis uses simple building blocks, like sugars or amino acids, that microbes then metabolize to the desired flavor molecules. These metabolic paths involve a number of steps.

### BIOTRANSFORMATION



FERULIC ACID

VANILLIN

Biotransformation uses microbes or their isolated enzymes to make specific flavor molecules from a starting substance in a simple reaction.