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Researchers Seek to Trick Bitter Taste Buds

By SHERRI DAY

The food industry, trying to offer healthier versions of popular foods without affecting the taste, is looking for new ways to trick the tongue. If it succeeds, grapefruit juice could be sweet without added sugar, and potato chips flavorful with half the salt.

In April the Linguagen Corporation, a biotechnology company in Cranbury, N.J., that is conducting taste research, received a patent for the first molecular compound that will block bitter tastes in foods, beverages and some pharmaceuticals. The compound, named adenosine 5'-monophosphate, or AMP, occurs naturally — it is found in human breast milk, among other places. When added to certain foods, including coffee and canned citrus fruit, Linguagen says, it blocks some of the acidic tastes from being absorbed by the tongue.

"The idea of a bitter suppressor is the holy grail," said Linda M. Bartoshuk, a professor at the Yale University School of Medicine and a taste research expert. "Everybody wants to find them."

Coca-Cola, Kraft Foods and the Solae Company, a soy-foods concern owned by DuPont and Bunge Ltd., have each expressed interest in flavor and taste technology. Kraft and Solae are Linguagen clients. Coca-Cola has signed a research deal with Senomyx of La Jolla, Calif., another private biotechnology company.

Some research has centered on the search for compounds that would trick the receptors on the tongue by accentuating or blocking certain elements in the food, allowing, for example, someone to enjoy a smooth, mild cup of coffee without adding cream or sugar.

Fat is another area where research is being conducted. Scientists are working to manipulate molecules so that consumers will be able to taste the sensation of full fat in low-fat offerings.

Despite Linguagen's early successes, some researchers into taste raise doubts about whether the company will actually be able to create a food utopia. If doing so were easy, they said, someone would have discovered a way to significantly alter foods long ago.

While many people think sugar and salt are added to foods simply to increase flavor, often the additives mask other, less agreeable tastes. Processed foods, like canned soups, sauces and potato chips, have high amounts of salt to mask the bitter tastes that emerge during the extremely hot cooking process. Some soft drinks are filled with sugars to tone down the bitter taste of caffeine.

"We've had calls from just about every food and beverage company," said Shawn M. Marcell, the chief executive of Linguagen, though he declined to name the companies. "They're very concerned, as a group, about health and nutrition now because of all the reports about epidemic obesity, epidemic diabetes, epidemic cardiovascular disease, epidemic hypertension. They don't want to be tainted with that."

So far, scientists at Linguagen have discovered about 20 compounds that block bitter tastes and received

patents to use four of the compounds as bitter blockers — molecules that disguise bitter taste in food. (Because humans have more than 30 bitter-taste receptors, finding a universal blocker is nearly impossible.)

Linguagen is also working to discover and market a natural sweetener to replace artificial ones like aspartame and saccharin, which can leave a bitter aftertaste.

The company hopes to license bitter blockers to food, beverage and medicine manufacturers in the United States early next year.

Senomyx is also working to develop and market bitter blockers, as well as molecules that block unpleasant odors and molecules that increase the salty taste in low-sodium snacks while decreasing the product's salt content. A client is Coca-Cola. A Coke spokesman, Ben Deutsch, said the research is in the early stages but declined to comment further.

Executives at Pepsi-Cola said the company was interested in taste technology, but they have not committed themselves to doing anything with bitter blockers. "It is certainly something that we've looked at and will continue to look at as developments occur," a spokesman, Bart Casabona, said. "Anything that can impact food or beverages on a grand scale is something that we need to pay attention to."

Nutritionists said that since AMP is generally regarded as safe and is not bioengineered, it appears to pose no safety risk to those who consume it in food or beverages.

Nonetheless, food companies and scientists have promised, often with great fanfare, to make the American diet more healthy but have often failed. The additive Olestra, for instance, which was supposed to revolutionize low-fat foods, is still on the market but has had limited acceptance. Consumers shunned products containing Olestra, in large measure out of fear of digestive discomfort.

Some scientists caution that what companies like Linguagen and Senomyx hope to do with foods and beverages may be far from what they are able to accomplish. They said that bitter blockers, in their current state, only block a small segment of bitter tastes in foods and may not translate well in mass production.

Introducing the taste of fat in foods while reducing the calories is also likely to be troublesome because scientists have not figured out exactly how to do it.

Much current taste research grows out of a radical rethinking of how humans perceive tastes that has taken place since 1993, when scientists published papers debunking earlier theories. Researchers have learned that the human brain has the ability to recognize a variety of flavors including bitter, sour, savory and sweet all over the tongue rather than in specific areas of the tongue, as many students erroneously learned in grade school. The tongue is covered in papillae, microscopic pinkish-red mounds that contain the taste buds. When food mixes with saliva, molecules dissolve on the papillae and, through the taste buds, send a signal to the brain that interprets the flavor of what is being eaten. When a bitter blocker hits the tongue, it prevents the bitter taste receptors on the tongue from being activated. Thus, the bitter flavor in the food is technically still there, but the brain is unable to recognize it.

In 1991, Dr. Robert F. Margolskee, Linguagen's founder and a professor of physiology and biophysics at Mount Sinai Hospital's School of Medicine in Manhattan, discovered gustducin, a protein that is central to the human perception of taste. He founded Linguagen in 1995 to determine how his research could be used in product development.

Linguagen has enlisted Beverly J. Tepper, an associate professor of food science at Rutgers University, to

conduct tests to determine if their laboratory science meets consumers' approval in real food and beverages.

On a recent afternoon, Dr. Tepper put sets of two glasses of grapefruit juice, salted crackers and water (to cleanse the palates) in front of three taste testers at her Rutgers lab. One of them, Natalia Ullrich, a dietitian and research assistant, tentatively lifted cup No. 793 to her mouth, sipped, then rolled her eyes. "This one is nasty," she said. "It's actually very sour." But the second sample — in cup No. 862 — was much milder.

There was agreement among the two other testers in the room: Cup 793 bore the unmistakably acrid taste of some grapefruit juice sold in grocers' refrigerators. The other cup contained juice that tasted like a milder version of commercial grapefruit juice, tangy without the edge of the first version. The juice in the second cup was identical to that in the first, but it was laced with AMP.

"We've tried it in grapefruit. We've tried it in coffee. Our feeling is that it really does reduce the bitterness in those two products," Dr. Tepper said. "It's a very exciting project because it really is brand new stuff."

The pharmaceutical industry is another huge potential customer for the makers of bitter blockers. Oral medicines to treat H.I.V. and AIDS patients are excellent candidates for bitter blockers. The medicines, which must be taken several times a day, tend to be so severely bitter that many patients are reluctant or unwilling to take them, according to a Duke University study in 1999 on the effect of protease inhibitors on the sense of taste.

Manufacturers of cough syrup and other liquid medicine for children, geriatric patients, pets and people who cannot swallow pills have expressed interest in putting bitter blockers into their products.

In March, Linguagen announced an agreement with Perrigo of Allegan, Mich., a big maker of generic nonprescription drugs sold as store brands and of nutritional products. Pfizer has also expressed interest in Linguagen's taste technology.

"If approved, it's going to be a useful addition," a Pfizer spokesman, Steve Lederer, said. "Anything which improves compliance is to be welcomed."

The biggest marketing hurdle that the makers of bitter blockers and food producers may face as new products go to market is convincing customers that the products taste the same once the sugar and salt contents have been reduced and replaced with a blocker.

"The proof will be in the pudding, maybe literally," said Michael F. Jacobson, executive director of the Center for Science in the Public Interest in Washington. But he added, "If companies use this to market products that are healthier, more power to them. If they used higher-quality ingredients or didn't cook them to death, they wouldn't taste bitter in the first place."