Chemistry

Elizabeth Pennisi reports from New York City at the Fourth Chemical Congress of North America

Roomy clays host molecular guests

Whether molded into bricks, shaped into pottery or added to paper, paint, plastics or rubber, all kinds of clay share a common trait: They consist of layers stacked like a deck of cards. To expand clay's utility, materials scientists have now expanded the spacing between the layers. This remodeled clay can host "guest" molecules that alter the material's properties, says Thomas J. Pinnavaia of Michigan State University in East Lansing. Clays that capture large molecules and help speed their breakdown could perform the same function as the zeolite crystals used in petroleum refining, he adds.

Pinnavaia and his students have remodeled two types of clay by propping their layers apart with molecular pillars. In one case, they made a "supergallery" pillared clay by inserting a positively charged metal ion between negatively charged clay layers. This created spaces, or "galleries," five times larger than the width of the clay "floors," he says.

But the researchers ran into difficulties when they tried to make the galleries even bigger. The pillars, if tall and abundant enough, tended to migrate and bunch together, cluttering up the gallery, Pinnavaia says. He now plans to pack the pillars in an organic surfactant to keep them apart as they settle between the layers. Burning off the surfactant should leave plenty of space in between.

Juiced-up fruit: Unbelievably flavorful

Food scientists have harnessed natural enzymes to make fruits taste almost too good to be true. Ralf G. Berger and his colleagues at the University of Hanover (Germany) developed a technique for storing apples, pears and bananas in airtight containers along with different kinds of alcohols. The alcohols serve as building blocks, or precursors, for molecules called carboxylic esters, which impart fruity flavors. When the alcohols seep into the fruit, they cause the enzymes inside to increase their ester production by as much as 30-fold, Berger reports. His team tested the technique by measuring alcohol concentrations outside the fruit and ester concentrations inside the treated fruit at 32-hour intervals.

Taste tests verified the transfer and transformation of the precursors, Berger says. For example, six of nine people who sipped juices made from treated or untreated apples could distinguish between the two. However, a few tasters said they preferred the juice from untreated apples because they believed that only an artificial flavoring could make the other juice so fruity. "You can have too much," Berger admits. "The [treated fruits] are like perfume, they have so much flavor."

The technique also works well with bananas and pears, he reports, although it doesn't do much to enhance the taste of citrus fruits. And there's nothing artificial about it. "We use natural precursor substrates, and we're making use of the natural biosynthetic pathways," Berger says.

Treated fruits stay firmer longer, he adds, because the excess precursors slow down natural degradation. But it's important to use the right kind of alcohol for each fruit, or the treatment may impart a funny taste. "I can flavor you a banana that tastes like strawberries," he says. "But I don't think that would be really well received."

Eastern radon ranked by region

Taking a tip from modern mail-sorting methods, two geologists are zipping along in their assessment of radon levels along the Eastern Seaboard, first in indoor air and most recently in drinking water.

George W. Mushrush and Douglas G. Mose of George Mason University in Fairfax, Va., compiled 71,000 indoor radon measurements gathered by five private testing companies. Then, using zip codes, they plotted the measurements by geologic province to show the level of radon risk, Mose says.

The densely populated Piedmont province, with its 500-million-year-old rock, and the Highlands province, with billion-year-old granites and gneisses, generate the most radon, especially where glacial deposits do not cover the bedrock, the team reports. These provinces include New York's Dutchess County and the New Jersey counties of Hunterdon, Morris and Warren. There, indoor radon concentrations averaged about four times higher than the level above which the Environmental Protection Agency recommends corrective action (4 picocuries per liter), says Mose. Coastal provinces had the lowest radon levels in the survey, he adds.

To gauge the risks of water-borne radon, Mose and Mushrush sent health questionnaires to Virginia and Maryland residents who had participated in previous studies of radon in indoor air. They also collected water samples from the roughly 250 homes with private wells in this group.

In 234 of the 250 well-water samples they detected radon levels exceeding 2,500 picocuries per liter. On the questionnaires, 5 percent of the participants living in these homes reported cancer diagnoses, compared with 2 percent of those whose well water had low radon levels, Mose says.

In July, EPA proposed setting a maximum acceptable level of 300 picocuries per liter for radon in water supplies. The agency is seeking public comment on the recommendation through mid-October.

Caterpillar stunned by its own peptide

Scientists have studied the tobacco hornworm (*Manduca sexta*) for decades, learning about its behavior, physiology and biochemical makeup. But the big, fat caterpillar still holds a few surprises.

In his quest for biologically based weapons against insect pests, toxicologist Gary B. Quistad tried injecting tobacco hornworms with various components extracted from their blood. One had a dramatic effect: It temporarily paralyzed the caterpillar. The insect "gets extremely rigid, as if frozen rock-hard," says Quistad. "It will bounce if you drop it. Then, after 20 minutes to a half-hour, it will fully recover."

He and his colleagues at Sandoz Crop Protection in Palo Alto, Calif., went on to pinpoint an unusual 23-amino-acid peptide as the hornworm's innate paralytic compound. Quistad speculates that the peptide may play a role in clotting, normally remaining harmless in the blood. Exposure to air – or the stress of a needle prick – may activate its paralytic powers by somehow changing its peptide structure, he suggests.

Quistad has since found this or a related peptide in three of 11 other species of insect pests. But the peptide did not cause paralysis when injected back into their bodies, he reports.

Rosy future for beetle juice

A tiny crimson beetle that preys on the prickly pear cactus can provide a safe, stable red pigment for coloring foods, reports a research team from the National Autonomous University of Mexico in Cuautitlán.

Sara E. Valdés-Martínez and her colleagues extracted pigment from female cochineal beetles (*Dactylopius coccus*) and tested how long the red color lasted in ham, syrup and yogurt. If the food's acidity increased or decreased sharply during storage, the color faded or turned yellowish, they found. Otherwise, it held its hue for years – even at a temperature of 50°C.

Derived from an entirely natural source, the dye needs no approval from the Food and Drug Administration, says Valdés-Martínez. But harvesting it is a labor-intensive – and therefore expensive – task, she adds.