

# Aroma Chemistry

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## The Chemistry of Aroma

Odorants are characterized chemically by their size ( less than 300 amu) and their volatility. They are composed of carbon, hydrogen, oxygen, nitrogen, sulfur and halogens in many different types of structures and shapes. Although the most potent odorant ever described was hydrogen telluride it is not one of the volatile chemicals in the natural environments that shaped olfactory systems over much of biological history. There are thousands of chemicals that have the size, volatility and structure necessary to have aroma but only a very few are above their threshold in the natural environments where mammals evolved and functioned. Probably close to 1000 chemicals. The Flavornet lists 800 of these. In wine there are only about 50 odorants that are above their threshold and capable of stimulating sensory neurons. Most of the odorants in wine cannot be discerned in the same way they are experienced in isolation i.e. mixed with purified air. Wine produces a mixture of odorants that cannot be completely described from our perceptions.

The first step in understanding wine aroma is to take it apart chemically to see what it is made of. By far the best tool for disassembling aroma is gas chromatography (GC). Developed in the 1960s, GC uses a narrow (0.2 mm) glass tube 10 to 100 meters long and coated on the inside with a thin (0.02mm) thick layer of a polymer. There are many different polymers (called GC substrates) used but the most common are based on polymethylsilicones. A carrier gas moves through the column and over the polymer layer and out the end. When a mixture of volatiles are introduced into this carrier gas stream the individual components emerge from the other end at different times. The volatiles that are more soluble in the polymer take the longest to elute. By simply adding a detector at the end we can tell when something is coming out and identify it and the most sensitive and specific detector for odor is the human nose itself. This technique of sniffing-out odorants in a mixture was initially called "sniff-port analysis".

### Gas Chromatography - Olfactometry

Sniff-port analysis or the use of a human as a highly selective and sensitive gas chromatographic detector is almost as old as gas chromatography itself. Soon after gas chromatography (GC) was described in 1952, research laboratories concerned with fragrance and flavor based products began to use effluent sniffing to detect component odorants of mixtures separated in gas chromatographic columns. In 1964 Fuller et al. at the Colgate-Palmolive Company published a paper complete with photographs that described a system for sniffing GC effluents. Called the "perfume detector", their system incorporated the essential components commonly used by many researchers at that time to detect component odorants: a GC with a chemical detector either preceding or split off a heated transfer tube or "sniff-port"; and a trained human sniffer. The special booth used in the Colgate system to isolate and ventilate the sniffer demonstrates the central problem with the technique: standardizing and quantifying the response given by the human sniffer.

Over the next 30 years sniff ports began to incorporate design features found in gas phase olfactometers while sniffer training and data handling methods began to include some of the practices commonly used in sensory testing. Taken together all these methods can now be called gas chromatography - olfactometry (GCO). The importance of GCO in the analytical chemistry of flavor and fragrance materials is as significant as gas chromatography - mass spectrometry (GCMS) in spite of GCO's greater noise, bias and higher cost. This is because the specific sensitivity of GCO for odorants often exceeds the sensitivity of GCMS by several powers of ten.