Biology

Ethylene gene control: Research ripens

Plants, like people, produce a variety of hormones as they enter adolescence and grow to maturity. In plants, however, these hormonal changes generally don't result in ruined complexions or an overwhelming desire to borrow the family car. Instead, they trigger a series of chemical reactions that cause, among other things, changes in the color and texture of fruiting bodies – a process we call ripening.

Scientists have now cloned the gene for the enzyme regulating production of the major plant ripening hormone, ethylene. The work advances prospects for engineering plants that ripen only at grocers' convenience. It also may result in an energy-efficient way to mass-produce the colorless gas, which today is synthesized from petroleum for use in making plastics and other products.

Ethylene (C_2H_4), one of the simplest organic molecules showing biological activity, plays a major role in fruit ripening, seed germination and flower maturation. Plants tightly regulate its production with several enzymes that sequentially convert a precursor molecule into the biologically potent gas. The chemical cascade leading to ethylene's synthesis ends with the production of 1-aminocyclopropane-1-carboxylic acid, or ACC, by a plant enzyme called ACC synthase. The plant makes ethylene from ACC.

For years, scientists have sought to clone the gene coding for ACC synthase. Their efforts proved fruitless, partly because the substance occurs in such minuscule quantities in plants. In a ripe tomato, for example, ACC synthase makes up only 0.0001 percent of the fruit's total protein. But using a novel combination of immunological and molecular biological techniques, Agricultural Research Service researchers Takahide Sato and Athanasios Theologis cloned the elusive gene from an unpurified preparation of ACC synthase. They performed the work at the USDA's Plant Gene Expression Center in Albany, Calif., and report their findings in the September PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (Vol.86, No.17).

With the ACC synthase gene now available for genetic tinkering, several lines of investigation become attractive, say these and other researchers. Using molecular biological techniques such as antisense engineering (SN: 6/10/89, p.360), scientists may gain the ability to block ethylene production in fruit- or vegetable-bearing plants or at least reduce its synthesis to slow the ripening process. Once the unripened food reached the market, grocers could expose it to ethylene in chambers, thus triggering ripening immediately before consumer purchase.

The procedure could save much of the billions of dollars lost worldwide each year from overripening of fruits and vegetables during transportation, the USDA researchers say. In the United States alone, they note, almost half the fresh fruits and vegetables harvested each year are lost to spoilage.

Moreover, inserting the gene for ACC synthase into bacteria or yeast – something the researchers have already accomplished – could allow mass production of ethylene gas. U.S. industry produces more than 50 billion pounds of ethylene from petroleum each year to make polyethylene plastic, antifreeze and high-tech fibers. The team hopes to splice the gene into photosynthetic bacteria or algae that could serve as solar-driven, ethylene-producing biofactories.

"There's a thousand different ways of playing with this," says Patricia Zambryski, a plant biologist at the University of California, Berkeley. She cautions, however, that ethylene plays many different roles in plants and that reducing its natural production may have untoward effects on some species.

Nonetheless, she says, the new technique for cloning genes should help other scientists working with genes whose products occur in very low concentrations.

Biomedicine

Latchkey kids risk substance use

So-called latchkey children, who routinely care for themselves without adult supervision, run a higher risk of alcohol, marijuana or cigarette use than do children who are supervised after school and in the evening, according to a new scientific report.

Jean L. Richardson of the University of Southern California in Los Angeles and her co-workers studied 4,932 middle-class eighth-graders attending public schools in the Los Angeles and San Diego metropolitan areas. The children at highest risk of substance use were the 28.6 percent who spent the most unsupervised time after school – 11 hours or more per week. The researchers found those students twice as likely to use alcohol, cigarettes or marijuana compared with students who had constant adult supervision after school. The group reports its findings in the September PEDIATRICS.

They found that 23 percent of the high-risk, latchkey children reported drinking 11 or more alcoholic drinks during their lifetime, while only 11 percent of children with constant supervision reported drinking that much. Thirteen percent of the high-risk children reported smoking at least a pack of cigarettes during their lifetime, compared with 6 percent of their supervised peers. And 24 percent of the high-risk students said they had tried marijuana at least once, compared with 14 percent of the supervised children. Lifetime measures of substance use are important, Richardson notes, because they tend to flag students who are likely to abuse these substances in the future.

Latchkey kids' heightened risk of substance use persisted even when the researchers controlled for factors that influence drug-taking behavior, such as the amount of stress a child experiences at school or at home. Nonetheless, Richardson says the study leaves many questions unanswered. For example, scientists know peer pressure can spur drug or alcohol experimentation. But Richardson doesn't know whether children left to fend for themselves after school have more substance-using friends or are more easily influenced by peers.

In the future, the scientists hope to learn whether certain parenting styles can reduce the risk faced by latchkey children. Evidence suggests parents who phone home regularly can reduce the chances that their kids will experiment with alcohol and other substances, Richardson says. The researchers plan to find out whether latchkey children who use alcohol, cigarettes or marijuana do in fact go on to abuse such substances. They also plan to test prevention strategies.

High school athletic injuries rated

High school football players face an injury risk surpassing that of all other student athletes. That's no surprise to worried parents concerned about their kids' participation in the hard-hitting sport. But a new report suggests most high school football injuries are minor scrapes and sprains.

Larry G. McLain of the Loyola University Medical Center in Maywood, Ill., studied 1,283 students participating in high school athletics during the 1987–1988 academic year, finding football led the injury list with 61 percent of all participants getting injured during the year.

But McLain found sprains, muscle strains and bruises accounted for most football injuries. In contrast, track participants were more likely to suffer a serious injury, such as a broken bone, that kept them sidelined longer. On average, injured football players couldn't return to their sport for about 6.7 days, while track participants stayed out of play an average of 32 days per injury for girls and 23.1 days for boys. McLain, who now directs the Parkside Sports Medicine Center in Parkridge, Ill., describes his findings in the September PEDIATRICS.