

The Taste Effect of Sodium Lauryl Sulfate or

Why does orange juice taste so bad after you brush your teeth?

by Paola DeCristofaro

"Why does orange juice taste so awful after you brush your teeth?" Over and over, Daniel Greenbaum, a student in my physics class, asked this question. I did not know the answer and even wondered whether the "problem" really existed. Some years later I came across a report of scientific experiments on just this question. Thanks to the work of Linda Bartoshuk at Yale University and her colleagues at the Medical College of Virginia we now know the scientific reason why orange juice tastes bitter to most people after they've brushed their teeth.

Flavor is in the nose of the beholder

When discussing taste, it is important to make some scientific distinctions between taste and smell. Taste is perceived by our tongues and palates; smell is the sensation provided by olfactory receptors in our noses. Flavor is the combination of the two.

We say that we "taste" vanilla and chocolate, apple and peach, and steak and salmon on our tongues, but this is an illusion. We perceive these flavors because food vapors rise from the mouth into the nose and stimulate the olfactory receptors. This greatly adds to the few sensations—sweet, sour, salty, and bitter—our tongue can detect. The brain constructs the sensation we commonly

call "taste" from these four sensations of the tongue and the myriad aromas we smell.

Taste begins with an ion or molecule docking in a receptor on the tongue or palate. The substances that trigger sweet and bitter tastes are usually large, complex organic molecules that fit these receptors like keys in a lock. (See "Artificial Sweeteners," *Chem Matters*, February 1988.)

In contrast, salty and sour tastes are triggered by tiny positive ions.

Taste suppressor

Bartoshuk showed that some substances can suppress one or more of the four tastes. Sodium lauryl sulfate (SLS, shown in Figure 1), a detergent in toothpastes and mouthwashes, is such a suppressor. Bartoshuk asked her subjects to hold a dilute solution of SLS in their mouths for 60 seconds, in an effort to duplicate the exposure from brushing one's teeth. She then measured their reactions to the salty taste of sodium chloride, the sweet taste of sucrose (table sugar), and the bitter taste of quinine as well as the dual tastes—sour and bitter—of citric acid.

Under the suppressing influence of SLS, sucrose tasted slightly less sweet and salt tasted less salty. The bitter taste of quinine was lessened as well. Citric acid's sourness was almost unchanged, but its bitterness was ten times stronger. Surprisingly, SLS suppresses one of citric acid's tastes and enhances the other. No wonder orange juice tastes



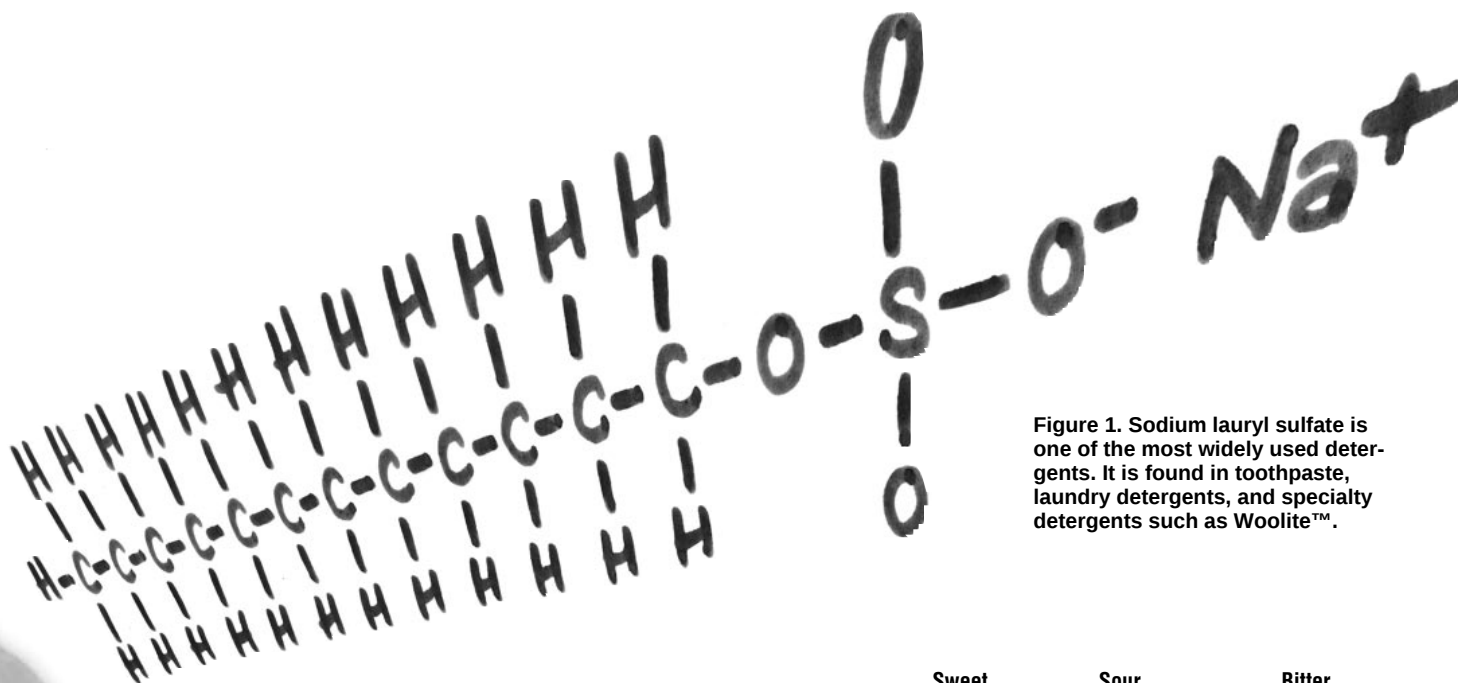


Figure 1. Sodium lauryl sulfate is one of the most widely used detergents. It is found in toothpaste, laundry detergents, and specialty detergents such as Woolite™.

so bad after tooth brushing! (See Figure 2.)

Most people find that orange juice tastes terrible after exposure to SLS. But orange juice tastes fine to me after I brush my teeth. There is a possible explanation for this.



Bitter genes

People have genetic differences in their ability to taste bitterness. In another set of experiments, Bartoshuk found that about one-third of the U.S. population is insensitive to the bitter taste of phenylthiourea

(PTC) and its close chemical relative 6-*n*-propylthiouracil (PROP). These individuals are also less responsive to other bitter flavors such as caffeine, potassium chloride, and sodium and potassium benzoate (preservatives in many foods).

These individuals failed to inherit a gene that makes them sensitive to bitter tastes. People who have inherited two copies of the gene (one from each parent) taste these bitter compounds in their full mouth-puckering glory. Those who inherit a single gene can taste the compounds but find them less bitter. It is quite possible that this gene controls development of tongue receptors that detect these bitter compounds. Thus, people with two copies of the gene would have lots of receptors for bitterness, those with one copy might have fewer receptors, and those with no copies might lack receptors for bitterness altogether. (However, there may be other genes for perceiving different types of bitter compounds.)

Bartoshuk's research subjects said that, after SLS, orange juice tasted truly yucky! But not me. Is this because I lack the gene for detecting bitter taste? No one knows, because the relationship between these two effects has not been explored. The tongue looks like a simple organ but, chemically, it is complex. And most of the research that will decode its workings is yet to be done.

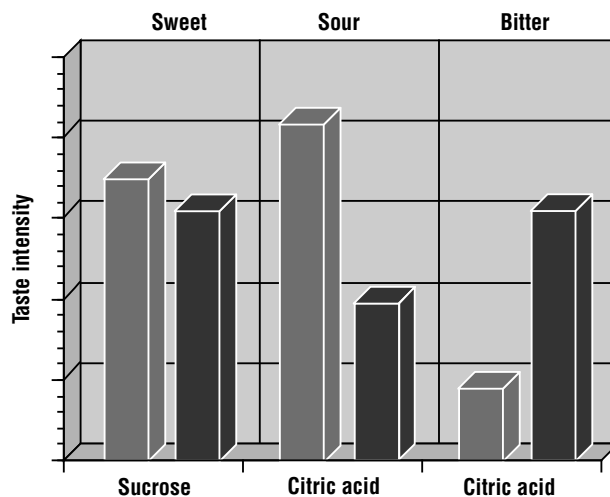


Figure 2. People in this experiment were asked to report the relative intensity of tastes from sucrose and citric acid (blue bars). Later, the same people rinsed their mouths with a solution of SLS, tasted the compounds again, and made another report (red bars). SLS slightly reduced the sweet taste of sucrose but strengthened the bitter taste of citric acid.

The orange juice test

Check the ingredients on different brands of toothpaste. Select one that contains sodium lauryl sulfate. Take a sip of orange juice and note the relative strength of the sweet, sour, and bitter tastes. Rinse your mouth with water, then vigorously brush your teeth with the SLS-containing toothpaste. Rinse with water again, then taste the orange juice again. Are the relative intensities of the tastes very different?

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FOR FURTHER INFORMATION

Bartoshuk, L. M.; Beauchamp, G. K. "Chemical Senses"; *Annual Review of Psychology* **1994**, *45*, 419.
Bartoshuk, L. M. "Separate Worlds of Taste"; *Psychology Today*, vol.14, p. 48, Sept. 1980.