Biochemistry

Analyzing protein cocktails in a snap

In less time than it takes to read an issue of SCIENCE NEWS, researchers now can use a mass spectrometer — a sensitive molecule-weighing tool — to detect and help identify dozens of different proteins in minuscule portions of even complex biological samples, such as breast milk.

The new technique measures the masses of huge protein molecules far more swiftly, accurately and easily than gel electrophoresis, the standard method for such analyses, say chemists Brian T. Chait and Ronald C. Beavis of the Rockefeller University in New York City. So far, the researchers have measured more than 160 proteins, some with molecular masses up to 350,000 daltons. One dalton equals the mass of a single hydrogen atom.

The new technique, which several research groups are developing, should prove helpful in basic biological and biochemical research, and in such quality-control operations as tracking differences in genetically engineered protein products intended for use in foods or drugs, Beavis says.

In the September PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol. 87, No. 17), he and Chait report successfully identifying proteins in such samples as egg whites, blood-cell extracts and human breast milk.

The Rockefeller researchers' mass spectrometer employs an electric field to accelerate charged gas-phase molecules or molecular fragments through a vacuum. The mass of these propelled molecules is proportional to the time it takes them to reach a detector about 1 meter away: The longer the wait, the heavier the particle.

To use mass spectrometry, scientists must convert sample molecules to a gas, usually by bombarding them with energetic electrons or ions. Until recently, however, attempts to volatilize proteins damaged the huge molecules beyond recognition. Then in 1988, researchers at the University of Münster in Germany reported successfully volatilizing proteins with a technique called "matrix-assisted laser desorption." The Münster chemists embedded sample proteins within a matrix of organic molecules, such as nicotinic acid. When they blasted the matrix with a laser, it disintegrated. Previously embedded proteins suddenly found themselves liberated, electrically charged, and streaming down the mass spectrometer's vacuum tube toward a detector.

At a meeting of the American Chemical Society in Washington, D.C., last month, one of the Münster researchers, Michael Karas, explained the volatilization mechanism by way of a metaphor: "The elephant at the 10th floor must fly if the building suddenly turns into fine grains of sand."

By using more precise detectors, which defense researchers originally developed for night vision devices, and different matrix molecules based on the perfume compound cinnamic acid, Beavis says he and Chait have refined the Münster team's mass-spectrometer technique into a routine protein-analysis tool. Beavis and Chait's matrix material, sinapinic acid, offers the additional bonus of allowing the researchers to use unpurified samples containing salts and pH-neutralizing buffers. Beavis says a Texas-based company expects to begin marketing such an instrument this fall.

Beavis and Chait "have made mass spectrometry into a tool for protein analysis," observes Peter Williams, a chemist at Arizona State University in Tempe, who is developing a similar method for analyzing nucleic acids such as DNA. Though mass spectrometric analysis of nucleic acids is proving a challenge, analytical chemists like Beavis and Williams nonetheless hope that as the Human Genome Project gains momentum, this technique will provide a door for their participation in the massive effort to sequence all the chromosomes in a human cell.

Earth Sciences

Rumbles along the San Andreas

Some offices conduct baby pools, others wager on professional sports. But the U.S. Geological Survey (USGS) has bet $15 million on a prediction that Parkfield, Calif., will feel a strong earthquake before the end of 1993. Judging from the behavior of the San Andreas fault in the last two months, scientists suspect that quake may be on its way.

In 1985, USGS issued the Parkfield prediction — its only official prediction to date — based on research showing that magnitude 6 shocks have occurred near the farming town about every 22 years throughout the last century. Because the most recent tremor struck in 1966, the survey concluded that the San Andreas segment running through Parkfield would generate another magnitude 6 quake within 5 years of 1988 (SN: 5/5/90, p.278). Seismologists have outfitted the region with a battalion of different devices to study the quake in unprecedented detail.

On Sept. 9 and 10, two magnitude 3 shocks rumbled through the northern end of the Parkfield fault segment, near the region where the predicted quake is expected to begin. This area has been particularly quiet since 1986, and the two jolts prompted officials to issue a "C" level alert, signifying a 1.4 to 6 percent chance the predicted shock would occur within 24 hours of the alert. In the past five years, the USGS has issued 22 "C" level alerts for Parkfield but no "B" or "A" level alerts, which indicate even greater chances of an impending quake.

In August, two magnitude 3 tremors rattled the southern end of the Parkfield segment. These shocks, in conjunction with the northern ones last month, have heightened the suspense for many geoscientists. Evelyn A. Roeloffs, chief scientist on the Parkfield Prediction Experiment, says, "My personal opinion is that we may be entering a phase when the earthquake is months away, instead of years away."

New Madrid fault sounds off

Halfway across the country from the San Andreas, another well-watched fault is grumbling. The New Madrid fault generated a magnitude 4.6 quake last week, rattling parts of Illinois, Kentucky, Arkansas, Missouri and Tennessee. In 1811 and 1812, this fault spawned three extremely large shocks and some seismologists give even odds that New Madrid will unleash a magnitude 6 tremor within the next decade. The significance of last week's shock remains unclear.

Will winds help cool a warming world?

Climate experts have long considered clouds a major source of uncertainty in predictions of global warming. Now two physicists raise another question concerning clouds. John Latham and M.H. Smith of the University of Manchester Institute of Science and Technology in England propose clouds could help keep Earth cool if they get a little help from the wind.

As air currents blow over the ocean surface, they carry tiny drops of water up into the atmosphere, where the drops can serve as nuclei for developing cloud particles. In the Sept. 27 NATURE, Latham and Smith suggest that rising global temperatures might speed up winds and thereby increase the number of small particles within marine clouds. This effect would make clouds more reflective, helping to block sunlight before it reached Earth's surface. According to the researchers' rough calculations, winds must quicken by 50 to 100 percent in order to completely balance the warming initiated by a doubling in the atmospheric concentration of carbon dioxide. The scientists say experts must account for this wind-cloud relationship when using climate models to forecast future climate changes. They also suggest humans can potentially slow the warming by artificially generating more droplets, although they offer no suggestions on how to accomplish this feat.