Biology

Cocaine each day keeps the bugs away

Although it might seem otherwise, coca plants do not make cocaine just for people to use and abuse. One of many alkaloids manufactured by plants, cocaine works to keep insects away, says James A. Nathanson, a neurobiologist at the Massachusetts General Hospital in Boston.

Previously, researchers had noticed that few insects nibble coca plants, a surprising observation given that their leaves are perpetually young and tender because of people harvesting them for the drug trade, says Nathanson. Also, since cocaine can cause mammals to become anorexic, he also wondered what effect cocaine might have on insect feeding behavior.

Nathanson and his colleagues put groups of five three-day-old moth caterpillars on tomato leaves sprayed with different concentrations of cocaine. Just being near the leaves made the insects rear up, shake, and walk away, behaviors that worsened when the caterpillars tasted the leaves. The concentrations were about equivalent to those that exist naturally in coca leaves, says Nathanson. Cocaine also killed mosquito larvae.

The Boston group then studied the effects of several other compounds that function in the nervous system the same way as cocaine. They also investigated cocaine's chemical cousins.

Cocaine bothers insects by preventing their nerve cells from taking up key chemical messengers, in particular one called octopamine. Octopamine functions like norepinephrine, the messenger that conveys the "fight or flight" response in mammals. When cells fail to take up octopamine, it accumulates, making the cells overly excited, the group concludes in the Oct. 15 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Because octopamine plays little role in mammalian nervous systems, these findings could lead to new pesticides that deter insects the same way that cocaine does, but without affecting people, adds Nathanson.

Alga makes its own sunblock

Not only are salt and sun the bane of beautiful skin, they can also make life miserable for plants. But like cosmetic companies, some plants have a secret for avoiding damage from the elements.

Molecular biologists have now learned this secret, at least for a single-cell alga called *Dunaliella bardawil* that thrives in the Dead Sea and the Sinai desert. The plant makes its own sunscreen and a molecular solar deflector, says Ada Zamir at the Weizmann Institute of Science in Rehovot, Israel.

To understand how this alga responds as dramatically and quickly as it does to harsh conditions, Weizmann scientists first isolated an algal protein produced when sunlight gets too intense. Zamir and her colleagues then realized that the protein, Cbr, resembles those used by plants to make molecular "antennas" to funnel light down to where photosynthesis takes place.

Although plants depend on the sun's energy to fuel photosynthesis, too much light causes them to make toxic oxygen molecules. To keep these toxins from forming and interfering with photosynthesis, this alga produces a yellow-orange pigment called zeaxanthin that joins with Cbr, says Zamir. The two substances form a "lightning rod" that helps shunt excess light away from where it could do damage, she and her colleagues report in the Oct. 5 JOURNAL OF BIOLOGICAL CHEMISTRY. Intense light also increases the alga's production of an orange pigment, beta-carotene, which the alga can then convert to the antenna pigment or use to filter out some light, they report.

Zamir thinks that because higher plants make similar pigments and proteins, they use the same protective mechanisms as this alga, but to a lesser degree. Now that researchers know these secrets, they can figure out how to increase this protective response in other plants, she suggests.

Biology

Gabrielle Strobel reports from Washington, D.C., at a conference on ancient DNA, convened by the Smithsonian Institution

Ancient DNA research: Growing pains . . .

When a promising, fast-moving field threatens to spin out of control, what do you do? Meet for a reality check.

That's exactly what scientists in the young area of ancient DNA research did recently. Instead of announcing success after success — the usual stuff of scientific meetings — the researchers pondered the many ways in which ancient specimens can lure experimenters down the wrong path.

In response to criticism voiced earlier by colleagues, Noreen Tuross called for "more analytical rigor to make this a credible field." Tuross is a biochemist with the Smithsonian Institution in Washington, D.C.

Ancient DNA comes from dead or extinct organisms 100 to millions of years old. If well preserved, such DNA can be recovered from ancient bone, animals frozen in Arctic soil, or creatures trapped in amber (SN: 10/24/92, p.280). Using a copying technique called polymerase chain reaction (PCR), scientists amplify — reproduce in large quantities — traces of such DNA and then decipher its genetic code.

The advantages of PCR — its simplicity and low cost — also present dangers, contends Tuross, since it attracts many people to the field, some of whom fail to scrutinize the condition of their samples with sensitive chemical methods. Results are sometimes hard to reproduce, the researchers agreed, particularly when one extracts DNA out of tiny, precious samples entombed in amber.

Ancient bone contains far less DNA than people originally thought, Tuross says. A chemical called fulvic acid caused false positive results in tests measuring DNA content and led to incorrect reports in the literature, she says, adding that the presence of fulvic acid makes it necessary to purify ancient DNA carefully. Over time, water and oxygen damage DNA. When scientists try to amplify old DNA, that damage can either yield erroneous findings or thwart PCR altogether, the researchers warned. PCR can also amplify minute contamination of DNA, such as an excavator's fingerprints, and delude scientists. Bryan Sykes of the University of Oxford in England cited a case in which amplified DNA, supposedly from a mammoth tusk, turned out to be human.

Not all is lost, though. Sykes says that much DNA contamination can be removed by treating the bones with bleach or by sandblasting them. Tuross is "very optimistic" that ancient DNA research will overcome its early troubles.

. . . and sometimes it works

Morphology may have assigned the extinct giant ground sloth a wrong spot on the evolutionary tree, reports Matthias Höss, a graduate student in the group of Svante Pääbo at the University of Munich in Germany.

Höss drew that conclusion from comparisons between the DNA sequences of the two living species of South American sloth and one extinct beast, Neomylodon. This slow-paced edentate roamed the steppes of Patagonia during the last ice age.

Traditionally, morphologists thought Neomylodon had branched off long before the two living sloth species developed. That would have made Neomylodon's family, the Mylodontidae, closer cousins of the South American anteater and opossum than Höss thinks they actually are.

Höss analyzed DNA he had isolated from 13,000-year-old sloth remains and subsequently amplified with PCR. "The outcome of the genetic information differs from previous morphological information," he says. It indicates that Neomylodon was more closely related to today's two-toed tree sloth than to the modern three-toed tree sloth and that it was only a distant cousin of anteaters and opossums.

If Höss is right, will other extinct sloths move to different places on the tree as well? Stay tuned, he says.