# Biology

## Bovine stomach holds sugary surprise

Examining the long sugar chains created by bacteria that live in the rumen, the first of four stomachs of animals such as cattle, sheep and goats, a scientist has discovered a sugar never before seen in nature. The sugar, L-altrose, is usually found at the end of "a long, tortuous route through organic chemistry" undertaken by companies interested in using the molecule as an artificial sweetener, says the discoverer, Robert J. Stack, a biochemist with the U.S. Department of Agriculture's Agricultural Research Service in Peoria, Ill.

Although Stack says he is not researching microbial techniques for producing L-altrose on a large scale, his finding could potentially allow anyone interested in the commercial market to do so. Today's methods of making the sugar are expensive, Stack says, and starting with the bacterial machinery instead of from "scratch" could reduce the costs. Chemically synthesized L-altrose has been patented by one company, and Stack has applied for a patent on his microbial method of making the sugar.

Stack stumbled upon the sugar while studying how cows use bacteria to help digest plant matter. He was looking at one of the long sugar molecules made by the bacterium *Butyrivibrio fibrisolvens,* in hopes of explaining why the long sugars constructed by some bacteria aren't broken down by enzymes from other bacteria. Finding L-altrose supports the idea that these chains contain unusual components unrecognizable to the other bacteria's digestive enzymes.

Stack says he wonders what cows do with the sugar chain containing L-altrose. Because the sugar is "left-handed" in contrast to the right-handed sugars common to animal diets, it may be difficult or impossible for animals to metabolize.

## Hormone triggers moth mating

Studies have shown that most female moths looking for mates release a self-manufactured perfume, or sex pheromone, as soon as they emerge from the cocoon. Now scientists have found a moth, the true armyworm, that waits to mate until weather permits, thereby controlling the release of the sexy substance with a chemical system.

Canadian biologists Michel Cusson and Jeremy N. McNeil of Université Laval in Sainte-Foy, Quebec, wanted to know if the same chemical, called juvenile hormone, that controls migration and ovary development in many insects might be responsible for the armyworm moth's release of pheromone and the behavior patterns, termed "calling," associated with this release. The researchers removed the corpus allatum, the source of juvenile hormone, from newly emerged, female armyworm moths and compared these to their normal counterparts as well as to armyworm moths that underwent a sham operation. Within five days, most of the controls and sham-operated moths "called," produced pheromone and developed mature ovaries, but none of the "allatectomized" moths did. However, the researchers restored all three of these traits in the organ-deficient moths by injecting juvenile hormone.

The armyworm moth findings support a decades-old hypothesis that hormonal control over pheromone release should evolve only in long-lived adult insects that suppress mating during certain times. Environmental cues probably prevent the armyworm moth from making large amounts of juvenile hormone and pheromone in the spring or fall, when the species usually migrates, the researchers write in the Jan. 13 SCIENCE.

Cusson and McNeil propose that juvenile hormone acts directly on the central nervous system, which responds by producing a protein molecule that initiates pheromone production and creates neural messages that tell the insect to start "calling."

# Technology

## Chiseling away at tumors with protons

In 1946, physicist Robert R. Wilson proposed that accelerated beams of protons — electron-less hydrogen atoms — might make good cancer stoppers. Now proton therapy is far more than a concept. Doctors around the world have used it to treat more than 6,000 patients with cancers and other abnormal growths. At the Loma Linda (Calif.) University Medical Center, doctors are preparing to install a newly designed accelerator that will open up proton therapy to many more patients.

The circular, 20-foot-diameter accelerator passed a crucial test on Dec. 29 when its designers — at the Fermi National Accelerator Laboratory in Batavia, Ill. — accelerated some protons in it for the first time. This summer, Fermilab technicians plan to dismantle the accelerator so that it can be shipped to Loma Linda and reassembled there.

Proton therapy is especially suited for treating tumors that don't respond well to traditional surgical or radiation therapies, says James M. Slater, a radiation oncologist at Loma Linda and head of the new facility. But for a number of technical reasons, applications have been largely limited to patients with head and neck tumors. For one, these tumors are more accessible to the fixed beams emanating from existing accelerators. Also, most beams of therapeutic protons are too weak to penetrate more than 6 inches into the body, doctors say.

Using the new, more powerful accelerator, doctors at Loma Linda expect to be able to treat virtually any tumor no matter where it is in the body, Slater says. "It's the first proton accelerator that ever has been designed specifically for treating patients," he says. In contrast, the aging accelerators now used for proton therapy were designed for basic physics research and are located in nonhospital settings. Presently under construction at Loma Linda is a building dedicated to housing the accelerator and treating patients.

The new accelerator will enable doctors to both scan the proton beam over a target area of tissue and quickly change the energy of the speeding protons, says principal designer Lee Teng, a senior physicist at Fermilab. It is the energy of the beam that determines how far each pulse of protons will penetrate. By combining area scanning with protons of varying energies, doctors should be able to bombard nearly any three-dimensional tumor while minimizing exposure of nearby and overlying healthy tissue, Slater says.

Perhaps more important, he adds, will be the unique ability to ferry the beam around the stationary patient using a movable structure that girdles the treatment table. "It's a great thing," says Wilson, professor emeritus of nuclear studies at Cornell University. No other therapeutic proton accelerator has this feature, he adds.

## A long-distance superconductor race

Widespread commercialization of high-temperature superconductors is probably 10 to 20 years away, according to a report released this month by a White House science advisory committee. To keep apace with Japan, the committee says, "an increase of a few million dollars" in federal research funding will go a long way to encourage more U.S. scientists to focus on superconductivity. The committee also recommends using another $25 or $30 million to form four to six "superconductivity consortia," each involving a university, a government laboratory and private companies. Japan already has two such collaborative efforts, the committee reports. Another set of recommendations — these by the National Commission on Superconductivity, formed by Congress in August — is due at the White House and Congress by late February. As of mid-January, however, the commission had yet to convene, according to Perry Lindstrom, technical director of the National Critical Materials Council.