Diet Causes Viral Mutation in Mice

A benign coxsackievirus can mutate and become virulent if its host, a mouse in this case, lacks the trace mineral selenium, researchers have discovered. Moreover, the altered virus can cause disease when it enters well-fed animals.

"This interesting work is the first to show that a nutritional deficiency can accelerate evolution of a virus population from benign to virulent in an intact animal," assert Charles J. Gauntt of the University of Texas Health Science Center in San Antonio and Steven Tracy of the University of Nebraska Medical Center in Omaha. Their comments appear in an editorial that accompanies the announcement in the May NATURE MEDICINE of the findings by Melinda A. Beck of the University of North Carolina at Chapel Hill and her colleagues.

Coxsackieviruses infect more than 20 million people annually in the United States and can cause illnesses ranging from a cold to an inflammation of the heart. However, most of the viruses are benign, so only about 10,000 infected people become ill.

In previous studies, Beck and other researchers had linked coxsackievirus and heart disease to selenium intake in humans as well as mice. People deficient in the mineral tend to develop Keshan disease, an inflammatory heart disease. Scientists had found coxsackieviruses in Keshan patients, they note.

Last year, Beck and her colleagues reported their first inkling that the coxsackievirus mutates in nutritionally deprived hosts. The team found that a normally benign strain of coxsackievirus B3 (CVB3) damaged the hearts of selenium-deficient mice. Injecting virus from these animals into selenium-rich mice caused the healthy creatures to develop heart disease.

In their new study, Beck and her coworkers fed mice either a diet very low in selenium or a normal diet for 4 weeks, then injected benign CVB3 into both groups. After 7, 10, and 14 days, the scientists killed and examined 10 mice from each group. After only 7 days, the mice that lacked selenium showed signs of heart disease, including inflammation. The well-nourished mice stayed diseasefree.

The researchers compared the original virus, the virus taken from the hearts of the selenium-deficient mice, and strains of CVB3 known to cause heart disease. In the deprived mice, the original virus' sequence of nucleotides, the building blocks of ribonucleic acid (RNA), underwent six changes. These same mutations appear in the CVB3 strain that causes heart disease, Beck and her colleagues report.

They speculate that the virus changes rapidly in selenium-deficient hosts because of the animals' weakened immune systems. The mineral, an antioxidant, helps protect the immune system from the damaging by-products of normal metabolic functions. Also, coxsackieviruses and similar viruses mutate readily.

Whether the virus requires all six or only one or two of the mutations to become virulent remains unclear, the authors note. They are now investigating why the changes occur at such specific sites on the genome and what happens to the virus in animals only slightly low on selenium.

If coxsackieviruses and other viruses become virulent when they infect nutritionally deprived people, that may "help explain the steady emergence of new strains of influenza virus in China, which has widespread selenium-deficient areas," Beck's team argues.

"Our findings might even help to explain the crossing over of certain viruses [such as HIV] to a new host species through accelerated mutation rates," the authors speculate. HIV apparently first infected monkeys and then moved to some humans living in selenium-poor regions of Africa, they note.

— T. Adler

Stone Age fabric leaves swatch marks

Four prehistoric pottery fragments found in Eastern Europe bear imprints that have made a big impression on archaeologists. The clay shards display the outlines of the world's oldest known examples of woven material, pressed into the clay while it was still wet, around 27,000 years ago.

The sophisticated twining methods apparent in the impressions attest that weaving had reached an advanced state much earlier than most researchers have assumed, according to a study presented in Minneapolis this week at the annual meeting of the Society for American Archaeology.

"We never anticipated that there was a fiber technology so long ago," says Olga Soffer of the University of Illinois at Urbana-Champaign. "These specimens provide positive evidence for the production of textiles or basketry in at least one part of Europe a minimum of 7,000 to 10,000 years earlier than documented anywhere else."

Soffer first noticed the imprints in 1991, while conducting an analysis of approximately 6,000 pottery fragments from Pavlov I, a site in the Czech Republic. Bohuslav Klima of the Czech Academy of Sciences in Brno directed excavations at Pavlov I from 1952 to 1972. Now retired from his academic position, Klima, in collaboration with other scientists, has initiated investigations of numerous types of artifacts from the site.

Soffer turned to ancient textile specialist James M. Adovasio of Mercyhurst College in Erie, Pa., for a detailed examination of the unusual pottery discoveries, which have been radiocarbon-dated to between 26,980 and 24,870 years old.

The impressions were undoubtedly made by pieces of cloth or flexible basketry, Adovasio argues. Two specimens display a crisscross pattern of tightly spaced rows typical of a portion of a finely woven bag or mat. No evidence of a finished edge appears in the impressions. Such material can be made by hand, but it is much easier to produce on a loom of some kind, Adovasio holds.

Two other fragments exhibit fewer distinct fiber imprints, Adovasio notes. Still, the material pressed into these artifacts was woven out of some sort of plant fiber, in much the same way as the cloth or basketry seen in the other pottery pieces, he contends.

Because of their complexity, the fiber impressions indicate that prehistoric residents of Pavlov I made or used woven cloth or basketry considerably before 27,000 years ago, he maintains. Inhabitants of the area probably also used string and rope, says Adovasio, judging from their weaving expertise.

It remains uncertain why the ancient pottery contains fabric impressions. One possibility is that wet clay was intentionally applied around woven, flexible containers that served as molds. Some early North American Indian groups made pottery in this way, Adovasio points out.

Aside from the Pavlov I finds, the earliest remains of human-made cord are 19,000-year-old twisted plant fibers found in Israel (SN: 10/8/94, p.235). Charred cord remains found at France's Lascaux Cave date to 17,000 years ago. Evidence of weaving and basketry in Asia and the Americas dates to no earlier than about 13,000 years ago. *— B. Bower*