

Why do oranges and lemons smell different?

There's a myth behind why oranges and lemons smell different, and it's incredibly pervasive. The myth has made its way into textbooks, research articles, and across the internet. It's popped up on the Nobel Prize website and in a few stories at Chemical & Engineering News. The Reactions team even helped spread it on social media! Now, we're here to help set the record straight.

The myth

According to the myth, the difference between orange and lemon scents is due to the two enantiomers of the molecule limonene. Enantiomers have the same chemical formula but a slightly different 3D arrangement of atoms. They end up being mirror-images of one another that cannot be superimposed—kind of like our left and right hands.

Rumor has it that orange oil has one limonene enantiomer—(R)-limonene— that smells like oranges, and lemon oil contains the lemon-scented mirror-image molecule, (S)-limonene. This is false.

The facts

Actually, both oranges and lemons contain mostly (R)-limonene. Only 1-4% of the limonene in either fruit is in the (S) configuration.

As for what these enantiomers actually smell like, (R)-limonene does have a pleasant, citrusy aroma, but does not smell like oranges. Instead, various other, fragrant molecules found in orange oil carry the odor.

At high purity, (S)-limonene carries notes of turpentine and lemon. However, this enantiomer is barely present in lemons and is unlikely to contribute much to their aroma. As with orange odor, a number of different molecules in lemon oil contribute to lemons' fresh scent.

Helpful hint: Odor chemistry is often complex, and smells are almost never caused by just one compound.

* Where did this myth come from?

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