Biomedicine

HTLV-II common among drug abusers

Using a sensitive genetic technique that distinguishes one HTLV virus from the other, scientists have found a surprisingly high percentage of a sample of New Orleans intravenous drug abusers infected with a retrovirus known as HTLV-II, or human T-cell leukemia virus type II. By studying the effects of HTLV-II infection on this newly identified group of asymptomatic individuals, scientists should be able to learn for the first time whether this virus is associated with a human disease, says study coauthor Irvin S.Y. Chen, a molecular biologist at the University of California, Los Angeles, School of Medicine.

"The identification of HTLV-II in drug abusers in this country raises the possibility that it might cause disease. It's another virus that blood banks and organizations that work with blood need to be aware of," Chen says. Among 121 people screened, 23 were confirmed to carry some form of HTLV. Of those carriers, 21 were positive for HTLV-II and 2 for HTLV-I, suggesting HTLV-II is the predominant form among New Orleans intravenous drug abusers, report Chen and his co-workers in the April 28 SCIENCE. Intravenous drug abusers frequently harbor some form of HTLV, which can be transmitted through blood products.

In contrast to HTLV-I, known to cause adult T-cell leukemia, HTLV-II previously had been isolated in fewer than half a dozen people and cannot be definitively blamed for any ailment. The antibody tests most commonly used to identify HTLV distinguish poorly between the two HTLV types. In fact, these tests indicated that all the screened individuals in the study were infected with HTLV-I, says study coauthor Joseph D. Rosenblatt.

The team's technique rapidly and unambiguously discriminates between HTLV-I and HTLV-II, Chen says. It is a modified version of the polymerase chain reaction, which involves the amplification of small bits of viral DNA.

Computer revealing language of life

Scientists have developed a new computer technology that speeds analysis of DNA sequences, a capability vital to identifying all 3 billion bases making up the human genome. The accomplishment will help researchers working on the federally funded human genome mapping project — a task so massive that molecular biologists often compare it to the Apollo moon landing.

Biologists urgently need faster ways to compare newly isolated DNA sequences to catalogs of known sequences in order to make progress on the project. Even with faster computing power, scientists estimate that their plan to map and sequence the entire human genome will take 15 years and cost $3 billion.

A team at the California Institute of Technology in Pasadena took a computer chip designed by Cleveland, Ohio-based TRW, Inc., and adapted it to search for specific patterns of already-cataloged DNA sequences at a rate hundreds of times faster than was previously possible, even with supercomputers.

"It took one day to compare a 10,000-bit gene to the preexisting database on an advanced supercomputer," says Caltech team leader Leroy Hood. "With the new technology it took 10 minutes."

Hood, along with researchers from Applied Biosystems Inc., in Foster City, Calif., announced the new development last week at a Washington, D.C., meeting on the Human Genome Initiative. The American Medical Association and the Alliance for Aging Research sponsored the meeting.

Eventually, such research will lead to better diagnostic tests for many of the 3,000 inherited illnesses that plague humankind, Hood says. Scientists now have tests for sickle cell anemia and some other inherited disorders. They hope to develop ways to identify many other illnesses with a genetic component, such as heart disease and certain cancers.

Materials Science

Ivan Amato reports from San Diego at the Materials Science Society's spring meeting

Making concrete smarter than it looks

Detecting early signs of material failure can help prevent tragedies such as the collapse of a bridge and the crumbling and leaking of concrete containers designed to entomb radioactive wastes.

Two materials scientists now say they may have found a way to build easy inspectability into widely used structural materials. Instead of having to remove a sample from, say, an elevated concrete walkway to look for the small cracks and voids that can lead to catastrophes, Robert E. Shannon and William G. Clark Jr., of Westinghouse's Nondestructive Evaluation Center in Pittsburgh, are developing a strategy to remotely monitor the condition of such structures.

By adding microscopic magnetic particles such as ferrite (an inexpensive, iron-containing industrial by-product) to wet concrete mixes, the composite material — called "smart concrete" by the researchers — hardens with internal tags. If the ferrite tags start out evenly distributed in the concrete structure, any subsequent unevenness in their distribution would indicate a defect. Inspectors could periodically monitor the concrete's integrity with a surface probe that responds to the magnetic fields of the embedded ferrite particles.

Shannon says the technique would also help improve quality control by uncovering newly made but defective materials that otherwise would pass factory inspections. But before smart concrete paves the way, Shannon says, researchers need to conduct more detailed studies of how the composites behave over long periods and how best to read the tags' signals.

Better materials through clusters

Though limited to a cast of 90 or so atomic elements, chemists can build a veritable universe of molecules and materials. Materials scientists have been learning how to assemble tens to many thousands of molecules into clusters, which in turn could become the assembly units for another, virtually unexplored universe of new materials tailored for specific structural, electrical or optical applications.

"We want to be able to first decide what material properties we would like to have, and then actually make the material from building blocks of clusters," says Richard W. Siegel of Argonne (Ill.) National Laboratory.

Compared with conventional bulk materials such as clay and metals, cluster-made materials have enormous proportions of their atoms on internal surfaces. In materials made of 5-nanometer-diameter (billionths of a meter) clusters, half the atoms are at the surfaces. In a hunk of metal — an assemblage of much larger grains — surface atoms represent only a tiny proportion of the total number of metal atoms.

Siegel's group uses a gas condensation chamber to make the clusters. For example, to make 12-nanometer clusters of the ceramic titanium dioxide (rutile), the researchers first place a piece of titanium on a heating element within a helium-filled chamber. As the metal atoms evaporate, they gather into nanometer-scale clusters and condense on a colder surface, also in the chamber. A dose of oxygen in the chamber then converts the titanium into rutile clusters, which are collected under a vacuum and mechanically pressed into ceramic pellets.

These clusters bake into a stable ceramic at far lower temperatures than do typical rutile grains 1,000 or more times larger, Siegel reports. Also, cluster-made rutile appears slightly more ductile, and therefore probably more formable, than its conventional counterpart, he says. With further development, the technique might enable researchers to fashion ceramics into intricate shapes unattainable with the normally brittle materials. The possibilities are so broad, Siegel remarks, that most of them have yet to be imagined.