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## Jim Felton: Food Mutagens

In 1978, a story broke about a group of Japanese researchers who found mutagenic chemicals in cooked hamburger meat. At the time, a group of us was studying mutagenic chemicals that were produced by oil-shale retorting and coal gasification. It was a complex problem involving separating several organic fractions and assessing each fraction for its potential to initiate genetic damage.

One day, the National Institute of Environmental Health Sciences (NIEHS) asked Mort Mendelsohn if Livermore had the expertise to study food mutagens. Curiously, oil shale and food have a lot in common because some of the chemical processes are similar when both substances are heated. NIEHS gave us a multi-year contract to begin assessing the mutagenicity of hamburger meat. Our people working on the project included Fred Hatch, Hector Timourian, Brian Andresen, and Dan Stuermer.

The early research was difficult because we had to extract dozens of fractions of cooked meat and assess their mutagenicity. After a couple of years, a group headed by Mark Knize isolated a group of heterocyclic amines, all carcinogenic, that were present in low concentrations and that the Japanese hadn't found. These mutagens were produced at normal cooking temperatures in beef and other muscle meats when fried or broiled. We didn't find them in nonmuscle meats, such as liver, or in invertebrates, like shrimp.