Chemistry

Janet Raloff reports from Los Angeles at the American Chemical Society's 196th national meeting

Sugars to fool plaque makers

Glucans are chain-like molecules whose links are units of the simple sugar glucose. Made by bacterial enzymes in the mouth, large glucans, containing 100 to 150 glucose units, become part of the structural matrix for decay-causing dental plaque. But K. Grant Taylor and colleagues at the University of Louisville, Ky., are devising an arsenal of "glucan mimics" to prevent that plaque.

Glucans help glue plaque bacteria and food particles to teeth. Taylor's water-soluble mimics do the opposite: The bacteria they bind become flushable from the mouth by saliva or water. Using mouth rinses or toothpastes that incorporate such mimics, people may one day be able to routinely wash away plaque makers before they can damage teeth, Taylor says.

By binding to glucan receptors on plaque-bacteria cell surfaces, these short-chain mimics can also tie up enzymes that ordinarily help make more glucans. Taylor reports preliminary findings showing that even a two-glucose mimic can block glucan production. But his future work will focus on even longer ones, because bacterial studies suggest eight-glucose mimics will provide the most effective binding.

What makes a tasty cake?

Isopentenal, furfural, methyl pyrazine, furan methanol and acetyl furan. Sound yummy? They should. Colleen Whorton, a doctoral candidate at the University of Minnesota in St. Paul, identified these flavorants as among the chemicals responsible for making a conventionally baked white cake so much better tasting than one baked in a microwave. In fact, the flavor profile of her microwaved cake more closely resembled that of batter than that of a "baked" cake.

Baked goods develop complex flavor compounds through chemical changes that reflect both baking time and temperature. The same changes that make a cake crust brown and crisp tend to introduce a characteristic baked, buttery and somewhat caramelly taste. Not surprisingly, Whorton says, the reduced time and temperature of microwave baking – and its lack of browning – result in a distinctly different flavor profile, one that is "typically judged inferior by consumers." She expects studies like hers will eventually be used to identify chemical additives that can be used to synthesize a natural baked flavor in microwave-baked foods.

Antibiotic polymer prostheses

Polymer plastics are already being used as implanted, controlled-release drug-delivery systems (SN: 6/4/88, p.360). Now researchers at the University of Cologne in West Germany are investigating a variation on this theme – the design of antibiotic-impregnated polymers for artificial heart valves and cardiac-pacemaker electrodes.

Skin bacteria often contaminate the surface of polymer prosthetic devices, causing serious infections, explains Bernd Jansen. Once such an infection occurs, he says, removal of the plastic device is usually necessary because antibiotic treatment of the patient at this stage is seldom successful. But he and his co-workers incorporated different antibiotics into polyetherurethane plastics at concentrations as high as 5 percent by weight. In test environments simulating body implantation, thin films of these plastics released either of the antibiotics clindamycin or flucloxacillin at constant, high rates for at least five days. And the Cologne scientists were able to tailor the rate of drug release by pretreating the plastic with gamma irradiation. Though the released antibiotics did not completely inhibit bacterial colonization of the plastic, Jansen reports data from *in vitro* tests showing they could reduce viable bacterial numbers to as little as one ten-thousandth of the original population.

Earth Sciences

Sudden sodium surges seen over Illinois

Clouds of sodium atoms that rapidly appear and then disappear have been detected high in the sky over Urbana, Ill. While it may seem strange that the vanishing clouds have been noticed only over that city, scientists from the University of Illinois who observed the phenomenon say they are not really perplexed, because they have the only machine that can detect the sodium clouds, which are probably coming from meteors as they burn up in the atmosphere.

Timothy Beatty and colleagues observed the clouds with a lidar – an instrument that sends laser pulses up into the atmosphere and measures the light that returns. Several features make the lidar in Urbana unique. The laser pulses about 200 times a second, which is 10 to 20 times more frequent than most lidars. Moreover, the Urbana lidar employs an unusually sensitive light-detection system with a telescope to gather incoming photons. Sodium atoms high in the atmosphere absorb the laser light and then emit much fainter radiation at a telltale wavelength that the detector picks up.

On at least five occasions the Urbana group found sudden surges and then drops in the concentration of sodium atoms at an altitude of around 85 kilometers, Beatty and colleagues report in the September GEOPHYSICAL RESEARCH LETTERS. Beatty suggests the clouds are vaporized meteor material, and his group expects to tune the lidar to detect other meteoric elements such as iron and calcium. All three elements exist in small concentrations at this altitude and are believed to be supplied by meteors.

Ions rain down over Earth's poles

In the mid-1970s, scientists discovered that electrons flowing away from the sun can latch on to Earth's magnetic field lines and follow a path to the planet's poles, where they penetrate the extreme upper layer of the atmosphere – a phenomenon known as electron polar rain. Physicists have long suspected that solar protons similarly nose their way to Earth's poles, but studies of satellite measurements have only once detected a glimpse of what is called ion polar rain. Now researchers have caught a second, more definite view.

On Dec. 10, 1983, instruments aboard two polar-orbiting satellites measured a large swarm of positive ions, located about 800 kilometers over the poles, report Patrick T. Newell and Ching Meng of the Johns Hopkins Applied Physics Laboratory in Laurel, Md., in the September GEOPHYSICAL RESEARCH LETTERS. The ion flow on this day was about 10 times stronger than that during the first detection of ion polar rain.

In their continuing analysis of the satellite data Newell and Meng have found several more instances of the rare ion rain, which is probably mostly protons, Meng says. It is still unclear exactly how electrons and ions in the solar wind can pass through Earth's magnetic barrier, called the magnetopause. One theory suggests the particles flow around Earth and then come up from behind the planet. Since fleet electrons could follow this route better than slower ions, this may explain why ion rain is rarer than electron rain. Further studies will help resolve the path of the particles, Meng says.

EPA sounds stronger ozone alarm

Environmental Protection Agency Director Lee M. Thomas last week called for a complete phaseout of the ozone-destroying industrial chemicals chlorofluorocarbons and halons. An international treaty negotiated last year will cut chlorofluorocarbon use by half and freeze the levels of halons consumed (SN: 4/9/88, p.234). New scientific work, however, suggests that only an elimination of these chemicals will stop a significant weakening of the ozone layer, says Thomas, who is calling for countries to strengthen the treaty.