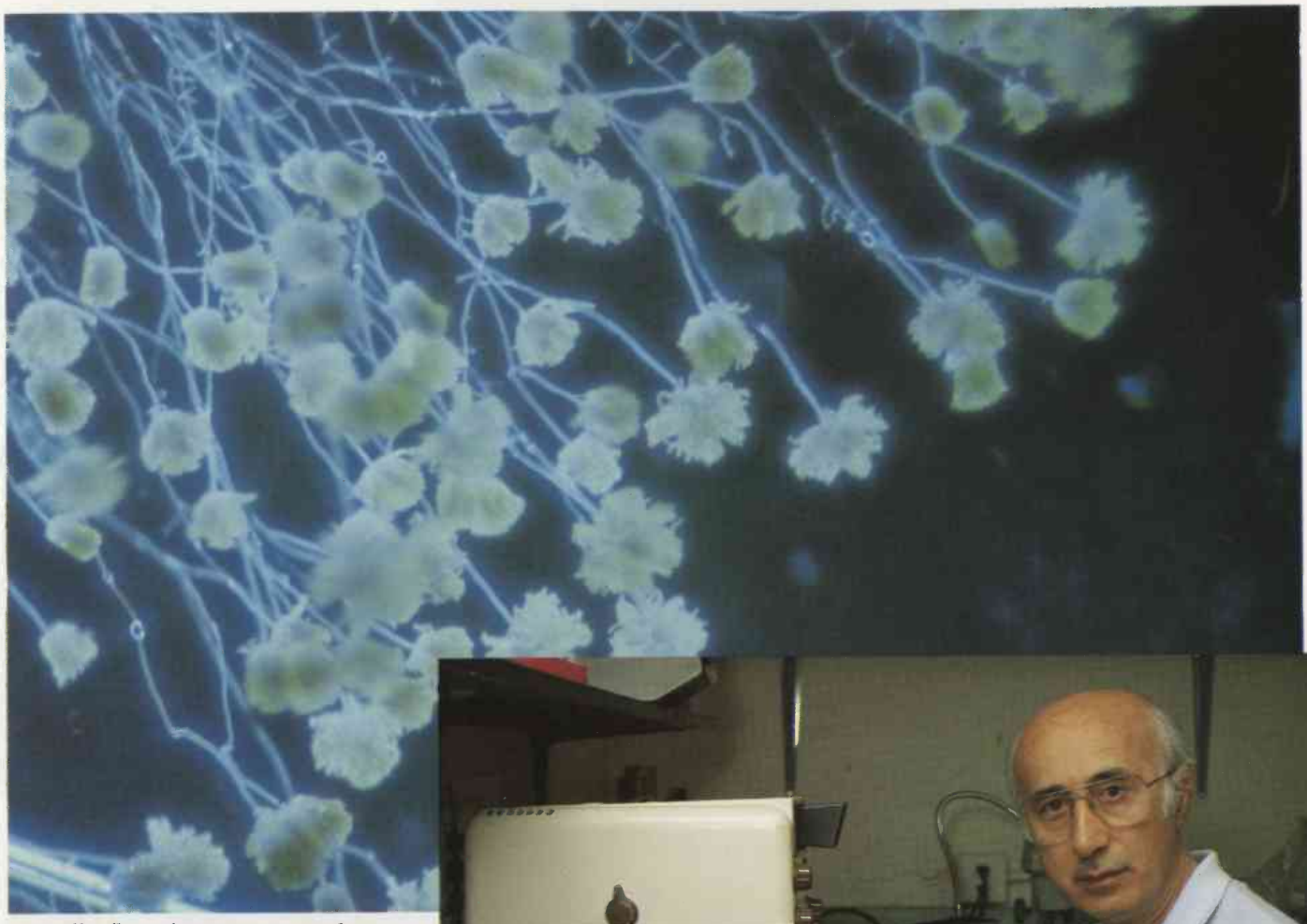


I. Misaghi

Aspergillus flavus **fungus spores produce aflatoxin.**

Control That Fungus!

By Jan McCoy

Michael Stoklos

Iraj Misaghi weighs a cottonseed sample.

Natural toxins in foods and animal feed present yet another potential health hazard to humans. University of Arizona scientists are looking at pre-harvest and post-harvest methods of ridding crops and food of the naturally produced carcinogen, aflatoxin.

Aflatoxins are produced by the *Aspergillus flavus* fungus, which infects oil seeds such as cottonseed, corn, tree nuts and peanuts. Human exposure to aflatoxins can result from either direct consumption of the contaminated product or consumption of foods from animals fed contaminated feed. In Arizona, dairy cattle are fed cottonseed meal, so both milk and cottonseed are tested routinely.

Iraj Misaghi, an associate professor of plant pathology, is working with harmless bacteria that prevent *Aspergillus flavus* from growing in cottonseed. Misaghi isolated several hundred bacteria that inhabit Arizona cotton fields and found a dozen that stop the growth of the aflatoxin-releasing fungus.

Supported by U.S. Department of Agriculture, preliminary field work done last summer shows the bacteria are able to arrest fungus growth.

"The neat thing about our system is that it is environmentally sound," Misaghi says. "We use beneficial microorganisms to go after pathogenic ones rather than using chemical control. These are the bugs that already exist in the field; we are not using genetically engineered bacteria."

The reason bacteria now in the fields are unable to prevent fungus growth, Misaghi says, is probably due to their low levels and uneven distribution. "Maybe if we increase the numbers and distribute them more

evenly we can protect the crop," he says.

But until aflatoxin contamination can be prevented, safe and effective decontamination procedures must be available, says Douglas L. Park, an associate professor of nutrition and food science and head of the Mycotoxin Research Program.

One decontamination measure involves treating contaminated products with ammonia under high pressure and high temperatures. This approach, Park says, is the most promising one. The U.S. Food and Drug Administration has withheld approval of ammoniation as a detoxification procedure due to the lack of information about the toxicity and cancer potential of ammoniation byproducts.

Since then, a number of studies have provided new information, several of which were Park's. When 20 years of research on detoxification and biological testing of the process are viewed as a whole, he says, the safety and efficacy of ammoniation are amply supported.

The process now is permitted only in certain areas and only for use in animal feed. California, Arizona and Texas allow ammoniation for treating cottonseed, and Texas, Alabama, Georgia and North Carolina use it for corn. Outside the United States, Mexico and South Africa permit ammoniation for corn, and France, Senegal, Sudan and Brazil use it for peanuts.

Park recently began a study for the Mexican Compania Nacional de Subsistencias Populares (CONASUPO) — the Mexican department of agriculture — to determine whether the ammoniation

Food Safety Concerns

OVERVIEW

By Lorraine Kingdon

In survey after survey, people stress that food safety is a major concern. Many share a belief that they're being poisoned; often people blame the food industry as contributing to their lack of health. A common misconception is that the diet-cancer relationship is due entirely to carcinogens in our food supply.

"People have a chemophobia about our food supply," says Ralph Price, an associate professor in the University of Arizona Department of Nutrition and Food Science. "They typically respond in one of two ways. Either people 'go natural' or give up and eat anything because they believe 'everything makes you sick.' Both responses concern food scientists.

"We're trying to promote food safety and a varied diet that contains high-nutrient foods," Price says. He believes food scientists would answer the same surveys about food safety entirely differently from people who are concerned about their diet but are not nutrition-educated.

"Pathogenic microbes — disease-causing organisms — are the No. 1 danger in the food supply," Price says. "And lay people don't even mention this problem. Also, people need to know that natural toxicants exist in products such as teas. 'Natural' is not necessarily safe."

The growth in "health-food" products has led to using exotic and potentially dangerous herbal substances in diets. Poisonings are becoming more frequent, according to the American Association of Poison Control Centers. Naturally occurring food-borne toxins can act as neurotoxins, immunotoxins and teratogens inducing birth defects.

Toxic substances in foods also can form during cooking or other processing, but additives themselves are rarely to blame. Heterocyclic amines sometimes produced during cooking meat at high temperature are among the most potent mutagens ever described. Proteins and carbohydrates can react during baking to form mutagenic browning products. Storing agricultural commodities can result in mutagenic lipid oxidation by-products.

"It's prudent to assume that the epidemiologic associations between diet and cancer are due, in part, to initiation of the cancer process by these — and other — food-related carcinogens," Price says. About 35 percent of the variation in cancer rates among individuals and populations in the United States is related to the diet. By comparison, genetic predisposition, industrial pollution and food additives play only minor roles in human cancer rates.

"Increasing the consumption of chemoprotective agents — such as fruits and vegetables — greatly appeals as a way to reduce the rate of cancer," Price says. Scientists also are interested in the role that dietary supplements or modern molecular genetics can play, but these need to be evaluated carefully before they can be recommended. Designer foods for maximum chemopreventive safety are already being tested in human trials.

Michael Stoklos

Ralph Price examines some of the processed foods that play a large part in today's diets.

"The U.S. food supply is one of the safest in the world," Price says. "Our life spans have increased partly because we have better food, but still the battle to keep improving our diet goes on."

Contact Price at the Department of Nutrition and Food Science, 332 Shantz, University of Arizona, Tucson, AZ 85721, or call (602) 621-1728.

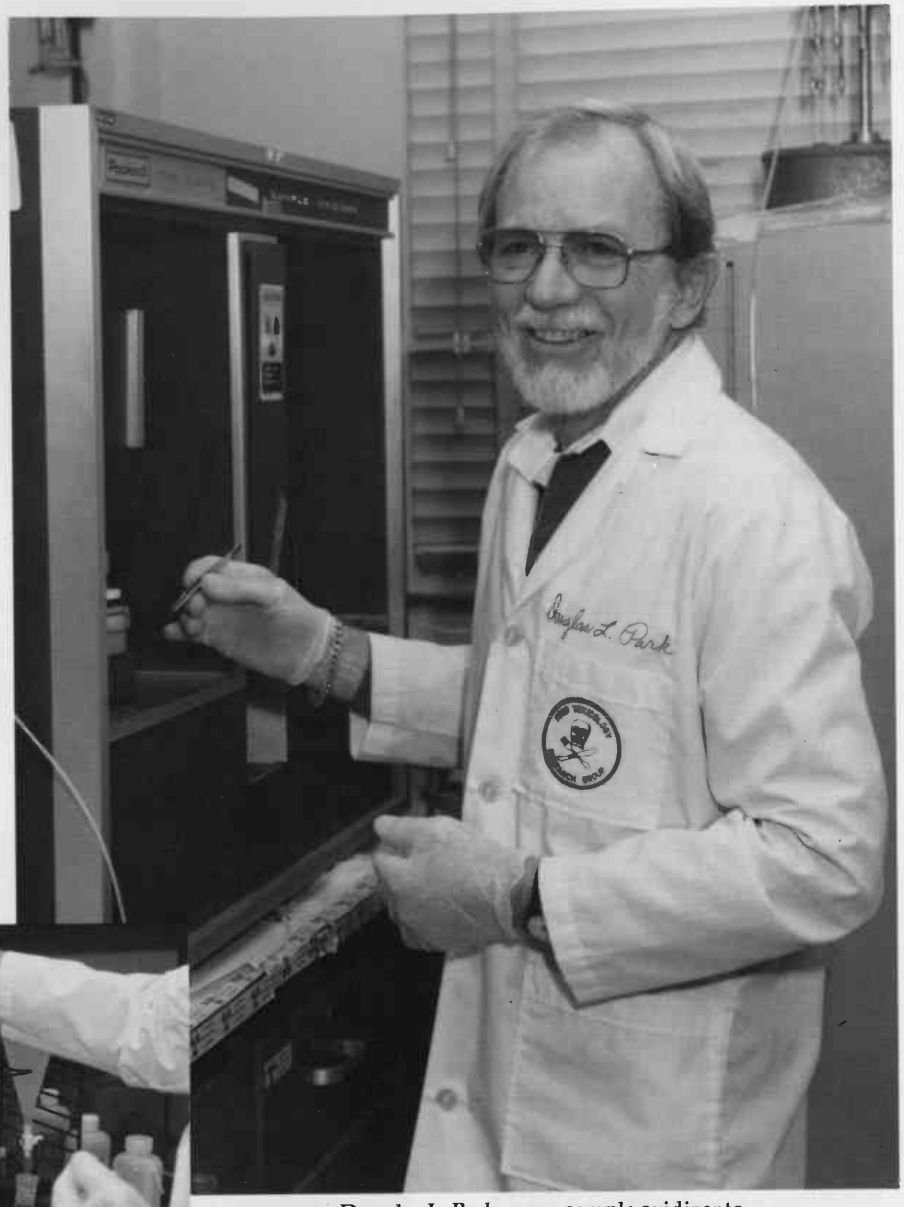
process can make aflatoxin-contaminated corn suitable for human consumption.

"Because Mexico has high amounts of aflatoxin contamination, government officials realized they had to do something," Park says. "Additionally, a large amount of their corn product goes into the human food supply (tortillas), meaning their citizens could be exposed to undue levels of aflatoxin."

The Mexican government asked Park and a Casa Grande, Ariz. company for help. Portable ammoniation units owned by the company were sent to Mexico and have treated a substantial amount of corn.

Park's research for the government involves adding radio-labeled aflatoxin B1 to a sample of contaminated corn and then treating the sample with the ammonia. The ammonia-treated product is then chemically treated to isolate and separate aflatoxin-ammonia reaction products. The radio-label is used to identify the byproducts and determine their movement and toxicity. Individual isolates are tested for mutagenic and toxic potentials. The samples also are tested for remaining aflatoxins.

In addition to safety, the samples also are tested for decontamination efficiency.



Michael Stoklos

Douglas L. Park uses a sample oxidizer to recover C-14-labeled aflatoxin from animal tissues.

Michael Stoklos

Separatory funnels move compounds from one chemical solvent to another.

"We'll take one of our untreated samples that contains safe levels of aflatoxin, and a decontaminated sample, use them to make tortillas and do the isolation and separation to see if the process of making tortillas affects the safety of the decontamination process," Park says. "Then we'll take a portion of the sample put it in an acid environment that mimics our stomachs to see if the aflatoxin stays inactivated."

Park says the Mexican government eventually hopes to use treated corn for human consumption, which would make the country the first in the world to do so. This research is a joint effort between the UA, CONASUPO and the Central University of Venezuela.

Park also works on the prevention of aflatoxin contamination. He and research specialist Sam Rua Jr. recently began another aflatoxin research project aimed at identifying factors that might contribute to the growth of *Aspergillus flavus* and aflatoxin formation in cotton fields and during storage of harvested cottonseed. Using the UA College of Agriculture's AZMET meteorological network, the team will monitor factors such as humidity, temperature and wind in cotton fields in four Arizona locations: in Yuma, Buckeye, Casa Grande and Safford. By following cottonseed production from planting through storage, Park and Rua hope to find factors that cause aflatoxin formation in fields and ways to change them. The project is a joint operation between the UA and the USDA.

Although natural toxins in the environment pose serious health risks, Park, a food safety expert, is assured that "in the United States, we have the safest food supply in the world, by far."

Contact Misaghi in the Department of Plant Pathology, 115 Forbes, University of Arizona, Tucson, AZ 85721, or call (602) 621-7156. Contact Park in the Department of Nutrition and Food Science, 421 Shantz, University of Arizona, Tucson, AZ 85721, or call (602) 621-5107.