Janet Raloff reports from Chicago at the American Association for the Advancement of Science's annual meeting

Fueling cleaner air

Two years ago, the big three U.S. automakers joined forces with 14 oil companies to investigate how changing the nation's mix of fuels and cars will likely affect urban air pollution. This Auto/Oil Air Quality Improvement Research Program has just completed its first phase — a series of tests that compared emissions from new (1989) and older autos (1983 to 1985 models) running on a wide range of experimental fuels. The more than 2,200 separate emission tests, involving 34 vehicles, quantified 150 components of exhaust and evaporative releases. Researchers then plugged the resulting 200 million data points into an air-pollution model for Los Angeles to gauge how changing such factors as the temperature at which 90 percent of the fuel evaporates (T-90), or the percent of aromatics, olefins and sulfur in a fuel, could alter outdoor levels of ozone and other toxic chemicals.

"The biggest effect we saw was a 22 percent reduction in projected air releases of [volatile organic] hydrocarbons in the current vehicles when you reduced the T-90 from 360° to 280° F," observes Leo McCabe, a chemist and consultant with Mobil Research and Development Corp. in Paulsboro, N.J. That's important, he notes, because hydrocarbons are a major ingredient in the recipe for generating the ozone in urban smog. The lower T-90 fuel also proved the only experimental gasoline to lower all four "air toxics" monitored in this program — benzene, formaldehyde, acetaldehyde and 1,3,-butadiene.

Oil companies produced the experimental, low T-90 fuel by removing the "heavy components" in today's gasoline, McCabe explains. The magnitude of this "heavy-end effect" proved both a surprise and a disappointment, McCabe adds, "because the reformulation [to reduce the T-90] is very expensive." However, he says, "if it needs to be done, we'll do it."

In general, the still-preliminary analyses indicate that reducing olefins, heavy components and sulfur is the most effective way of reducing ozone; altering a fuel's concentration of aromatics or oxygenates offered no clear ozone improvements. Reducing sulfur content proved the only reliable means of cutting all three major classes of vehicular emissions — hydrocarbons, carbon monoxide and nitrogen oxides.

Finally, these analyses indicate that phasing in the best reformulated fuel would reduce the automotive contribution to Los Angeles' ozone significantly—from 33 percent today, to only about 7 percent by the year 2010. However, the gradual disappearance of older, more-polluting vehicles is projected to reduce the share of LA's ozone from cars to 9 percent over the same period—without any fuel changes. Is 2 percent less ozone worth the high cost of reformulating gasoline? Probably, McCabe says. In fact, "we feel that [our] goal of approaching zero emissions for the automobile is within reach."

Look what's hidden in the pawpaw

During World War II, when bananas were scarce, Jerry L. McLaughlin's dad gave him some "Indiana bananas" — the custard-like fruit of *Asimina triloba,* better known as the pawpaw tree. Though only about 4 years old at the time, McLaughlin recalls, "I threw up and never forgot them."

A pharmacognosist at Purdue University in West Lafayette, Ind., McLaughlin now searches for plants possessing natural medicinal properties. Based on his unforgettable encounter with the Indiana banana, he focused a few years ago on the pawpaw. After all, he notes, "pharmacology is simply toxicology at a lower dose." The result: He reports finding a family of biologically active compounds — acetogenins — "that's very good against cancer, and also terrific at killing insects."

A crude extract of pawpaw twigs killed brine shrimp at a concentration of just 0.04 parts per million (ppm)—well below the 70 ppm concentration of strychnine needed to elicit the same effect. One novel acetogenin his team isolated from the pawpaw extract — asimicin — also proved lethal to blowfly larvae, two-spotted spider mites, Mexican bean beetles, mosquito larvae, melon aphids, striped cucumber beetles and a nematode. McLaughlin expects that natural asimicin-based pesticides, for which he holds a patent, may be marketed within four or five years.

McLaughlin also subjected brine shrimp to extracts from the pawpaw's relatives. He hit a lode with *Annona bullata,* a Cuban native closely related to the "custard apple." From this plant he extracted two acetogenins with anticancer prospects. In tests conducted by a major pharmaceutical company, one of those acetogenins—bullatacin—proved 1 million times more potent than the common anticancer drug cisplatin in inhibiting the growth of human ovarian tumors transplanted into mice. The National Cancer Institute is currently testing his acetogenins in *in vitro* trials, he says.

The acetogenins' mode of action differs from that of most anticancer drugs: Rather than killing a cell by scrambling its DNA, they starve the rapidly dividing cells of the ATP that fuels them. As a result, McLaughlin says, "I don't think we'll have to worry about these [acetogenins] ever causing cancer—as some anticancer agents do."

"Nor do we have to rely on Cuba to get bullatacin, the most potent acetogenin," McLaughlin notes. In the March JOURNAL OF NATURAL PRODUCTS, he and his co-workers will announce isolating bullatacin and six other biologically active acetogenins—including a new compound, trilobacin—from the common pawpaw. The report also shows that trilobacin exhibited high levels of growth suppression in cultured cells of some leukemias, small-cell lung cancer, colon cancer, melanoma, ovarian cancer and renal cancer.

If the pawpaw contains so many potentially toxic agents, how can anyone stomach its fruit? In moderation, McLaughlin observes, the ripe fruit can prove quite edible. But his team's assays indicate that unripe fruits "are almost as toxic as the twigs — really potent." And that makes sense, he suspects, "because nature wanted to discourage animals from eating it and spreading its seeds before the fruit was ripe."

Beefing up livestock

Breeders have made great strides in reducing the percentage of fat in cattle, pigs and sheep. But fearing these genetic approaches to leaner meat may be nearing their limit, livestock researchers have turned their attention to a class of experimental drugs known as repartitioning agents. Currently under federal review for use in animals intended for human consumption, these compounds could dramatically increase the proportion of its diet that an animal converts to protein instead of fat, according to Donald H. Beermann of Cornell University.

One type, known as beta-agonists, appears to mimic steroid hormones. Beermann showed recent data indicating that, compared with untreated animals receiving the same diet, supplemented lambs will lay down up to 40 percent more muscle — edible meat—in their hind legs. "Similar effects were obtained in cattle . . . and to a lesser extent in pigs," he notes. The drawback? Compounds and doses producing the greatest repartitioning from fat to protein often led to tougher cuts of meat.

Somatotropin, also known as growth hormone, has exhibited similar effects in growing livestock — without causing a corresponding toughening of their meat, Beermann reports. For instance, he showed data from pigs indicating that low doses of the drug could increase muscle deposition by 28 to 38 percent, while reducing fat content in the edible cuts from 37 to 78 percent. "That's better than we could achieve with 10 to 20 years of breeding changes," he concludes.